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CANADA
DEPARTMENT OF MINES

HON. W. A. GORDON, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

BUREAU OF ECONOMIC GEOLOGY
GEOLOGICAL SURVEY

MEMOIR 184

Descriptions of Properties, Slocan Mining Camp, British Columbia

BY

C. E. Cairnes

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

Illustrations

PREFACE

This volume is supplementary to Memoir 173, "Slocan Mining Camp, British Columbia," in which the general and economic geology of the area are discussed. Memoir 173 is accompanied by geological maps.

Figure 1. North slope of Carpenter Creek valley, north of Cody, showing claim boundaries and lode system.

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Descriptions of Properties, Slocan Mining Camp, B.C.

CHAPTER I

DESCRIPTIONS OF PROPERTIES, SLOCAN MINING DIVISION

AJAX GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 58; 1898, p. 1074; 1911, p. 144.

The Ajax group (*See* Figure 1), consisting of the Ajax, Crown Point, and Random Shot Crown-granted claims, is owned by Ajax Mining and Development Company, Limited, % Mr. Alf. Robinson, 81 Wilson avenue, London, Ont. The group lies on the northern side of Carpenter Creek valley and may be reached from Sandon, via the trail to the American Boy property.

The claims were located in the early nineties, and were worked until the close of that decade. Since 1900 the property has lain idle and the mine workings are now mostly inaccessible. All camp buildings were destroyed by forest fire in 1903. During the first few years the property was controlled by Matthews and Braden, representing the Ontario Gold Fields Mining and Development Company, Limited, of Toronto. Prior to the acquisition of the group by the present owners early in 1898, ore to the value of about $50,000 was produced. In February, 1899, a shipment of 38 tons assayed 118 ounces in silver to the ton, 53¼ per cent lead, and 13 per cent zinc.

The group is underlain by comparatively massive, sedimentary rocks flanked on the southwest by overlying slates. The general strike is north 58 degrees west and the dip is southwest at angles varying mostly from 40 degrees to perpendicular. The border of the slate belt follows in a general way the boundary between Crown Point and Ajax claims. The sediments are intruded by a few quartz poryhyry dykes.

Two vein lodes, an East lode and West lode, respectively, have been explored by workings ranging in elevation from 6,000 to 6,750 feet above sea-level. The underground workings aggregate more than 1,650 feet in length and are entered by ten adits.

Most of the production came from the " West vein " of the West lode (*See* Figure 2). This vein has been explored by four drift adits which, together with stopes extending for 180 feet above the highest adit, give a vertical depth of about 500 feet. The vein strikes about north 20 degrees east and dips southeast at an angle of 70 degrees or more. It parallels a prominent set of joint planes in the country rock and, presumably, fissuring followed the joint planes. The workings are entirely inaccessible and little

could be seen of the vein matter at the surface. Judging, however, from mine plans, an ore shoot was nearly continuous from the uppermost stopes to the lowest adit (No. 3 on Figure 2). The shoot paralleled and was worked out to the surface. The shipment of 38 tons referred to above came from workings on this ore-body.

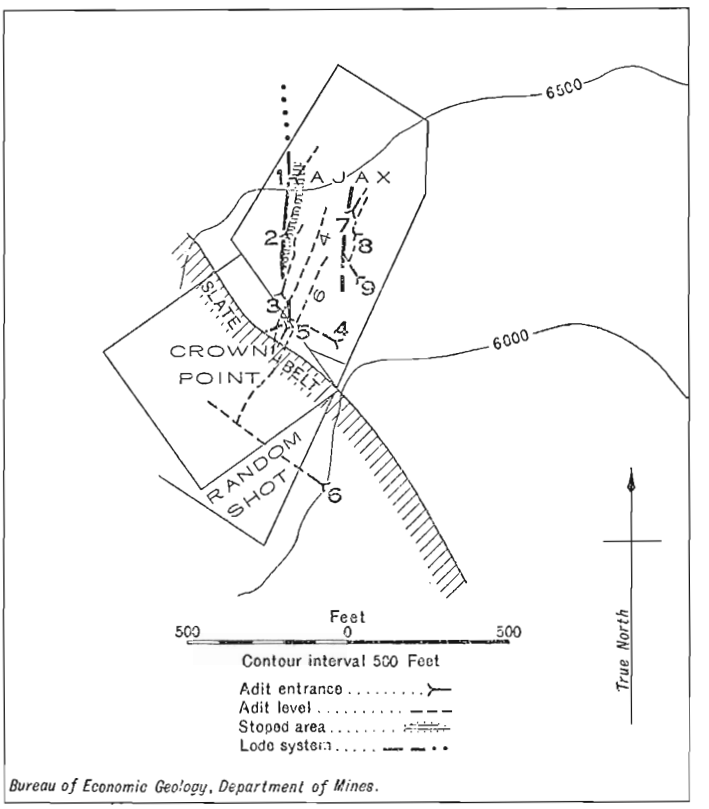

Figure 2. Ajax group, showing outcrop positions of lodes, principal adit levels, and the section of underground workings from which most of the ore was obtained.

The "Main vein" of the West lode was explored chiefly by an adit (No. 4 on Figure 2) 126 feet vertically lower than the lowest adit (No. 3 on Figure 2) on the "West vein." The adit is a crosscut for about 230 feet to where it meets a strongly sheared zone striking about north 30 degrees east and dipping southeast at an average angle of 55 degrees. This was drifted on for about 150 feet southwest and 450 feet northeast. In the northeast drift, about half-way between the crosscut and the face of the drift, some vein matter carrying grey copper was observed near where a winze has been sunk a few feet. At this point a fissure vein striking nearly north and dipping east at about 65 degrees crosses the drift. Elsewhere along the shear zone very little vein matter was observed. Three or more

raises have been run above the level without encountering any significant mineralization. It is claimed that this "Main vein" was picked up by a 50-foot crosscut from the lowest adit level on the "West vein" and that it was drifted on for 78 feet. In this drift it is stated that although the lode was wide and carried considerable galena it was, as a whole, low grade. A sample of ore from the adit level on the "Main vein," was, however, reported to have assayed 452·7 ounces in silver, 5·3 ounces in gold, and 28·5 per cent lead to the ton.

What is probably a continuation of the West lode occurs on the Crown Point claim on the southwest side of a gulch which follows, nearly, the boundary between the Ajax and Crown Point claims. Here, an adit (No. 5 on Figure 2) 25 feet lower than the lowest adit on the West vein has been run south along a shear-vein lode for about 65 feet to its termination in the broad slate belt previously referred to. The lode fingers out in these slates, but nearer the portal some stoping has been done above the level and a small body of ore taken out. A crosscut tunnel (No. 6 on Figure 2), now inaccessible, was driven from a point about 100 feet lower than the other crosscut adit (No. 4 on Figure 2) to pick up the Main vein. It is not known whether this tunnel reached its objective.

Work on the East lode comprises three short adits aggregating about 400 feet of crosscut and drift. One of these (No. 8 on Figure 2) is about 500 feet higher than and almost directly north of the American Boy cabin and is about 270 feet above the crosscut adit (No. 4, Figure 2) to the "Main vein" of the west lode. It reaches the lode by a 30-foot crosscut and is continued as a drift to the northeast for about 160 feet. The lode strikes north 35 degrees east and dips about 70 degrees southeast. A little stoping has been done above the level at places where some galena and oxidized lode matter were discovered. Another adit (No. 9, Figure 2) about 75 feet below is a crosscut for 70 feet and a drift to the northeast for 130 feet. This drift closely follows the lode which includes, here and there, an inch or more of galena. At one point along this drift the lode is offset a few feet by a slip following a bedding plane striking north 30 degrees west and dipping steeply southwest. A little clean galena was seen near this slip.

The East lode appears to lie about midway between the West lode and the American Boy-Last Chance lode and strikes at an angle of 15 degrees or 20 degrees with the latter. It is similar in structure and mineralization to tributary vein fissures encountered in the American Boy and Last Chance mines. The lode is not much more than a line of fissuring in which mineralization is vein-like, discontinuous, and composed of quartz and, probably, some carbonate, associated here and there with a little galena. The lode's direction and dip have been controlled by jointing in the rocks.

AJAX FRACTION

This claim is northwest of and adjoins the Ajax (*See* Figure 1). It is owned by Rosebery Surprise Mining Company, New Denver, B.C. The workings are in poor repair and little either of workings or mineralization could be seen at the time visited. According to mine plans two

short adits have been driven northerly, 80 feet apart vertically, and with portals about 150 feet apart on the slope of the hill. A shaft 55 feet deep reached the lower adit about 90 feet from the portal; and a raise to the surface was driven from the same level at a point about 60 feet from the portal. Judged by the branching course of the lower adit level, the lode was difficult to follow. There are no records of production, but a little silver-lead-mineralization was reported to have been encountered in the higher level along a joint fissure in argillaceous rocks. The fissure strikes north 25 degrees east and dips steeply to the southeast. Its supposed outcrop position lies west of that of the west lode of the Ajax group which, presumably, extends into Ajax Fraction ground, but, so far as known, has not been located there. As the workings on the lower Ajax Fraction adit lie southwest of the upper adit, any mineralization encountered in this lower adit must occur in a separate fissure or fissures from that followed in the upper adit.

ALTOONA GROUP

References: Ann. Rept. of Minister of Mines, B.C., 1928, pp. 288-289.
Dept. of Mines, B.C., Bull. No. 1, 1929, pp. 47-48.

The Altoona group comprises Altoona and Bow Knot Crown-granted claims and the Commander claim held by location, and is in Carpenter Creek valley below Sandon, on the road to Three Forks. It is owned by Altoona Mines, Limited, Nelson, B.C.

The group lies towards the northeastern edge of a broad belt of massive quartzitic and argillaceous beds and some limestone and other calcareous strata of the Slocan series. These measures are overlain a short distance to the northeast of the workings by carbonaceous slates which form part of a wide belt. The sediments strike northwesterly, dip southwest, and are intruded by two granitic stocks and by porphyry dykes and sills.

The workings comprise four adits, aggregating about 1,400 feet of lineal work. They are designed to explore a lode striking about north 65 degrees east and dipping 60 degrees southeast. The lode follows along or near the contact of sheared argillites with a spur of granite from a nearby stock. Only the upper two adits have encountered any mineralization. No. 3 adit has not reached the lode and the lowest or No. 4 apparently has been run entirely in foot-wall rocks. On No. 1 level the lode has been followed for 350 feet. Over the greater part of this length the lode is narrow and vein matter meagre and discontinuous, but at one place, for a length of 20 feet, it widens to several feet and carries disseminations and streaks of pyrite, zinc blende, and galena in a gangue of quartz, siderite, and sheared country rock. No. 2 adit is 150 feet below No. 1; the portal is on the old K and S railway grade. This adit has been driven about 380 feet. Commencing at about 100 feet from the portal, it follows for a length of more than 100 feet what appears to be the downward continuation of lode matter from No. 1 level. For this distance the vein matter averages several inches in width and varies from less than an inch to over 6 feet. The mineralization is much the same as in the adit above. No shipments are recorded. Samples taken by the

management and by the Government resident engineer indicate that such ore as has been encountered is mostly of milling grade averaging from 2 to 5 ounces in silver to the ton, 1 to 5 per cent lead, and 7 to 15 per cent zinc. The distinctive ore mineral is pyrite occurring plentifully both in disseminated grains and in massive aggregates. Zinc blende is more abundant than galena. The chief gangue mineral is quartz, but, locally, dark brown siderite is also abundant.

The mineralization encountered in the two upper adits is very like that found on a number of properties in the vicinity, where sediments are intruded by granitic stocks and dykes. Though this association is favourable enough for ore deposition the character of the mineralization is not, in the writer's opinion, such as to encourage deeper developments on the chance of encountering better silver or silver-lead values. Rather, the mineralization suggests that the lower part of the main ore zone for this general locality has been reached and that most of this ore zone, containing, possibly, important silver-lead mineralization, has been eroded.

AMERICAN BOY AND LAST CHANCE GROUPS

References: Ann. Repts., Minister of Mines, B.C., 1922, p. 199; 1923, p. 224; and other years.
Rept. of Zinc Commission, 1906, pp. 255-256.
Geol. Surv., Canada, Ann. Rept. 1895, pt. A, pp. 30-31.

These two important groups can be conveniently described together as they adjoin and the mine workings are on the same lode system and are connected. The American Boy group consists of the American Boy, Treasure Vault, Chicago, and Jessie claims, and Franc and Black Hawk fractions. The Last Chance groups consists of the Last Chance, Starlight No. 3, Galena[1], and Blizzard claims, and Little Widow and Starlight fractions. All claims and fractions on both groups are Crown-granted. The American Boy Mining and Milling Company, 642 Peyton Building, Spokane, Wash., owners of the American Boy group, have acquired the Last Chance and Blizzard claims of the Last Chance group from the Silver Cord Mining Company, Limited, % C. A. Stewart, 525 Seymour Street, Vancouver, B.C.

These groups (*See* Figure 1) are situated on the steep, open, southern slope of the high ridge west of Reco mountain overlooking Carpenter Creek valley to the northeast of Sandon. Workings range from an elevation of about 5,700 feet to the summit of the ridge, over 7,700 feet above sea-level. The properties may be reached by trail, 2 miles from Sandon. An aerial tram 6,000 feet long extends from the portal of No. 4 adit, Last Chance mine, to the old K and S railway grade less than a mile by road from Sandon. Underground, the workings are connected with the adjoining Noble Five mine and by way of them it is possible to reach either the Sovereign or Noble Five aerial tramways, the former leading to Sandon and the latter reaching the Noble Five concentrator at Cody, about 1½ miles by road from Sandon.

The principal claims of these two groups were located in 1891 and were among the first to be staked in Slocan. Claims staked in that year

[1] See separate description of claim.

had extralateral rights which in the case of the American Boy group were allowed to lapse but are still retained by the Last Chance claim.

Development work commenced on both groups in the early nineties and an important production, particularly from the Last Chance mine, had been recorded by the close of that decade. Operations continued fairly steadily until 1908 when both properties were closed. The Last Chance remained closed until 1920 and the American Boy until 1922. Since then small shipments, mostly the work of lessees, have been recorded from both mines. Considerable friction, resulting in costly litigation, arose in early years between the companies controlling these groups as a result of the proximity of their developments on the same lode system and the extralateral rights of the Last Chance mine. Exploratory work at the Last Chance mine commenced on an outcrop of the main lode which, at the time, looked none too promising. An incline, sunk for 80 feet from near the portal of the Upper or No. 1 adit, encountered from 1 to 3½ feet of high-grade galena bordered by several feet of "carbonates" and concentrating ore. Operations on this ore shoot in 1896 by the Last Chance Mining and Milling Company provided $20,000 in dividends and gave impetus to further exploration of the vein lode both on this property and the adjoining American Boy group to the southwest.

Production returns are incomplete. They indicate fairly uniform values in the silver-lead shipments. From the American Boy mine the first consignment of 100 tons yielded about 100 ounces in silver to the ton and 50 per cent lead. A shipment of 32 tons in 1923 assayed 56 ounces in silver a ton, 45 per cent lead, and 15 per cent zinc. Ore shipped in 1908 ran high in zinc. In 1905, 170 tons of hand-sorted zinc blende gave from 45 to 47 per cent zinc, up to 8 per cent lead, and 15 ounces in silver to the ton. Total recorded shipments, aggregating 4,066 tons, had an average content of 65 ounces in silver to the ton and 35 per cent lead. Early production included much oxidized or "carbonate" ore. Records of old shipments of this material show a ratio of silver to lead of about 1½ ounces to the per cent, but in some instances as high as 5 ounces. Returns from Last Chance shipments have on the whole indicated better values. This mine is credited with its heaviest production during the years 1895 to 1898, inclusive, and 1901. The average content of 1,700 tons produced in 1898 was 150 ounces in silver to the ton and 60 per cent lead. Shipments in 1920, 1921, and 1922, amounting in all to 109 tons, averaged 100 ounces in silver and 44 per cent lead. The total recorded production of 4,721 tons from this mine (to the end of 1922) averaged 124 ounces silver and 48 per cent lead.

The rocks on these groups are chiefly compacted sediments varying from massive, light-coloured quartzites to more argillaceous and to calcareous types. For the most part the sediments are well bedded. They are distinctly banded where quartzitic layers are interbedded with more argillaceous strata. Weathered surfaces of these banded rocks in many places show a pseudo-conglomeratic structure, as a result, apparently, of brecciation of the quartzitic bands and flowage of the softer strata around the dislocated fragments. Associated with the more massive rocks are slaty sediments forming belts 100 feet or more wide. The sediments have a fairly uniform strike of north 58 degrees west, and dip southwest at angles

that vary from 30 to 35 degrees in the Last Chance mine workings to much steeper angles on American Boy ground where vertical dips and even overturned strata were noted. Towards the western boundary of the American Boy group the above-described sediments pass beneath a broad syncline of slates the eastern border of which (*See* Figure 1) follows the main gulch running past the American Boy cabin and may be observed underground between the two crosscuts in workings on the Chicago claim. The sedimentary formations are intruded by many quartz porphyry dykes, which, in general, tend to follow the strike and, to some extent at least, the dip of the enclosing sediments. The dykes are commonly from 10 to 30 feet or more thick. There are also a few, small, basic augite-olivine-biotite dykes.

The workings on the main vein-lode of the American Boy-Last Chance group (*See* Figure 3) comprise eleven adits and several intermediate levels aggregating about 3 miles of drift and crosscut. These workings are connected by raises and explore the lode over a vertical depth of about 1,150 feet or for over 1,300 feet measured down the dip. Most of this work has been done on the main lode and only short crosscuts were required in any instance to tap it. Adits are numbered from the top down and include levels 1 to 8 Last Chance and 1 to 7 American Boy, numbers 5 to 8 Last Chance corresponding to numbers 1 to 4 American Boy. Certain workings are continuous on the two groups and have developed the main lode for a length of 2,700 feet. Aside from workings on this lode, the only important mining work is the Galena (No. 12, Figure 3) driven for 2,060 feet as a crosscut on No. 4 level (No. 4, Figure 3) Last Chance mine. It intersects the main lode and extends for 1,700 feet to the north of it. This crosscut was driven to pick up the downward continuation of the Galena vein-lode developed on the Galena claim on the north slope of the ridge 800 feet above. The supposedly Galena lode was encountered about 470 feet from the face of the crosscut and was drifted on for 534 feet to the southwest (*See* Figure 3).

The main American Boy-Last Chance vein-lode follows a strongly fissured zone which cuts across sediments and porphyritic intrusives. Its strike varies from about north 45 degrees east on the American Boy to about north 60 degrees east on the Last Chance claim. The dip is to the southeast at an average angle of from 60 to 65 degrees. The lode includes two and, in some places, more than two well-defined fault fissures, each marked by from one to several inches of gouge and by a variable width of crushed rock. The strike and dip of each fissure varies from point to point so that the fissures meet and separate at irregular intervals, and thereby develop a braided structure varying from a few inches to over 20 feet in width. In general where the lode is widest, vein matter and ore are confined to the vicinity of one or both walls, with but slightly mineralized country rock between. In such cases the richest paystreak commonly favours the steeper wall. Where the walls of the lode are as much as 2½ feet, perhaps somewhat more, apart, the whole width may be vein matter, though even in such cases the paystreak may be confined to a few inches immediately adjacent to one or other of the walls. Where cross fractures occur in the wider parts of the lode, the mineralization may be as much as several feet wide.

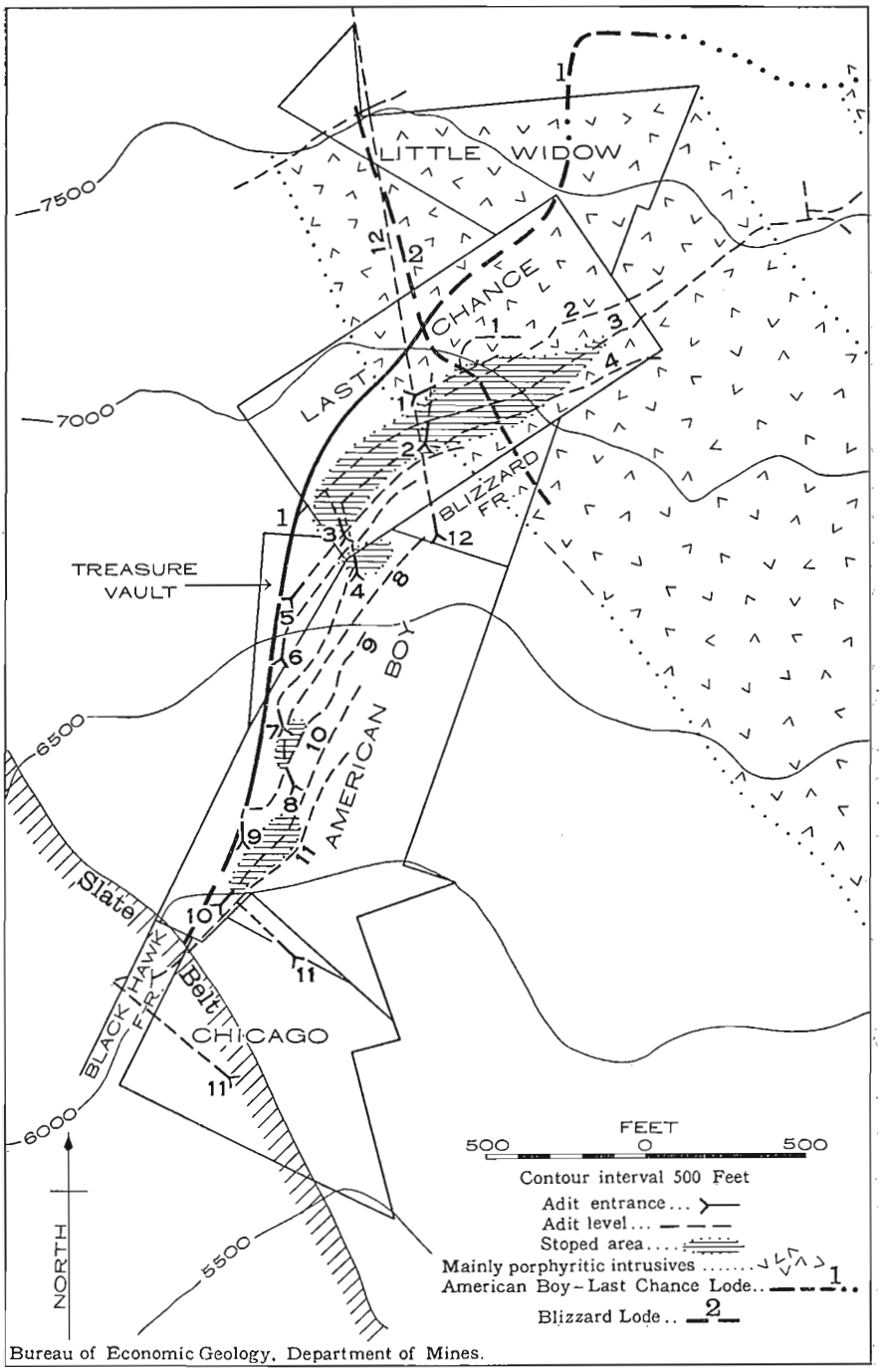

Figure 3. American Boy-Last Chance groups, showing outcrop positions of lodes, principal adit levels, and the sections of underground workings from which most of the ore has been obtained.

The main lode is joined in places by vein-bearing fissures entering from the hanging-wall side on a strike mostly a few degrees east of north. These fissures dip east at angles varying from 45 degrees to nearly perpendicular. At different places in the American Boy and Last Chance workings good ore has developed at the junctions of such fissures with the main lode. In certain instances the tributary fissures have been controlled by jointing in the rocks. In most cases they occur where the main lode swings from an easterly direction to one more nearly corresponding to the strike of the tributary fissure. In the Last Chance workings a prominent vein-bearing fissure striking almost at right angles to the main lode extended from No. 3 level to the surface. It outcrops (*See* Figure 3) on the Blizzard fraction and has been called the " Blizzard vein ". Where it joined the main lode the ore-body in the Last Chance workings had a maximum width of about 25 feet.

The vein matter is mainly argentiferous galena, zinc blende, pyrite, quartz, siderite, and crushed rock. Grey copper and ruby silver are associated with the sulphides; native silver was not observed. In general the proportion of zinc blende increases with depth. Galena was the principal ore mineral in the upper workings and towards the surface was commonly associated with " carbonate " ore carrying high silver values. The galena was either coarsely cubical or dense, steel-like, and, in places, had a gneissic structure. It occurred in nearly solid masses and also as intimately mixed galena, gangue minerals, and crushed rock. The zinc blende also occurred alone or mixed with the other vein constituents. Between the ore-bodies the lode was either essentially barren of vein minerals or was mineralized with gangue minerals only.

Most of the ore-bodies were small and were erratically distributed, but in the aggregate they provided a fairly steady production over a number of years. Important ore was discovered and developed in at least four distinct sections (*See* Figure 3). (1) The original discovery developed from No. 1 to below No. 4 Last Chance adit (No. 4, Figure 3), an ore shoot stated to have had a maximum stoping width of 25 feet, and to have been especially well developed at the junction of the Main and Blizzard veins. This ore shoot, together with leaner vein matter on either side, provided continuous stoping ground over most of the length of the Last Chance claim. (2) An ore-body lying below the boundary between the American Boy and Last Chance claims, mostly between No. 2 (No. 6, Figure 3) and No. 4 (No. 8, Figure 3) American Boy levels, and having a maximum length of over 150 feet. (3) An ore-body lying between 4 (No. 8, Figure 3) and 5 (No. 9, Figure 3) American Boy levels and having a length of 100 feet or more on either side of the No. 4 crosscut (No. 8, Figure 3). (4) An ore-body lying between Nos. 5 (No. 9, Figure 3) and 7 (No. 11, Figure 3) American Boy levels, situated towards the portals of these levels, and having an aggregate length of nearly 300 feet. Of these shoots the first was the largest, most continuous, and, in general, contained the best values in silver and lead; the shoots in American Boy ground included much low-grade material and contained more sphalerite than the Last Chance ore.

The more recent work on the American Boy mine has included the extending of Nos. 4 (No. 8, Figure 3) and 5 (No. 9, Figure 3) levels about 200 and 600 feet respectively, to get under the ore-bodies developed in upper levels of the Last Chance mine. These operations were attended with some success in the case of No. 4 level, where at intervals over a length of 175 feet from the face vein matter, including as much as 18 inches of solid sphalerite and considerable galena, was discovered and partly stoped out. Less ore was found on No. 5 level except at one point about 60 feet from the face where a winze and raise encountered as much as 2 feet of ore which played out at depth. At other points recent work has opened up encouraging mineralization. A winze sunk 50 feet below No. 7 level (No. 11, Figure 3), about 250 feet northeast of the more northerly crosscut, shows, all the way down, milling ore up to 3 feet in width, including some high grade. About 200 feet from the portal of No. 5 level (No. 9, Figure 3) a vein of zinc blende several inches wide was discovered in the hanging-wall of the main lode and was followed northeasterly for 100 feet or more to where it turns back into the main lode. At the junction some lead ore was opened up and a couple of carloads shipped. At one point along its course this vein of zinc blende was offset along a bedding plane for a distance of 10 feet.

Little development work has been done for a number of years on the Last Chance mine and it has fallen into disrepair. No. 4 Last Chance level (No. 4, Figure 3) is connected with workings on the adjoining Noble Five property by a 170-foot raise from a crosscut 700 feet long, driven on No. 4 level of the Noble Five mine.

To the southwest, beyond the American Boy claim, the lode enters a broad belt of slates in which there is little chance of discovering important mineralization. The border of this slate belt, therefore, marks the southern limit of favourable ground. Northeast of this border the main lode is well defined and continuous throughout the ground explored by the mine workings. It should continue to greater depths, but since the content of zinc blende has increased in the lower mine workings and the amount of mineralization has decreased, it is possible that the bottom of the zone of mineralization has nearly been reached. Before venturing on any extended program of deeper exploratory work, more work should be done on the present lower levels to determine if the character and amount of mineralization at these depths is such as to give reason for believing that ore occurs at still deeper levels.

Certain features of the ore occurrences developed to date are significant. In general the lode is steeper in the more competent rocks than in intervening more slaty strata. The ore-bodies favour the more competent rocks and there seems to be a tendency for ore to concentrate in them close to the less competent beds and the larger porphyry dykes. It is noticeable that certain of the ore-bodies favoured the foot-wall and others the hanging-wall of the lode. The tendency for ore-bodies to have developed where branch veins join or where other veins cross the main lode has been proved in various places, as in connexion with the Blizzard vein. All these features suggest: that in searching for further ore-bodies particular attention should be paid to the parts of the main vein zone where it has developed

in the more competent sediments or porphyry dykes, and more particularly near the junction of such rocks and less competent, more slaty strata; that where the main vein zone is wide and marked by definite walls, both walls should be explored; and that, other conditions being favourable, the junctions of the main vein-lode and tributary veins should be carefully investigated.

ANTOINE CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 63; 1904, p. 202; 1925, p. 245.

The Antoine claim is owned by H. W. Foster, G. A. Mitchell, and Thos. R. Scott, % James Anderson, Stock Exchange Building, Vancouver. The property lies in Antoine basin at the head of the south fork of McGuigan creek, about 6 miles by road and trail from Rambler station. The camp is 7,100 feet above sea-level. The Red Fox and Silver Bell No. 2 claims are staked on the northeasterly extension of the Antoine lode; to the southwest this lode is either the same or is closely parallel to the lode developed by the Galena tunnel, on the Galena claim of the Last Chance group.

The Antoine claim was staked on October 9, 1891, and has extra-lateral rights. Most of the production and development work are referable to the years 1895 to 1905 inclusive, since which time the mine has been worked intermittently and production has been relatively small. Underground workings, camp buildings, shaft housing, etc., are in a state of disrepair. In 1903 an extensive exploratory program was undertaken including the projection of the long No. 5 crosscut adit to connect with the lower workings. Over 200 tons of ore was shipped during that year. In 1925 an attempt was made by a lessee to rework the old dump at the portal of No. 5 adit, and in the following year two lessees found some good ore 20 feet above the 50-foot level about 300 feet northeast of the shaft. Total recorded shipments of about 1,300 tons have averaged 190 ounces in silver to the ton and 48 per cent lead. This record is not complete but represents the bulk of shipments.

The mine is opened up by an upper or Red Fox drift adit; by an incline shaft connecting at a vertical depth of 150 feet with the main or No. 5 adit; by two intermediate levels driven from this shaft at 40 feet and 80 feet, respectively, below the collar; by the 800-foot adit crosscut and workings on the fifth level; and by a short winze below No. 5 level. These workings aggregate a length of over 3,500 feet. The Red Fox adit is driven easterly from a point about 25 feet vertically above and 100 feet or so north of the collar of the shaft. The 800-foot crosscut is driven southeasterly and its face is about 500 feet west of the Red Fox shaft on this level. The winze below this level lies about 140 feet south of the shaft.

The rocks at the Antoine include both sediments and intrusives. The sediments are chiefly massive argillaceous and quartzitic rocks and form part of a belt of such strata that extends northwesterly from the high ridge west of Reco mountain through and beyond the workings of Washington and Payne mines. The rocks immediately east of this belt are chiefly slates and fissile argillites and some slaty beds are encountered in the Antoine workings. Occasional narrow beds of limestone were also

observed. The general trend of these formations is northwest and the dip is mostly to the southwest at angles varying from 35 degrees to 60 degrees. The sediments are intruded by numerous porphyritic bodies varying from quartz-porphyry to feldspathic types in which quartz is a less important constituent. These bodies occur as irregular masses and as dykes, most of the latter rather closely following the strike of the sediments. A few basic dykes were observed. Of these a dark green lamprophyre dyke about 5 feet wide, cut by the vein-lode on No. 5 level (Figure 4) and followed by the inclined shaft, forms a noticeable feature in the underground workings. Near the winze on No. 5 level it apparently cuts across a broad, quartz-porphyry dyke, and has been drifted on for 240 feet south of the winze to where it encounters a fault running north 69 degrees west and dipping 30 degrees southwest. The fault displaces the dyke about 50 feet to the west where it is again drifted on to the south for an additional 65 feet.

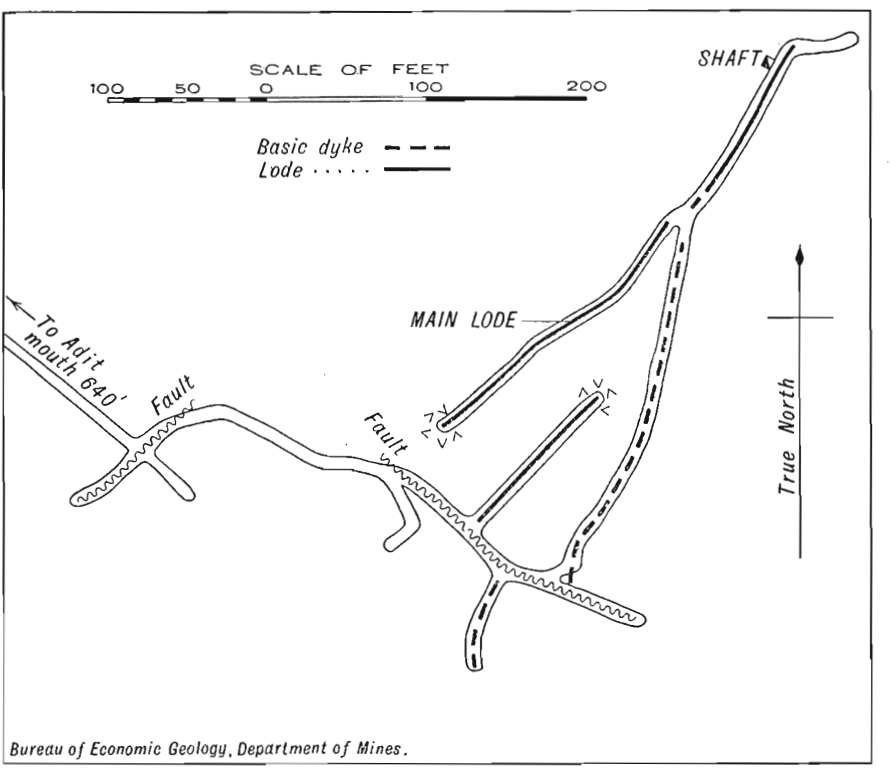

Figure 4. Plan of part of fifth (main) level, Antoine mine.

The main lode of the Antoine mine has a general northeasterly course, but northeast from the incline shaft it curves towards the east as it approaches Red Fox ground. The average dip is 65 degrees southeast. Near the Red Fox line, a spur of this lode strikes northeast and has been

drifted on to the boundary of the claim. Southwest of the shaft the lode carried a vein which has been followed for about 130 feet on the upper intermediate level, 220 feet on the next lower level, and 325 feet on No. 5 level (*See* Figure 4). In the southwest face of No. 5 level this vein enters a quartz-porphyry dyke and pinches to a width of about 1½ inches. It is composed of siderite containing a little pyrite and zinc blende. It seems likely that the vein widens on the other side of the porphyry dyke, but in this direction it could extend only about 35 feet before encountering the southeast-northwest fault that has been followed by the crosscut adit on this level (*See* Figure 4). No vein or fissure, however, was noted in No. 5 crosscut farther to the west unless the fault drifted on much farther west, and which strikes about parallel with the Antoine lode, is the continuation of the same vein-lode. This seems unlikely as the displacement along the northwest-southeast fault would be so much greater than that suffered by the basic dyke, and furthermore the fault is not mineralized and dips southeast at an angle much lower than that of the main vein. It seems that the latter, if it continues southwest of the porphyry dyke, must pinch to a mere crack which has escaped observation where it crosses No. 5 crosscut. On No. 5 level a vein, 50 feet east of and paralleling the main vein, has been followed by a drift running northeast from the crosscut (*See* Figure 4). This vein pinches in porphyry rock at the northeast face of the drift; in the opposite direction it is lost on encountering the fault followed by the crosscut and has not been found south of the crosscut. No vein has been discovered immediately south of the main crosscut and yet it seems likely that veins do exist. For instance, some 1,100 feet south 15 degrees west of the portal of No. 5 crosscut, Antoine mine,[1] the Galena vein-lode was drifted on in the Galena tunnel and from its average strike and dip should reach No. 5 crosscut level of the Antoine somewhere near the face of the crosscut. If the Galena vein-lode does extend northerly to about the calculated position it may also extend beyond parallel with the known Antoine veins, and if so it should be prospected along that part of its course opposite the ore-bearing parts of the Antoine lode where the possibilities of finding further ore-bodies are best. It might also prove profitable to pick up the northeasterly continuation of the easterly vein on the fifth level opposite the productive length of the main Antoine vein.

Two important ore shoots have been developed on the Antoine property, an eastern shoot lying on either side of the Antoine-Red Fox line and a western shoot or series of shoots in the vicinity of the inclined shaft. The eastern shoot was about 200 feet long and did not go much below the upper intermediate level. The western shoot continued from near the surface to below No. 5 level. It pitched south, had a length of from 250 to 300 feet, and carried a paystreak varying from an inch or less to 18 inches wide. On No. 5 level the ore was continuous for about 300 feet and in one place had a thickness of 3 feet.

The vein matter consists of ore minerals, siderite, and quartz and is associated with fragments of country rock. In the southwest face of No. 5 drift quartz prisms were seen lying at right angles to the walls and

[1] This location is approximately correct, but should be checked by more accurate survey as any alteration in its position would affect the subsequent calculation.

projecting into siderite. Several specimens of vein matter were noted in which pyritized fragments of argillaceous country rock were completely surrounded by vein matter. The ore minerals include galena, zinc blende, grey copper, ruby silver, and native silver, the latter in leaf and wire form. Pyrite is commonly abundant and a little arsenopyrite was observed. Clean ore is stated to have run from 45 to 60 per cent lead and from 190 to 200 ounces silver to the ton. The zinc blende carries about 30 ounces in silver.

The continuity of the ore of the west shoot to below No. 5 level and the strength and character of the vein matter in the vicinity of the winze below No. 5 level seem to warrant developing the property to greater depth. If this is done, and if further crosscutting is attempted, advantage might be taken of the crosscut to the Tom Moore lode on the claim adjoining the Antoine on the northwest. This crosscut if projected about 1,450 feet farther, in a direction south 65 degrees east, should tap the Red Fox-Antoine lode at a depth of 400 feet below the winze from No. 5 level.

APEX CLAIM AND MOUNTAIN CHIEF GROUP

References: Ann. Rept., Minister of Mines, B.C., 1921, p. 136.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 189.

These properties are on the south side of Carpenter creek, near the New Denver-Sandon road.

The Apex is owned by W. J. C. Wakefield, Peyton Block, Spokane, Washington. Development work has been confined to a quartz vein striking north 70 degrees west and dipping about 40 degrees south. The vein is reached at 485 feet from the portal of a crosscut 565 feet long, driven southerly from about the New Denver road. It has been worked on this and one upper level 85 feet vertically above the crosscut adit and shows a maximum width of from 2 to 3 feet of quartz containing pockets and disseminations of ore minerals and fragments of the wall-rocks. The ore minerals include sphalerite, galena, and grey copper. The country rocks are argillaceous and calcareous sediments striking north 40 degrees west and dipping about 45 degrees southwest. They are intruded by large porphyry dykes and by a granitoid stock which occupies a considerable area north of Carpenter Creek valley opposite the portal of the crosscut adit. Lessees shipped 28 tons of silver ore from this property in 1924. Previous shipments contained some lead, but in small amounts as compared with the silver content.

The Mountain Chief group includes the Mammoth, Mountain Chief, and Egypt claims. The Mammoth is owned by Marcus M. McCune, J. A. Finch, G. W. Hughes, and A. J. Davis, % H. Giegerich, Kaslo, B.C.; the Mountain Chief by Payne Mines, Limited, % C. H. Law, St. James Street, Montreal; and the Egypt by the Crown. The group was worked between 1892 and 1897, when 1,260 tons of high-grade silver-lead ore and several cars of zincy ore were shipped. Operations were then suspended for a number of years owing probably to the marked increase of zinc with depth. In 1921 and following years, development was resumed by lessees who by the end of 1924 had shipped about 114 tons of ore carrying an average of about 70 ounces silver to the ton, 11 per cent lead, and 15 per

cent zinc. In 1925 a two-compartment jig was erected about 200 feet above the road and operated for the recovery chiefly of the sphalerite from ore still remaining in the old stopes and dumps. Development work includes nine adits, driven mostly on the Mountain Chief claim near its northwestern boundary and varying from 100 to about 500 feet in length. The strike of the vein-lode is from north 40 degrees east in the lower workings to north 65 degrees east on No. 3 level and to north 50 degrees east at the surface. It is interrupted by faults which displace it to the east. The principal production has been from the upper three levels, where ore has been stoped to the surface. This ore is said to have been composed chiefly of galena with zinc blende increasing in amount with depth. The zinc blende invariably carried good silver values. In the lower levels the vein matter varies from a few inches to 4 feet in width and is composed chiefly of quartz containing bands of zinc blende up to 8 or 10 inches wide. The country rocks are like those on the Apex claim.

ARGO GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 53.

The Argo group includes the Marie fraction, Belt, Loudoun, and St. Charles claims and is owned by J. M. Harris, *et al.*, of Sandon. It is situated at Sandon, the workings lying immediately above the old K and S railway grade. The workings include three short adits driven to explore a lode that at the surface as originally exposed carried some promising vein matter. The lode strikes north 65 degrees east and dips about 45 degrees southeast. It intersects massive argillaceous to quartzitic beds and three or more quartz porphyry dykes or sills, the sediments striking about north 55 degrees west and dipping to the southwest. Where explored, the lode is a strongly sheared zone composed of from 1 to 2 feet of gouge and crushed rock associated here and there with vein quartz, but exhibiting, so far as could be seen, little trace of ore mineralization.

BEST CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 61.

The Best claim is owned by Marcus M. McCune, A. J. Davis, P. Layson, and J. F. Finnucane, % H. Giegerich, Kaslo, B.C. It lies in the upper basin of McGuigan creek at an elevation of about 5,800 feet and is accessible by the Rambler-Cariboo mine road from Rambler station.

The claim was staked in 1891 and has extralateral rights. Mining commenced in 1892 and between then and the close of 1896 considerable ore was produced. No further production was recorded until 1918 when 37 tons were shipped and yielded 134 ounces a ton in silver and 23 per cent lead.

The country rock at the workings is quartz diorite which occurs as a stock with dyke-like apophyses penetrating adjoining sediments of the Slocan series. The stock is seamed with a great number of quartz veins ranging from a few inches to several feet in width and mostly very

irregular. The more persistent veins follow fault fissures occurring along joint planes striking north 20 degrees west and dipping from 25 to 45 degrees northeast.

On one of these veins an incline shaft has been sunk for 75 feet and from the bottom (?) a drift run for 25 feet. The vein varied from a few inches to 3 feet wide, contained important amounts of grey copper and jamesonite, and assayed high in silver. The crosscut adit was driven easterly from a point 120 feet, vertically, lower down the hill than the collar of the shaft. At 110 feet from the portal it intersects a quartz vein, 6 to 12 inches wide, striking south 20 degrees east and dipping 28 degrees northeast. The vein was drifted on for 78 feet to the southeast. It is mineralized with galena and grey copper. At 230 feet from the portal a raise was started to connect, presumably, with the bottom of the shaft and is up 55 feet. At the foot it is in a quartz vein, 18 inches wide, carrying galena, grey copper, and sphalerite. Beyond this intersection the crosscut continues easterly for another 100 feet to where it swings to south 60 degrees east for 105 feet and then to south 34 degrees east for an additional 195 feet to the face. In the south 60 degrees east part of the adit two mineralized fractures were observed striking north 75 degrees east and dipping 73 degrees southeast. The more easterly of these carries as much as 6 inches of vein matter consisting mainly of quartz holding some galena and pyrite.

Elsewhere on the Best property quartz veins outcrop carrying, here and there, small concentrations of silver-rich minerals. Locally a little galena and zinc blende are visible. Pyrite and, to a lesser extent, chalcopyrite are generally present. Values are mostly in silver.

BLACK COLT AND SILVERITE CLAIMS

References: Ann. Repts., Minister of Mines, B.C., 1926, p. 251; and other years.

The Black Colt claim, owned by Consolidated Queen Bess, Limited, Alamo, B.C., has been worked under lease. It is on the southwestern slope of Carpenter Creek valley 2½ miles by trail northwest of, and about 1,250 feet above, Sandon.

The underlying rocks are sediments of the Slocan series and consist, chiefly, of crushed, black argillites. These are interbedded with more massive, pyritic argillites and with banded argillaceous and quartzitic strata. The beds are much faulted and lie in a low fold striking northwesterly.

Mineralization occurs along a fracture zone, probably 60 to 70 feet wide, striking about north 55 degrees east, and is investigated by a branching adit driven southwesterly for about 450 feet. Within this zone vein deposits have formed in fractures striking in various directions and dipping at various angles. In part these mineralized fractures are parallel with bedding structures, but most of them have formed along joint planes. Probably the best showing occurs in a drift run from near the face of the adit, along a fault fissure striking from north 65 degrees east to about east. In this drift for a length of 40 feet good milling ore 1½ to 2 feet thick was encountered. A flat-lying fault in the roof of the drift disrupts the deposit, but a raise farther along the adit picked it up again.

A crosscut adit on the adjoining Silverite claim was being driven to pick up the downward continuation of the ore. Vein deposits of less importance were found at several other places in the adit workings.

The wider parts of the vein matter are commonly brecciated, fragments of ore minerals and wall-rock lying in a matrix of quartz and siderite. A little calcite is also present. The ore minerals include argentiferous galena, zinc blende, and pyrite, in varying proportions. Clean ore runs from 1 to 2 ounces in silver to the per cent of lead.

The first recorded shipments were made in 1919 and amounted to 22 tons carrying on an average 76 ounces in silver a ton and 60 per cent lead. Shipments to the end of 1926 include 208 tons containing, on the average, about 60 ounces silver to the ton and 37 per cent lead.

The Silverite claim, adjoining the Black Colt, is owned by John Long and is also under lease. The crosscut adit referred to above was started from a point on the Queen Bess mine trail 200 feet or so below Black Colt adit. When visited it was in about 400 feet but had not reached its objective.

BLACK GROUSE GROUP

Reference: Amn. Rept., Minister of Mines, B.C., 1927, p. 274.

The Black Grouse group, comprising three claims and a fraction, is on the west slope of Kane creek about $2\frac{1}{2}$ miles by road and trail from Three Forks. It is owned by R. Fowlie of New Denver, B.C.

The property was staked in 1896 and, later, was operated under lease. No work had been done on it for several years past, with the result that the workings are partly caved and inaccessible.

Much of the work was done from one adit. This is a crosscut, at an elevation of about 3,600 feet, run into the hill in an easterly direction for 190 feet, at which point it encounters a wide zone of sheared, carbonaceous, slaty rocks striking northeasterly and dipping to the northwest at from 45 to 60 degrees. This zone nearly coincides with the attitude of the enclosing rocks. It has been followed to the southwest for 100 feet, in which distance small bodies of quartz carrying argentite and native silver were encountered and stoped out. An upper adit intersected the same shear zone at 75 feet from the portal and picked up small pockets of high-grade ore.

Production in the years 1915 to 1917 amounted to 23 tons carrying an average of 114 ounces in silver to the ton.

BLUEBIRD GROUP

References: Geol. Surv., Canada, Amn. Rept. 1894, pt. A, p. 34.
Ann. Repts., Minister of Mines, B.C., 1928, p. 287; and other years.

The Bluebird group consists of the Bluebird, Stranger, Rawson, and Idaho No. 2 claims, owned by Bluebird Mines, Limited, Kaslo, B.C. It is on the divide at the head of Jackson creek and west of the Bell-Sunset group.

The principal workings are on the Stranger and Bluebird claims (*See* Figure 1) and on the northern and southern slopes, respectively, of the divide. The workings on the Stranger were entirely inaccessible at the

time visited and those on the Bluebird largely so. From examinations of surface exposures and such underground workings as could be entered, coupled with information gathered from owners of the property and plans of the workings, some idea was obtained as to the character and extent of mineralization on this group.

The Bluebird and Stranger were staked in 1892. Over $10,000 was expended in 1892 on development work, which included 600 feet of tunnelling and the construction of a trail up Jackson creek. Later in the year 100 tons of ore, carrying on an average 144 ounces in silver to the ton and 71 per cent lead, was shipped. Shipments to the end of 1894 amounted to 540 tons of similar ore. By the close of that year, 1,800 feet of drifting and 200 feet of shaft work had been done. In 1896, 240 tons, and in 1898, 60 tons, of ore similar to the above was produced. The property then lay idle until 1903. In 1903-04-05 some 85 tons averaging 115 ounces silver and 56 per cent lead were shipped. Trail smelter receipts from June, 1903, to the end of 1910 show shipments of 151 tons, of which one lot of 15 tons assayed 138 ounces silver to the ton and 62 per cent lead.

Three veins outcropping on the southern slope of the Bluebird claim have produced ore. The zone of fissuring that includes these veins extends northeasterly across the ridge to workings on the north slope.

Slates and fissile, thinly banded argillites form a wide belt between the workings on the Bluebird and Stranger claims. On either side of this belt are more massive quartzitic and argillaceous beds. Several narrow limestone beds were observed at different horizons in the section. The strike varies from north 25 degrees to north 55 degrees west and the dip, with rare exceptions, is southwesterly at an angle of 40 degrees or 45 degrees. The sediments are intruded by a dyke-shaped mass of granodiorite porphyry striking northwesterly and angling across the Stranger claim about midway between the Stranger workings and the portal of the Bluebird tunnel on the north slope of the ridge (*See* Figure 1). The intrusive body is the northwesterly continuation of a porphyry belt crossing the Trade Dollar claim on the Bell-Sunset group. On the Stranger claim it has a maximum width of about 200 feet and in places, particularly towards the northwest, splits into a number of dykes. There are, also, several smaller, quartz porphyry sills and dykes and a few narrow basic dykes.

The workings on the Bluebird and Idaho No. 2 claims comprise six main adits, and a number of short adits and open-cuts. One main adit, now caved about 25 feet from the portal, has been driven from the north slope of the ridge at an elevation of approximately 7,075 feet. The other workings are on the south slope and extend from near the top of the ridge at 7,300 feet to 900 feet below.

Three vein-lodes outcropping on the Bluebird claim (*See* Figure 1) are from north to south, respectively, named the West vein, The Big or Idaho vein, and the Little vein. The "Big vein" strikes north 55 degrees east, dips 60 degrees to 65 degrees southeast, and has been developed by No. 2 adit, now mostly inaccessible. The lode is stated to have been traced on the surface from the portal of the adit down the steep slope of the hill to workings on the Idaho No. 2 claim 500 feet below. These lower workings, consisting of a 90-foot shaft and an adit 200 feet long[1], are inaccessible,

[1] According to a recent report (1928) this adit has been opened up and driven for 314 feet.

but are reported to have encountered bunches of silver-lead ore. Some galena was observed in vein matter on the dump at the collar of the shaft. The outcrop of the "Big vein" near the portal of No. 2 adit has a width of about 8 feet and is of more or less oxidized material showing no clearly defined walls. It marks a zone of brecciation cemented by quartz, but in which very little ore mineralization was noted. No. 2 adit follows the lode for 350 feet. From the face of the adit, a crosscut runs northwest for 180 feet and at the end is connected by a raise with No. 1 level driven on the nearly parallel West vein.

The Little vein lode strikes north 70 degrees east, dips 60 to 65 degrees southeast, appears to join or may intersect the "Big vein" near the portal of No. 2 adit, and has been explored on Nos. 2, 3, and 4 adits. Most of the production of the Bluebird property probably came from this lode. As developed it was not as wide as the "Big vein" but carried higher values and had the advantage of well-defined walls. It varied from 1 to 5 feet wide and contained a paystreak of solid galena from a fraction of an inch to over a foot wide. Good ore persisted for 250 feet along No. 4 level and 100 feet above it and has been mostly stoped out. The ore was argentiferous galena, in part in coarse cubes, and zinc blende in a gangue of quartz, siderite, and calcite, associated with some crushed country rock. In 1909 a lens of zinc blende 3 feet wide was encountered in this lode near the east end of No. 4 level, but as it carried no silver values it was not stoped out. A specimen of the coarse cube-galena from the Little vein lode yielded, on assay, silver at the rate of 1,437 ounces to the ton but only a trace of copper. The lode is intersected by two faults, one striking north 33 degrees west and the other nearly north and south. Both dip easterly at 60 degrees. The more westerly fault has offset the lode 20 feet to the north. The displacement effected by the other fault has not been determined. If the Little vein lode intersects the Big vein lode it would, farther southwest, be continuous with or closely parallel with the western of the two vein lodes on the Grey Copper claim (*See* Figure 1). The presence of outcrops of vein matter between the Grey Copper and Bluebird claims lends support to this possibility.

The West vein lode lies 100 feet northwest of and nearly parallel with the Big vein lode. It has been developed by No. 1 adit which is now inaccessible. Much brecciated vein matter was seen on the dump. The lode has been traced up the slope for nearly 200 feet by a series of short adits and open-cuts. As exposed it contains a width of 1½ to 2 feet of oxidized lode matter showing here and there a little galena. Some stoping was evidently done from one or more of the shorter adits. At one point a clean-cut foot-wall was observed striking north 60 degrees east and dipping 73 degrees southeast. It seems likely that a continuation of this lode was drifted on in the adit whose portal is on the north slope of the ridge, near the boundary of the Stranger claim and at the same elevation as No. 1 adit. This adit is about 350 feet long. It was inaccessible in 1927 but has since been reopened. It is reported that 15 to 20 tons of ore were taken out of a winze about 120 feet from the portal. Specimens on the dump indicated that the ore was largely of zinc blende carrying some galena and much pyrite in a gangue largely of quartz with some siderite.

The workings on the Stranger claim are inaccessible. They include two main adits about 85 feet apart vertically and one short adit about 25 feet above the lowest. There is some evidence of stoping having been done, but no data as to production are available. The elevation of the portal of the lowest adit is the same as that of No. 4 adit on the Bluebird slope. The trend of the principal lode in these workings appears to have been influenced by well-defined jointing in the country rocks. The joint planes strike north 55 degrees east and dip 75 degrees southeast. This attitude corresponds closely with that of the "Big" and "West" vein lodes on the Bluebird claim and it is probable that these veins are the southwesterly continuation of the zone of mineralization on the Stranger claim. The Little vein lode, if it maintains the same strike as on the Bluebird claim, would pass close to the Stranger workings. Ore specimens seen on the dumps of the Stranger workings are chiefly of sphalerite and pyrite with some galena. The lode matter is brecciated, as is characteristic of exposures on the southern slope of the ridge.

BOSUN

References: Ann. Repts., Minister of Mines, B.C., 1898-1928.
Rept. of Zinc Commission, 1906, pp. 209-213.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 190-191.

The Bosun mine, owned by Colin J. Campbell, New Denver, B.C., is on the east shore of Slocan lake about 1½ miles south of New Denver. The property comprises the Boatswain fraction, Fidelity, Fidelity fraction, Tyro, Tyro fraction, Broken Lock, Cracker Jack, and Sielig fraction Crown-granted claims.

An outcrop of vein matter in the Bosun lode or lode system was discovered in 1898 on the Fidelity fraction about 400 feet above the lake. Development work that year, including a couple of adits and a shaft, provided some 420 tons of ore averaging 100 ounces in silver to the ton and 50 per cent lead. Subsequently, the vein was picked up nearer the lake shore and energetic development work was carried on in 1900 and following years by Bosun Mines, Limited, a consolidation of the N.W. Mining Syndicate and the Fidelity Mining Company jointly controlling the Bosun and Fidelity groups. The property was distinguished in these early years of operation by the high silver values contained in both its zinc and lead ores. The Zinc Commission reports that up to February, 1904, 1,440 tons of zinc ore averaging 71·3 ounces in silver to the ton, 41·8 per cent zinc, and 1·8 per cent lead were shipped. Government statistics for the period show shipments of 4,599 tons of silver-lead ore averaging 84 ounces in silver to the ton and 20 per cent lead. After a further shipment of 173 tons of silver-lead ore in 1906, the mine lay idle until 1916 when it was taken over by the Rosebery-Surprise Mining Company. The Bosun mine was operated continuously by this company until 1928 when it was acquired by the present owner and operations continued. The heaviest production was during the years 1918 to 1924, inclusive, and in particular in the year 1919 when 18,637 tons of crude ore was shipped averaging nearly 14 ounces in silver to the ton, 3·7 per cent lead, and 2·9 per cent zinc.

The property has been developed by six main adits, several intermediate levels, a shaft from the lowest or No. 6 adit, and a level (No. 7)

driven from the bottom of this shaft. From the vein outcrop to No. 7 level the depth is about 470 feet. The portal of No. 6 adit, the main working level, is about 30 feet above the lake. This adit, the longest level in the mine, follows an irregular course and is about 3,700 feet long. During the period of development various parties of lessees have produced a considerable tonnage, mostly from older workings abandoned by company operations.

A cross-section of the formations in the mine is exposed along the shore of Slocan lake, south of the compressor house. The rocks are mainly massive, argillaceous, quartzitic, and tuffaceous varieties but include some limestone beds and other calcareous strata. The sediments are intersected by dykes varying from 2 to 3 feet to 85 feet wide and striking about with the bedded rocks. They are mostly rather dark and carry much biotite and considerable quartz. Under the microscope they were observed to contain a large proportion of both alkalic and lime-soda feldspars, and may be classified as quartz monzonite.

The Bosun lode cuts across the country rocks on a strike of about north 55 degrees east, dips southeast at an angle averaging 50 degrees, and varies in thickness from a few inches to over 5 feet. Vein matter is discontinuous and forms several veins composed in part of galena and sphalerite associated in the richer parts with grey copper, ruby silver, native silver, and small amounts of other silver minerals. Some chalcopyrite is also present. As followed northeasterly along the drifts the lode is offset to the southeast at intervals by strong zones of shearing which strike about north 55 degrees west and rather closely follow bedding planes in the country rocks. These shear zones lie along, or near, what appear to be narrow, highly altered dykes or sills of, probably, quartz monzonite. The lode was most difficult to follow, for it presented numerous smaller irregularities, the foot-wall lacked definition, and slips or faults leading off into the hanging-wall were common. These slips are in several instances accompanied by more or less mineralization and are difficult to distinguish from the main lode, which in places swings in the same direction as these slips for considerable distances before assuming its regular course. The structure of the Bosun lode is further complicated in the vicinity of the "Main" or "Central" ore shoot by a split commencing a little below No. 4 level. The ore followed, principally, the hanging-wall section of this split and has provided most of the production from workings in this section of the mine; the foot-wall split has been only partly investigated.

In the central part of the mine workings ore persisted almost continuously from the surface to the lowest (No. 7) level and has been largely stoped out from a block of vein matter nearly 500 feet long within which the ore raked to the northeast or into the hill at about 55 degrees. This block, for the most part, is bounded by strong faults following the bedding of the sediments and the course of narrow, highly altered dykes. It is also intercepted about midway of its length by another shear zone, on either side of which vein mineralization is almost continuous.

Southwest of this ore-body considerable stoping has been done on a vein deposit that closely adjoins the main ore-body in the uppermost workings, but diverges from it downwards as it dips more steeply and,

in this respect, is analagous in position to the foot-wall split of the "central" ore zone. This southwesterly deposit is fairly continuous to some distance below No. 5 level. It included an ore-body whose average length hardly exceeded 200 feet and which narrowed appreciably on the lower levels where the lode tightens to negligible proportions.

Development work in the last few years has been largely concentrated on exploring a third ore-body, encountered towards the face of No. 6 level and developed by this and an intermediate level above. It furnished some good silver-lead and zinc ore, but has been stoped out without affording much encouragement for further development in this section of the mine. The ore was cut off above the intermediate level by a wide zone of brecciated and slickensided rocks striking northwesterly and dipping northeasterly at an angle of 25 degrees. No encouraging mineralization has yet been encountered within or northeast of this zone, the position of which is marked at the surface by a depression several feet deep. To the northeast and southwest of this zone very similar rocks are encountered, and the zone seems due to slipping along bedding planes, which here have a low dip, rather than to any pronounced displacement of the formations. Had the main lode continued strongly up to the fault zone there would appear to have been good possibilities of picking it up again on the other side, but the Bosun lode apparently becomes very tight on approaching the zone on the lower levels and, consequently, the situation affords little encouragement that anything of importance will be discovered beyond the fault zone.

Other recent development work includes the sinking of an incline shaft from No. 6 level and the exploration of the lode on the downward continuation of the Central ore-body by means of a level (No. 7) about 100 feet below No. 6. The lower level, at the time it was visited in 1928, included some 1,400 feet of lineal work, chiefly drifting. This work had proved the downward continuation of the Central shoot which, however, decreased in size and carried a lower content of silver and of lead and zinc minerals. At this depth the vein-lode also narrowed and gives the impression that it does not continue much deeper. The level in 1928 was being extended northeasterly to get under the more easterly ore shoot. Most of the galena encountered at this lower level is strongly sheared and gneissic, indicating considerable post-mineral strain.

Vein matter in the more productive parts of the lode has a width varying up to more than 5 feet and is contained between well-defined walls, which are commonly more or less sheared. It is composed of varying proportions of clean ore and mixtures of ore minerals, and gangue minerals, and, in addition, commonly large proportions of crushed wall-rock and gouge. The clean ore occurs either as somewhat tubular or cigar-shaped masses lying nearly horizontally or at a slight pitch, or as bands along one or other walls of the veins, chiefly the hanging-wall. The gangue minerals include quartz, siderite, and a small amount of calcite. With depth, or as the lode is followed into the hill, it becomes progressively narrower, in places being a mere crack, but abruptly widening to include lens-shaped masses a foot or more wide composed chiefly of siderite lying between tightly "frozen" walls. Such siderite may, in places, carry or be inter-

banded with ore minerals that locally form veins several inches wide of nearly clean galena or zinc blende. On either side of these lenses the lode is hard to follow for, on the one hand, the slightest fracture must not be overlooked as it may lead to an important body of ore, and on the other hand promising fissures when followed may prove barren and it is difficult to decide where to cease exploration.

BUFFALO GROUP

The Buffalo property, comprising the Buffalo and Evelyn Crown-granted claims, is on the north slope of Silverton Creek valley about 2,000 feet above the stream and near Arison (Buffalo) creek. It is owned by the Buffalo Mining Company of Slocan, % D. S. Wallbridge, 525 Seymour Street, Vancouver, and is accessible by road and trail from Silverton.

All workings are on the Buffalo claim and comprise three adits and an intermediate level between the lower two. They represent a vertical development of about 250 feet on a lode that strikes north 50 degrees east and dips 55 degrees southeast. The lode is a shear zone that intersects compact, hard, argillaceous sediments of the Slocan series and averages 4 to 5 feet in width. In it vein mineralization formed paystreaks along both the foot- and hanging-walls, the better grade ore favouring, in general, the hanging-wall. The ore minerals include galena, a conspicuous amount of grey copper, and zinc blende. They are associated with a quartz gangue and abundant crushed fragments of the wall-rocks partly silicified and replaced by vein minerals.

Production has been small and has been mostly won by lessees. Altogether shipments of 71 tons of silver-lead ore were recorded to the end of 1915. This ore averaged 150 ounces in silver to the ton and 32 per cent lead. In 1925 a shipment of 23 tons of zinc ore carried an average content of 40 ounces in silver and 20 per cent zinc.

CALIFORNIA AND CLIPPER CLAIMS

This property owned by California Clipper S. L. Mines, Limited, Box 1101, Nelson, B.C., is on the northwest slope of Idaho mountain at an elevation of about 3,600 feet above Slocan lake. It is accessible by wagon road and trail from New Denver. The property was worked intermittently from 1896 to 1907, during which period shipments of 343 tons were recorded. This ore averaged 88 ounces in silver to the ton and 52 per cent lead.

The workings include two crosscut adits and drifts from them. They give a vertical development of 70 feet on a vein that strikes north 75 degrees east and dips 75 degrees southeast. The vein occupies a fissure cutting siliceous argillites and impure quartzites, and varies from a few inches to over a foot in width.

CANADIAN AND ADAMS GROUPS

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 56; 1923, p. 223; 1926, p. 251; 1928, pp. 287-88.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 191-192.

These two groups can best be described together. They are on the summit and north and south slopes of Silver ridge at the head of the west fork of Sandon creek, and are accessible by road and trail from Sandon a distance of 3 to 4 miles. The Canadian group, owned by the Ontario and Slocan Mines Development Company, % R. L. Clothier, 464 Lampson Street, Victoria, B.C., and W. E. Buckingham, Guelph, Ont., includes the Adams, Brandon, Sarah B, and Katie D claims and the Hill Top fraction, all Crown-granted claims comprising 165 acres, and four other claims held by location. This property is adjoined by the Adams group on the east, consisting of the Britomarte and Chamblet claims and the Midnight and Slater fractions. The Adams group is owned by W. H. Brandon, Columbus Hall, Winnipeg.

Comparatively little development work has been done on the Adams group and the only shipment recorded from his property was in 1907 when 11 tons of silver-lead ore averaging nearly 100 ounces in silver to the ton and 50 per cent lead were produced. The group received its name from one of its original owners, Captain R. C. Adams of Montreal, and was initially prospected in the mid-nineties by open-cuts and short adits on the principal vein exposures. The Canadian group has had a more productive history. Development commenced on it in 1895 and the first ore, amounting to about 38 tons, was shipped in 1898. This ore averaged about 114 ounces in silver to the ton and 57 per cent lead. Altogether over 570 tons of ore having an average metal content of 73 ounces in silver to the ton and 39 per cent lead have been shipped from this property. Recent shipments from operations on the No. 1 Canadian vein have shown considerably higher values, 84 tons in 1923 and 1924 yielding an average of 118 ounces silver to the ton, 65 per cent lead, and a small percentage of zinc. In December, 1927, and February, 1928, shipments aggregating about 102 tons gave an average assay value of about 111 ounces in silver, 68 per cent lead, and 3 per cent zinc. One lot of 25 tons assayed 0·251 ounce in gold.

The country rocks are chiefly Slocan sediments which along the course of Silver ridge have a general synclinal structure complicated by much faulting, so that the direction of strike and the angle of dip vary to almost any direction or angle. The sediments are chiefly massive to greatly broken, dark grey and black argillaceous rocks showing, in part, well-defined banding. These are interbedded with quartzitic strata and a few narrow limestone beds. The sediments are intersected by a few dykes and sills of porphyry.

Most of the development work has been on the Canadian group where productive veins have been discovered in at least three lodes. Outcrops of other vein matter have been located and prospected a little but not sufficiently to prove either their commercial importance or to determine their relations to the vein-lodes on which most development work has been done. The mine workings range over a vertical distance of about 1,400

feet, from the portal of No. 8 Ivanhoe tunnel to the summit of Silver ridge on the Adams group.

The principal lodes strike northeasterly and in order from east to west are the Ivanhoe-Canadian, the No. 1 Canadian, and the Brandon. The Ivanhoe-Canadian lode as explored on Canadian ground is presumably an extension from the adjoining Ivanhoe property, where the Ivanhoe vein was developed. Both No. 4 and No. 8 levels of the Ivanhoe mine have been extended into the adjoining Katie D claim of the Canadian group. The lower level, No. 8, in its extension of about 1,500 feet, encountered an ore-body alleged to be on Canadian property about 100 feet beyond the Ivanhoe line. Over 40 tons of crude ore, 2·2 tons of clean ore, and about 18·5 tons of milling ore were shipped in 1928 from this ore shoot. According to a report by the mining company the crude ore assayed 70·6 ounces in silver, 26·6 per cent lead, and 17·4 per cent zinc; the clean ore assayed 114·6 ounces in silver, 64·3 per cent lead, and 5·4 per cent zinc; and the millfeed assayed 65·7 ounces in silver, 24·3 per cent lead, and 20·2 per cent zinc. No vein matter of paying quality was discovered on No. 4 level on Canadian ground although the lode is strong and promising. It is 10 feet or more wide and, because of the somewhat erratic distribution of vein mineralization, requires systematic crosscutting in order that no important deposits may be overlooked. Where discovered, the ore is essentially a concentrating proposition, being a mixture of galena and zinc blende in a gangue of quartz, calcite, and a little siderite, associated with crushed country rock. The average trend of this lode, as explored on Canadian ground, is north 38 degrees east and the dip is southeast at about 50 degrees. Nos. 4 and 8 levels are connected by raises. The lower level is connected by a snow shed to the head of the old Ivanhoe tramway down to Sandon. A vein deposit discovered on the south slope of the divide, and from which a few tons of silver-lead ore were shipped, may be on the continuation of the Ivanhoe-Canadian lode on that side of the ridge.

Most of the production of the Canadian group came from the No. 1 Canadian lode, which crosses the summit of the ridge in a low saddle about 800 feet above and 1,700 feet southwest of the portal of No. 4 Ivanhoe. The principal development work on this lode has been done on the north side of the ridge where it has been tapped by three adits at depths of about 200, 300, and 525 feet, respectively, below the apex. The production to date has come from the uppermost or No. 1 adit where, in 1925, two shoots had been encountered, one near the portal and the other between 350 and 450 feet from the portal. From the first shoot some high-grade ore has been obtained by sorting and has been shipped; there remained considerable concentrating ore in the stope and on the dump. Much of the recent shipments have come from the inner ore-body. On No. 2 level the vein was picked up 100 feet from the portal and some concentrating ore was encountered within the next 80 or 100 feet. On No. 3 level what appears to be the same vein was encountered 350 feet from the portal and from there was drifted on for over 200 feet. No ore has yet been found on this level which, however, has not been extended far enough to get under the ore shoots discovered on the upper levels. The same vein has been traced on the surface for a couple of hundred feet

from the portal of No. 3 level, down the south slope of the ridge. A carload of high-grade ore was sorted and shipped from workings below No. 3 level. These workings include three short adits and an aggregate length of about 150 feet of drifting. The No. 1 Canadian lode, as developed on both sides of the ridge, is a shattered zone in places 30 or more feet wide. Mineralization is irregularly developed across and along this zone, which has a general strike of 15 to 20 degrees east of north and a general steep southeasterly dip. Locally within this zone are well-defined faults dipping either northeast or southeast at angles that are mostly steep. Along or between these faults, veins varying from 1 to 2 or more feet wide have formed and contain paystreaks a few inches wide along either side of veins that otherwise are composed of mixed ore and gangue minerals and contain fragments of the wall-rocks. The ore is mixed galena and zinc blende in a gangue in which calcite, often coarsely crystalline, is abundant and is associated with more or less quartz, a little siderite, and much fractured and crushed country rock. Some pyrite is present and its oxidation products give a rusty appearance to vein outcrops.

The Brandon vein-lode lies about 1,200 feet west of the No. 1 Canadian lode, which it resembles in general character, strike, and dip, and has been explored on both slopes of the ridge. On the south slope it has been traced by open-cuts and three short adits over a vertical range of more than 250 feet. A small production is recorded from these workings where the ledge matter has a width of 3 feet or more and is composed of zinc blende and galena in a gangue of quartz, calcite, and fragments of argillite. On the summit and north slope the lode appears to lie partly or entirely within the adjoining Adams group property. On the northern slope, vein matter has been traced down hill through a vertical distance of about 250 feet and two short adits have been driven to explore it. The uppermost adit along its entire length of 120 feet shows vein matter varying from 1 to 3 feet in width, striking nearly north, and dipping about 70 degrees west. Some ore has been stoped from this adit in which vein matter includes a paystreak ranging from 3 to 8 inches in width. It is stated that one car lot of this ore averaged 115 ounces in silver to the ton and 55 per cent lead, and that another car lot averaged 88 ounces silver and 55 per cent lead.

A fourth lode nearly parallel with the Brandon lode, and lying about 150 feet west of it on Adams group ground, has been traced for several hundred feet and one short adit has been driven on it from the north side. A fifth lode, known as the "No. 2 Canadian Vein," strikes about 70 degrees east of north and dips 60 degrees southeast. This lode intersects the fourth on the summit of the ridge and has been traced down into the Canadian basin by a series of open-cuts.

The discoveries on the Canadian and Adams groups, and those on the adjoining Ivanhoe property, occupy a somewhat isolated position. They are high up on a bare ridge and, consequently, development work has been handicapped by the lack of convenient timber and water supplies. Mining has hitherto been conducted on a small scale and only hand-sorted, high-grade ore has been shipped. The ore, however, is in general a concentrating ore and, consequently, effective operations would require work on a larger scale and more convenient transportation facilities than are avail-

able. The mineral discoveries to date have been encouraging, but have not been sufficiently developed to prove the existence of important ore-bodies or even to permit correlating the components of the rather complicated lode system.

The vein-lodes on the Canadian and Adams groups are notably irregular both in respect to size and mineral composition. Their strike and, in a still greater degree, their dip varies markedly from point to point and their walls, as a rule, are not sharply defined. The value of crosscutting underground and of close continuous trenching on the surface can, therefore, hardly be over-estimated. The No. 1 Canadian lode, the Brandon lode, and the lode on the Adams group about 150 feet west of the Brandon lode, seem to be distinct and nearly parallel, but the relationship of the No. 2 Canadian lode and the Ivanhoe-Canadian lode is not so evident. The productive part of the latter lay within a comparatively short distance on either side of and above the No. 4 crosscut and this productive length has a strike and dip corresponding closely with that of the No. 2 Canadian lode. But the Ivanhoe-Canadian lode, where it lies in Canadian ground and also along a considerable part of its course on the Ivanhoe claim, has a strike more nearly corresponding to that of the No. 1 Canadian lode. It is possible that two lodes have been confused as one and that, as is the case on the Ivanhoe property, the chief mineralization occurs near their intersection. The productive part of the so-called Ivanhoe-Canadian vein projected westerly would come close to or possibly even coincide with the No. 2 Canadian lode. In any case the intersections of this cross-lode or lodes with the No. 1 Canadian lode, the Brandon lode, and the lode on the Adams property should be investigated as being likely sites for the occurrence of important mineralization.

CAPELLO GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1904, pp. 179-180.

The Capello group includes the Capello, Dewery, Wallace, and Turris Crown-granted claims, owned by W. R. Will and V. E. McNaught and Mrs. N. F. McNaught, % Mrs. McNaught, Silverton, B.C. It is on the southern slope of mount Carpenter, about 3,000 feet above Slocan lake and 1½ miles by trail from New Denver.

Workings on different claims and over a vertical range of 1,000 feet have been on a series of four or five nearly parallel quartz veins cutting part of a large stock of granite that underlies mount Carpenter. The veins strike north 25 degrees east and dip northwest at from 35 to 40 degrees.

The principal vein has been explored on the Capello claim by two crosscut adits, and by drifts and raises for about 120 feet below the outcrop. No. 1 (upper) crosscut adit, driven northwesterly, intersects the vein at 80 feet from the portal, from which point drifts have been run in both directions, for an aggregate length of 200 feet. Considerable stoping has been done over a length of 100 feet southwest of the crosscut. The lower crosscut adit reaches the vein at 210 feet and continues past it for 50 feet. From near the intersection a raise connects with the upper level.

A drift runs southwest for 100 feet and at a point 25 feet from the face a raise communicates with two intermediate drifts above, the lower being 115 and the upper 30 feet long.

The vein follows a well-defined fault fissure in the granite. It is composed largely of quartz with some calcite, and averages 5 or 6 inches in thickness. In places the vein matter spreads through a width of 3 feet of crushed wall-rock. The values favour the hanging-wall side of the vein and are silver-rich minerals, including native silver and probably both argentite and grey copper, with some pyrite carrying values in gold. The ore is typically "dry," carrying no lead or zinc.

Production from this property was mainly during the years 1901 to 1903 inclusive, when 151 tons yielded 37 ounces in gold and 70,176 ounces in silver. These shipments included, probably, the richest carload of ore that ever came from the Slocan district, assaying 879 ounces in silver and $7.80 in gold to the ton. A final shipment of 4 tons of ore, averaging 245 ounces in silver, was made in 1919.

CARNATION GROUP AND JENNY LIND AND ROBERTSON CLAIMS

References: Ann. Repts., Minister of Mines, B.C., 1921, p. 135; 1926, p. 250; 1927, p. 269; and other years.

The Carnation group, comprising the Dalkeith, Read, Tenderfoot, Carnation, Evening[1], Jennie[1], Rienzi, Violet, Violet fraction, Minniehaha[1], Minniehaha fraction, Nettie fraction, Western fraction, and Western fraction No. 2 Crown-granted claims, owned by Carnation Silver Lead Mines, Limited, Vancouver, B.C., and the Crown-granted Jenny Lind and Robertson claims of the adjoining Wakefield group may be conveniently described together. These various claims occupy an irregular strip over 1½ miles long, extending southwesterly from an elevation of 4,400 feet in the basin of Tributary creek across the high divide between Carpenter and Silverton creeks to about 6,000 feet on the Silverton slope; the summit of the divide rises to over 7,000 feet in elevation. The claims are accessible by road from Sandon or by road and trails from Silverton. Recently an aerial tramway has been installed on the southern slope to connect the mine workings with the Hewitt mill.

The chain of claims extends across a broad belt of Slocan sediments whose general structure in this vicinity is illustrated in cross-section ZZ, Figure 3 of Memoir 173, in pocket, but faults and minor flexures are not represented. On the divide, and for several hundred feet below, the structure is synclinal and the strata are chiefly massive, argillaceous and quartzitic beds with more thinly bedded members beneath and lower down considerable limestone and otherwise limy rocks. Farther down the slopes on either side, the same strata are repeated in synclines with intervening, rather sharp anticlines. The sediments are intersected by a few dykes of quartz porphyry and of feldspar porphyry.

The veins on these properties belong to a lode system that can be traced southwesterly through the Mammoth property and farther to the

[1] See separate accounts of these claims.

west and southwest where it may be correlated, in part, with the lode system developed on Standard and Emily Edith ground. In the opposite direction, the lode system appears to correspond with that developed on the Ruth-Hope property at Sandon. The lode system is of irregular width, probably averaging several hundred feet. The belt has been only partly explored and includes much ground whose worth is becoming more fully appreciated as investigations continue.

Within this lode system one major and several subordinate lodes and veins have received attention. The major lode may be referred to as the Carnation lode. It has been partly explored on and close to the north-eastern corner of the Carnation claim, on the Carpenter Creek slope, by three adits and a shaft from the surface. The lower adit is a crosscut, driven northwesterly for 150 feet and then drifting southwesterly along the lode for 400 feet, in which distance the lode is well defined, dips 70 degrees southeast, and is mainly composed of brecciated rock, partly cemented by calcite. The portal of the next higher adit is 350 feet southwest of and about 200 feet above the portal of the lower adit and is at an elevation of 6,435 feet. This adit has been driven southwesterly through the mountain and opens on the Silverton slope on the Jenny Lind claim. This tunnel is a drift, is 2,800 feet long, and for the most part follows a nearly straight course south 52 degrees west. The lode is a crushed and sheared zone several feet in width and filled chiefly with broken wall-rock, but, locally, holds abundant, coarsely crystalline calcite. It dips 45 to 50 degrees southeast and for a considerable part of its length the hanging-wall is a porphyritic dyke 10 feet or more thick. This wall is well defined and is marked, here and there, by several inches of gouge. Grooves running northeast and dipping from 20 to 40 degrees in that direction were observed on the hanging-wall and, as has been the general experience, probably indicate the rake of the vein matter. No important ore-bodies have been disclosed in this tunnel, but some mineralization has been encountered, and this together with the width and persistence of the lode and character of the vein filling has lent considerable encouragement to further exploration.

The same faulted zone has been traced from the tunnel entrance up the steep southern slope of the divide, on the Jenny Lind and Read claims, by a series of eight or more short adits and open-cuts in most of which some attractive looking ore has been encountered, associated in each case with abundant calcite and minor quartz gangue. The ore in general was brecciated, fragments of lead and zinc minerals and wall-rock being held in a cement of coarsely crystalline calcite. Bands of cleaner ore were encountered near the hanging-wall and, less commonly, the foot-wall of the heavy fillings of calcite. These various showings do not appear to be on one lode, but seem rather to represent several distinct veins occurring on two or more components of the one lode system. The vein matter in places has formed in lodes developed along bedding planes of the enclosing rocks, as at the Wakefield mine, described elsewhere in this report.

Production from the workings on these claims has been small and records are not complete. The first shipments were in 1895 and came from the Jenny Lind claim. They amounted to some 30 tons of ore estimated to contain an average of 200 ounces in silver to the ton and 60 per cent

lead. Subsequent shipments totalling 63 tons are recorded, the last, in 1923, amounting to 3 tons, carrying an average of 115 ounces of silver to the ton and 53 per cent lead.

CHAMBERS GROUP

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 191; 1922, p. 200.

The Chambers group includes the Chambers, Wellington, Eureka, and Jay Gould Crown-granted claims. It is owned by E. A. Becker, H. S. Stone, and Louise Berens, % R. C. Becker, 210-1st Street, Medicine Hat, Alberta, and is being operated by M. J. Byrne, Sandon. The property is on the lower northern side of Carpenter Creek valley about half a mile above Cody. The claims were located in October, 1891, and comparatively little work has been done on them for many years.

The property is underlain by both massive and slaty argillaceous sediments of the Slocan series intruded by several acid porphyry dykes and, in the upper workings, by a dyke-shaped mass of quartz porphyry 100 feet or more wide.

The workings include five adits at elevations that range from 4,200 to 5,000 feet. They represent in the aggregate several hundred feet of work and are (1927) partly inaccessible. The lowest is a crosscut into the Wellington from the adjoining Gem claim. The others are on the Chambers claim. These workings, except the uppermost adit, explore a lode that cuts sediments and porphyritic intrusives, and has a northeasterly strike and steep northwest dip. The lode is a strongly sheared zone from 5 to 10 feet wide. It is partly filled with vein quartz and contained small shoots carrying argentiferous galena from which the total recorded production is 26 tons, averaging 96 ounces in silver and 70 per cent lead.

Recent work has included the investigation of vein matter in a lode intersecting the large porphyry dyke. The lode has been investigated by the uppermost adit on the Chambers claim. This adit is a crosscut for 55 feet to the point where it reaches the lode and which strikes north 77 degrees east and dips 74 degrees southeast. The lode carries disseminations, pockets, and small stringers of ore minerals, chiefly galena. It is disrupted along its strike by faults and its relations to the lode explored in the lower workings are not clear.

CINDERELLA GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1924, p. 196.

The Cinderella group, comprising the Cinderella, Medford, and Keyser fraction Crown-granted claims, is in Carpenter Creek valley, about 1½ miles by trail southeast from Three Forks. The group is owned by Leonard Keyser, % Tupper and Ball, Vancouver, and has been operated in the past, under lease, by George Petty, Three Forks.

The first production from the Cinderella workings is recorded as being in 1904, when 188 tons of silver-lead ore, carrying 77 ounces in silver a ton and 68 per cent lead, were shipped. Altogether 236 tons of ore are credited to this property, the last shipment, in 1924, amounting to 2 tons.

The property is underlain by Slocan strata which here comprise massive quartzitic and carbonaceous argillites interbedded with lesser amounts of slaty rocks, quartzites, and limy beds. These sediments strike northwesterly and commonly dip at low angles either to the northeast or southwest. They are intruded by a few dykes and by one stock-shaped mass of biotite-quartz diorite.

The workings include six adits and one short incline adit, and range in elevation from about 100 to 800 feet above Carpenter creek. The two uppermost adits at elevations of 3,630 and 3,690 feet, respectively, are caved. It is reported that in 1913 and 1914, 22 tons of silver-lead ore were obtained from these upper workings. Below them, at elevations of 3,170 and 3,270 feet, respectively, are two adits 650 and 780 feet long. The upper adit for the first 200 feet from the portal follows a vein-lode striking north 42 degrees east and dipping about 70 degrees southeast, and on which considerable work has been done and, apparently, connexions established with the adit below. Very little mineralization was observed. The lode varies in width from a few inches to more than 3 feet, follows a line of fissuring that is controlled by a system of jointing in the sediments, and is mainly crushed rock carrying some gangue mineral, chiefly quartz, associated here and there with a little galena, pyrite, and oxidized products. Farther along the adit branches repeatedly and though vein mineralization occurs at a number of places along fractures running in different directions, some along, but most across, the bedding planes of the enclosing rocks, no one vein has been found to persist for any considerable distance and no appreciable quantity of ore has anywhere been disclosed. The conditions encountered in this part of the adit are analagous to those described as occurring on the Black Colt property.

The lower adit (elevation 3,170 feet) discloses very little mineralization until it comes under the inner branching part of the upper adit just described. Here over a length of 60 feet, and within a zone of fracturing 15 or 20 feet wide, a series of fractures running northeasterly and dipping 45 degrees southeast show from a few inches to from 1 to 2 feet of vein matter composed largely of siderite carrying zinc blende, pyrite, and a trace of galena.

COLONIAL, CHICAGO, AND FREDDIE LEE

References: Ann. Repts., Minister of Mines, B.C., 1892, p. 531; 1893, p. 1060; 1925, p. 245; 1928, p. 294.

The Colonial, Chicago No. 2, Chicago fraction, and Freddie Lee are adjoining, Crown-granted claims and may be conveniently described together. The Colonial claim is owned by Margaret S. Coplen and J. E. Harton, 2408 Altamont Building, Spokane; the Chicago No. 2 and Chicago fraction are the property of F. P. O'Neill and Lillian E. Hall, 474 Astabula Street, Pasadena, Cal., and the Freddie Lee claim is owned by Marcus McCune, % H. Giegerich, Kaslo, B.C. These claims occupy a part of the eastern slope of the ridge that rises south of Carpenter creek between the tributary valleys of Sandon and Cody creeks. The workings range from an elevation of 5,000 feet near the eastern boundary of the Chicago No. 2 claim to about 6,300 feet on the Freddie Lee and adjoining claims.

The earliest work was done on the Freddie Lee, a claim staked in 1891 under the law providing extralateral rights. The first ore shipments from Sandon district were made from this claim. Recorded shipments, in 1892, amounted to 120 tons and carried an average content of 120 ounces in silver to the ton and 70 per cent lead. In 1893, 558 tons were shipped and averaged 97 ounces in silver and 56 per cent lead. Subsequent shipments aggregated 139 tons and were made in 1917, 1918, 1919, and 1921. The last shipment, in 1921, amounted to 25 tons, carrying 173 ounces in silver to the ton and 62 per cent lead.

There is no recorded production from the Chicago claim. In 1906, 19 tons were shipped from the Colonial and further shipments were made in 1907, 1913, 1914, 1926, and 1927. Aggregate shipments amounted to 294 tons of silver-lead ore. In 1926 the 111 tons shipped carried 65 ounces in silver to the ton and 58 per cent lead.

The claims are underlain by sediments of the Slocan series which, towards the top of the ridge, form a broken syncline composed chiefly of massive, quartzitic rocks carrying one important bed of limestone (*See* structure section DD, Figure 3 of Memoir 173, in pocket). To the east this syncline is faulted against another and broader syncline, in which the strata dip easterly and in which the limbs of the fold, in a zone 600 feet thick, include considerable limestone. The centre of this syncline is occupied by a wide belt of slaty, commonly rusty weathering argillites.

The uppermost workings are in the western syncline of quartzitic rocks. The highest adit, at about 6,300 feet elevation, is on the Freddie Lee vein-lode which occurs in a well-defined fault fissure striking north 65 degrees east and dipping 65 degrees southeast. The adit is only partly accessible, but it is apparent that much stoping has been done on an ore-body that appears to have been about 100 feet long. Farther down the hill, between elevations of 6,000 and 5,600 feet, are eight adits, the lower four of which comprise the principal workings on the Chicago and Colonial claims. These eight adits are for the most part in the limb of the eastern syncline. The lowest or main adit is connected by a raise with an intermediate level representing altogether over 400 feet of lineal work. The main level follows a strong lode striking north 25 degrees east and dipping 50 degrees southeast. Some vein mineralization has been discovered along this lode, but no important body of ore has been found. The intermediate level explores a mineralized cross-fissure striking nearly east and dipping about 65 degrees south. The cross-fissure carries a little ore mineralization for a length of about 50 feet. The intermediate level is connected by a short raise with an adit about 40 feet above. This upper adit is partly inaccessible, but it is reported that several tons of silver-lead ore were extracted from it. At a level intermediate between the two adits is a third adit which was 90 feet long in September, 1927. This intermediate adit picks up the main lode explored by the lowest adit and near the face encounters a well-mineralized cross-fissure striking nearly east and standing vertically. The cross-fissure carried a vein, a few inches wide, of nearly solid galena constituting the best ore seen on the property. Above these adits other adits, some now inaccessible, have been run to explore the Freddie Lee lode down the dip, but the work to date has not demonstrated that vein matter of consequence continues to the level of these workings. Some attractive mineralization

was, however, noted in a short adit at an elevation of about 6,000 feet, where a fault-fissure dipping 24 degrees southeast carries a few inches of galena at one point.

The veins and lodes exposed in the different workings have not been correlated because of the lack of accurate surveys, the inaccessibility of some of the adits, and the marked variations in the strike and dip of the lodes both underground and at the surface.

A little development work has been done farther south on the Colonial claim at an elevation of 5,700 feet where a quartz vein 1 foot wide, and carrying some galena and a little zinc blende, has been investigated by an open-cut and an adit, now caved. The vein occurs in a strong shear in argillaceous rocks and appears to strike nearly north and to dip about 45 degrees to the east. It was claimed that this lode had been traced northeasterly down the slope of the hill across the Colonial and Chicago No. 2 claims and that at an elevation of about 5,150 feet on the Chicago No. 2 claim it had been picked up by a short adit and yielded a pocket of high-grade silver-lead ore.

Workings on the eastern or lower half of the Chicago claim include eight or more short adits, driven for the most part in crushed, black, argillaceous rocks and following a series of narrow fissures in which little vein mineralization could be seen. Half of these adits, however, were inaccessible at the time visited, but the impression gathered was that little mineralization might be expected in these broken rocks and that any veins present would be discontinuous. Further prospecting might be done higher up the hill where the formations are more massive, the structure more regular, and where the presence of limestone beds and other calcareous strata afford a better opportunity for important mineralization.

COMSTOCK GROUP

References: Ann. Repts., Minister of Mines, B.C., 1898, p. 1,074; 1904, pp. 176-177.

The Comstock group consists of seven Crown-granted claims and fractions and is situated on the divide east of Fennell creek at an elevation of about 6,100 feet. It is accessible from Silverton by road and trail 8 and 2 miles long respectively. The group is owned by the Consolidated Mining and Smelting Company, Trail, B.C.

The property lies within the northern tip of a body of medium to fine-grained granite and granodiorite, a member of Nelson batholith. Nothing has been done on this property for many years and the workings are mostly inaccessible. The earliest recorded work was done in 1898 and the first production, a shipment of 295 tons, was made in 1904. This ore averaged 98 ounces in silver to the ton and 56 per cent lead. Subsequent production, aggregating 92 tons, was made in 1905, 1908, 1916, and 1920.

At the foot of the hill, on Fennell creek, a mill was erected in 1897 to treat the Comstock ore. This concentrator was complete, well equipped, and cost $23,000. It was used for two months, closed down in 1898, and never reopened.

The mine workings include nine adits having an aggregate length of about 2,800 feet, the longest or No. 5 had a length of 720 feet in 1904.

The workings have explored a brecciated and mineralized zone to a vertical depth of 400 feet. This lode strikes north 55 to 65 degrees east and dips southeast at an angle varying from 35 to 55 degrees. It intersects fine-grained hornblende granite and follows, in places, a dyke of biotite lamprophyre. On No. 5 level, for example, the lode had a granite foot-wall and a hanging-wall of the basic dyke. It varied a foot to several feet in thickness and was composed of brecciated granite partly cemented by quartz containing streaks and disseminations of ore minerals. Where stoped there was a paystreak of galena about 3 inches thick. On No. 4 level several small shoots carried streaks of galena 1½ inches thick and several feet long. The ore appeared to occur mainly where the lode lay between granite and the basic dyke. On No. 9 level a small streak of rich ore carried as much as 360 ounces silver to the ton.

CORINTH GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 55; 1925, p. 244; and other years.

The Corinth property, comprising the Corinth, Miantonomah, and Wild Goose No. 2 Crown-granted claims, is owned by the Corinth Silver Lead Mining Company, Limited, Seattle, Wash. It is situated towards the head of Howson creek, in Sunshine basin. The main workings lie between elevations of 5,800 and 6,000 feet and are accessible by way of the Queen Bess road up Howson creek to Queen Bess mine and from there by a trail up the valley to the Corinth workings, 700 feet vertically above the Queen Bess bunkhouse. The property may also be reached by road and trail from Sandon.

The underlying rocks (*See* structure section EF, Figure 3 of Memoir 173, in pocket) are chiefly massive quartzitic and limy members of the Slocan series, striking north 35 degrees west and dipping northeast at angles of 50 degrees and more.

The workings include three or more adits, of which only the lower crosscut adit is completely accessible. These workings explore one, or perhaps two, lodes striking nearly east and dipping 50 degrees to the south. The crosscut adit is driven southerly, intersects a lode at 870 feet from the portal, and is continued past the intersection without encountering further lode matter. From this crosscut drifts run 200 feet to the east and west. Two raises, one up 110 feet, a little stoping, and two short crosscuts into the hanging-wall from the east drift comprised the work done on and from this level up to September, 1926. The lode at this level is a much brecciated zone filled mostly with crushed wall-rock but containing pockets in which fragments of zinc blende and galena and a little disseminated pyrite are distributed through a gangue of coarsely crystalline calcite. A caved adit, about 70 yards west of and at about the same level as the crosscut adit, intersected limestone outcropping at the surface and, judged from material on the dump, encountered lode matter more heavily mineralized but otherwise like that seen in the main adit.

The old workings are situated near the Corinth camp and about 150 feet above the crosscut adit. They include either one through tunnel or two adits run from either side of a low divide. The portals are at about

the same elevation. These adits are only partly accessible, but appear to follow vein matter in a strong, brecciated lode cutting across the sedimentary formations. The lode averages several feet in width and where it could be examined is largely filled with calcite carrying the same ore minerals as noted in the lower workings.

The first recorded shipments from this property were made in 1906 and consisted of 29 tons of silver-lead ore carrying an average of 43 ounces in silver to the ton and 59 per cent lead. A further shipment of 18 tons of similar ore was made in 1925.

DANIEL

Reference: Ann. Rept., Minister of Mines, B.C., 1922, p. 199.

The Daniel group comprises the Daniel, Donnelly, and Elvira Crown-granted claims. The Daniel and Elvira have reverted to the Crown. The Donnelly is owned by R. C. Morton, Sandon, B.C. It is one mile from Sandon and immediately above the road to Three Forks.

Work on these claims was designed to investigate the mineralization in a zone of sheared ground, lying in part along the contact between argillaceous sediments of the Slocan series and a large dyke or sill of quartz porphyry that strikes north 35 degrees west and dips steeply southwest. The intrusive is probably an apophysis from a large granitic stock occupying much of the hillside to the north of the mine workings.

The workings consist of three adits, of which the uppermost opens on the Payne road and the lowest is a little above the road between Sandon and Three Forks. The intermediate adit has its portal on the old K and S railway grade. These workings are reported to include about 1,000 feet of tunnelling, but were only partly accessible when examined in 1925.

The shear zone as seen in these adits carries considerable vein quartz, with which is locally associated appreciable amounts of galena and particularly of zinc blende and pyrite. Faulting disturbs the continuity of the lode.

A small shoot of ore encountered in the intermediate adit provided 18 tons of ore which carried an average of 8·9 ounces in silver to the ton, 8 per cent lead, and 39 per cent zinc.

DARDANELLES

Reference: Ann. Rept., Minister of Mines, B.C., 1898, p. 63.

The Dardanelles group comprises the Dardanelles, Dardanelles fraction, Fly fraction (formerly Diamond Cross), Okanagan, Bosphorus, and Gibraltar Crown-granted claims and the Dardanelles No. 2 surveyed claim, and is in Dardanelles basin at the head of the north fork of McGuigan creek. The property is accessible by wagon road from Rambler station via the Rambler mine. It is owned by the Dardanelles and Okanagan Mining Company, % R. L. Clothier, 464 Lampson Street, Victoria, B.C.

The underlying rocks are chiefly slate, finely banded argillite, and limestone of the Slocan series interbedded with one another and intersected by many sill-like bodies and dykes of quartz porphyry and feldspar porphyry. The sediments strike north 60 degrees west and dip 50 degrees southwest.

Three lodes have been discovered on this property, one, known as the "Diamond Cross," on the Fly fraction; a second, referred to as the "Okanagan," on the Okanagan claim; and a third, the principal lode and known as the "Dardanelles," on the Dardanelles claim. The first two lie about 250 feet apart, and have a general east strike. The Diamond Cross lode is reported to contain vein matter carrying silver-lead ore. The Okanagan lode, on the other hand, is occupied by a quartz vein, up to a foot or more wide, from which high values in silver were obtained.

Most of the development work has been confined to the Dardanelles lode which strikes about north 25 degrees east, dips 38 degrees southeast, and has been traced on the surface for several hundred feet. It has been explored by a shaft and drifts therefrom, and by two or more short adits that drift on the lode on either side of the shaft. These workings were inaccessible in 1927. According to mine plans the shaft followed the foot-wall of the lode for a vertical depth of 300 feet, in which distance the lode had a regular dip of 38 degrees. From this shaft drifts were run on the lode at nine equally spaced levels and included an aggregate of about 2,000 feet of drifting. From these workings an ore shoot was stoped out along the foot-wall of the lode. This shoot extended continuously from the surface to No. 8 level 420 feet below on the dip, and had a maximum stoping length along the vein of about 100 feet and an average length of perhaps 30 or 40 feet. Old reports indicate that some good ore was also obtained from the hanging-wall section of the lode and more work might profitably be done in exploring this section.

The lode has an average width of from 15 to 20 feet, the central part being occupied by a decomposed rock resembling a dyke. On either side of this "dyke" the sediments have been fissured and sheared and the channels so formed occupied by more or less continuous bodies of vein quartz with which the ore minerals are associated. The latter are chiefly galena and high-grade silver minerals. The lode is stated to continue strongly to the lowest level, along which encouraging mineralization was found over a length of between 400 and 500 feet.

Production began in 1892 when 10 tons of ore was shipped. This averaged 200 ounces in silver to the ton and 30 per cent lead. The property was worked intermittently from that year to 1902, the total recorded production being 631 tons of silver-lead ore averaging 215 ounces in silver to the ton and 25 per cent lead. Some of this ore carried up to 470 ounces in silver and 56 per cent lead. Good values are reported to occur in the large dump at the shaft collar.

DOROTHY CLAIM

The Dorothy claim, owned by C. B. White, New Denver, is Crown-granted and adjoins the Ruth-Hope property on the west.

On this claim, at an elevation of about 4,800 feet, an adit 400 feet long has explored a vein of high-grade silver-lead ore several inches wide. The vein occurs in a fault fissure striking nearly east, dipping 50 degrees south, and has been partly stoped out above the adit level. The fissure intersects banded argillites striking north 15 degrees west and dipping 75 degrees northeast, and is exposed in open-cuts and pits about 150 feet above the portal of the tunnel.

EAGLE CLAIM

The Eagle claim, held by location, is on the lower north slope of Carpenter creek ¼ mile west of Three Forks. Some development work has been done on a quartz vein in a small stock of hornblende diorite intersecting massive quartzitic and argillaceous sediments of the Slocan series. The vein varies in width from 1 to 8 inches, strikes nearly west, and dips 38 degrees north. It has been drifted on westerly for about 80 feet to a point where it pinches out. Near the face of the adit the quartz carries a conspicuous dissemination of grey copper. Four tons of ore were shipped from the property in 1928. Selected samples carry high values in silver.

ECHO GROUP

References: Ann. Repts., Minister of Mines, B.C., 1915, p. 126; 1916, p. 197; 1917, pp. 157-158; 1918, p. 169; 1926, pp. 256-257.

The Echo group comprises the Echo and Graphic Crown-granted claims and, it is understood, other adjoining claims held by location. The property is owned by the Echo Silver Lead Mining Company, Limited, Spokane, Wash. The claims are on the southwestern flank of Idaho peak, to the north of and adjoining the Alpha claim of the Standard mine property. Most of the workings lie close to the Alpha-Echo claim boundary.

Work was commenced about 1914 by the original owners. The first production is recorded in 1917 when 81 tons of silver-lead ore yielded an average of 96 ounces in silver to the ton and 42 per cent lead. Subsequent production in 1918, 1919, and 1922 amounted to about 700 tons, of which 646 tons of silver-lead-zinc ore in 1919 carried an average content of about 79 ounces in silver to the ton, 30 per cent lead, and 17 per cent zinc. A further production of 25 tons of silver-lead ore is recorded in 1926.

The underlying rocks are chiefly sediments of the Slocan series and comprise argillite, calcareous argillite, limestone, and some quartzitic beds. The general strike varies from north to northwesterly and the dips are principally to the east or northeast at about 50 degrees. The sediments are intersected by a few small dykes of intermediate to acid composition.

The workings consist of four adits of which the uppermost or No. 1 was driven on the Link fraction, near the Tiger claim of an adjoining property to the north of the Echo claim. This adit was inaccessible in 1927. The other three adits, Nos. 2, 3, and 4, were driven northeasterly into Echo ground from the Alpha claim. They crossed the boundary at distances of about 200, 425, and 750 feet respectively from their portals and extended into the Echo claim for additional distances of approximately 600, 500, and 650 feet. No. 3 adit is 100 feet and No. 4 adit 250 feet vertically below No. 2 adit. From near the portal of No. 4 adit an aerial tramway connects with the old Standard tramway to Silverton.

The workings explore the main Standard-Alpha lode (*See* Figure 5) which, on Alpha-Echo ground, has a general strike of about north 60 degrees east and dips southeast at an average angle of 45 degrees. The lode is a strongly fissured zone along which much movement has occurred, and has formed widths of from 25 to 70 feet or more of crushed, slicken-

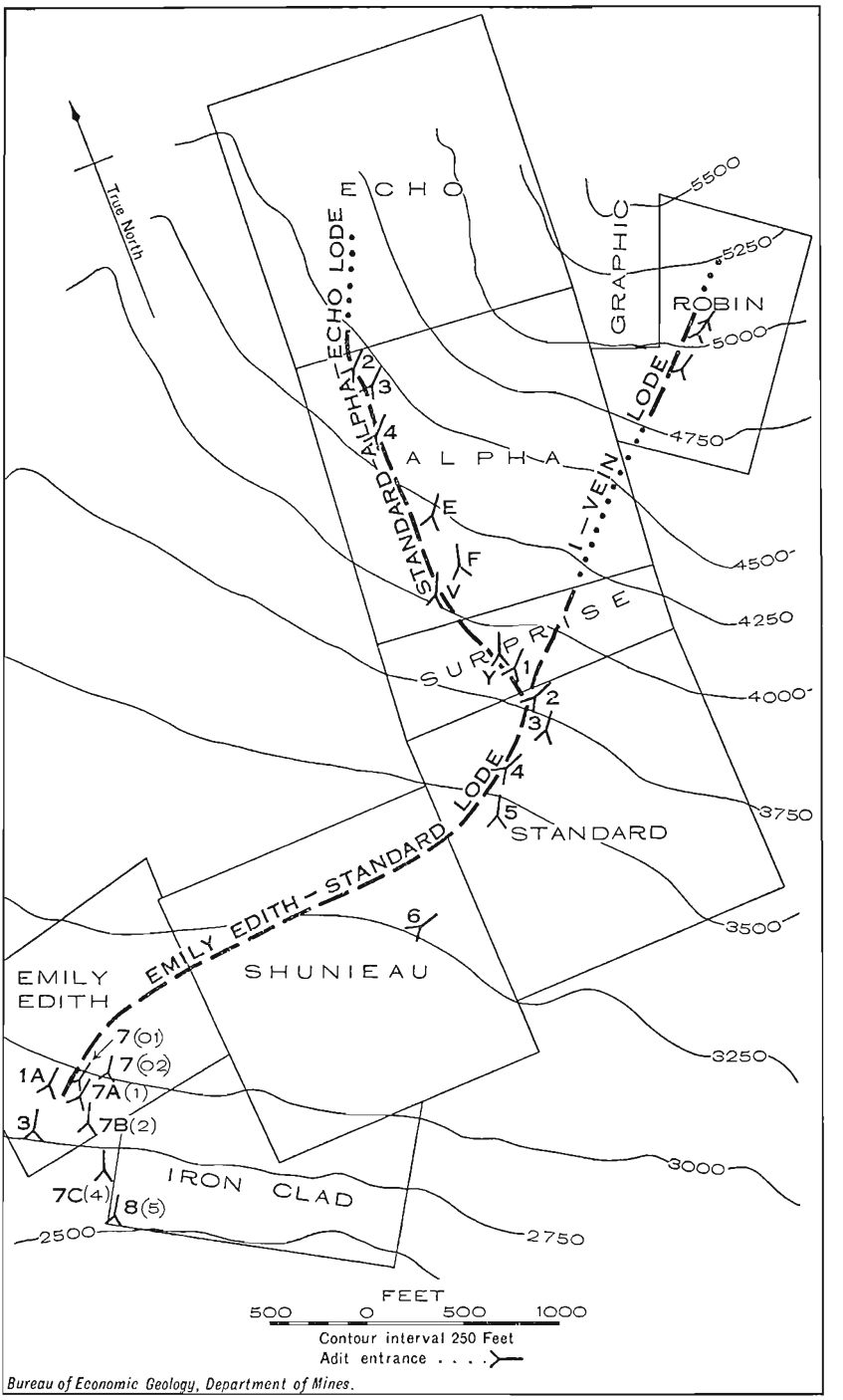

Figure 5. An area near Silverton, showing claim boundaries and positions of lode system.

sided ground in which vein mineralization occurs and in which several ore shoots have been found and partly stoped out. One small shoot was discovered near the portal of No. 3 adit on Alpha ground and another on the Alpha-Echo boundary between Nos. 2 and 3 levels. The latter shoot is reported to have carried as much as 5 feet of solid or nearly solid galena. It forms part of an ore-bearing zone 100 feet or more long pitching into the hill at about 35 degrees to the horizontal. Within this zone considerable ore has been stoped out on Echo ground between Nos. 3 and 4 levels, and, to a less extent, above No. 3 level.

The principal ore minerals are galena and zinc blende. The galena occurs in coarse cubes, in banded or gneissic form and fine grained or "steely." The zinc blende is dark brown, massive, and shows evidence of much fracturing, veining, and replacement by other minerals. Other sulphide minerals include grey copper, pyrite, and, locally, a conspicuous amount of chalcopyrite. The gangue minerals include calcite, quartz, and siderite in about this order of abundance. Coarsely crystalline calcite forms bands and lenses up to 3 feet in thickness and commonly carries brecciated fragments of galena, zinc blende, and wall-rock.

Further references to this property are made in the accounts of the Standard, Emily Edith, and Alpha group.

ELKHORN GROUP

References: Ann. Repts., Minister of Mines, B.C., 1907, p. 99; 1927, p. 274.

The Elkhorn group consists of two claims and two fractions, of which the Elkhorn claim only is Crown-granted. The group is on the lower southwestern side of Carpenter Creek valley about 400 feet above the railway and a mile by trail northwest of Sandon. The Elkhorn claim is owned by J. W. Stewart, Spokane, Wash., and the remainder of the group by Geo. T. Gormley, Three Forks, B.C.

The underlying rocks are sediments of the Slocan series intersected by one large and several smaller dykes and sill-like bodies of quartz porphyry.

The workings comprise a shallow shaft and five adits which may be referred to, from uppermost to lowest, as Nos. A, B, 1, 2, and 3, respectively. The adits are spaced over a vertical distance of over 200 feet, and altogether include about 2,000 feet of lineal work. Most of the work has been done on the lower two adits, Nos. 2 and 3. No. 3 adit was caved at the time of visit in September, 1927.

Work on No. 2 adit level has exposed a strong zone of shearing along the contact of a porphyry sill and argillaceous sediments. The zone strikes north 55 degrees west, dips 75 degrees to the southwest, and averages several feet in width. It has been followed for over 200 feet in which distance some encouraging mineralization has been encountered, mostly in the form of small shoots. Raises and stopes connect with the surface workings 70 feet above, in which direction the shear zone flattens appreciably. The productive parts of the shear zone are at points where it is intersected by mineralized cross-fissures striking about north 65 degrees east and dipping from 40 to 70 degrees southeast. A great deal of exploratory work has

been done on this level to the south of the main drift, probably in the hopes of discovering ore mineralization on one or other walls of porphyry dykes and sills.

The lowest or No. 3 adit is a crosscut for about 460 feet to where it is reported to have intersected a fissure which may correspond with one of the mineralized cross-fissures encountered in the upper workings, possibly the one drifted on for a few feet from the uppermost adit, near the shaft. Judged from material on the dump from No. 3 level, the fissure at this depth carries abundant pyrite and considerable zinc blende in a gangue composed largely of siderite.

In the upper levels the principal ore mineral is galena. With it is associated some zinc blende, pyrite, and chalcopyrite. The galena is stated to carry about $1\frac{3}{4}$ ounces of silver to the per cent lead. The zinc blende carries almost no silver. A little gold is also present, probably in association with the pyrite.

Shipments in 1907, 1908, 1916, and 1923 aggregated 67 tons and had an average content of 66 ounces in silver to the ton and 58 per cent lead. Shipments of 43 tons of silver-lead-zinc ore were made in 1928.

EVENING AND JENNIE CLAIMS

These Crown-granted claims adjoin the Western fraction of the Carnation group (*See* account of this group) on the south and are situated at the headwaters of Tributary creek. They are owned by the Carnation Silver Lead Mines, Limited, Vancouver, B.C.

From 1910 to 1914 attention was directed to a lode that towards the southwest extends into the adjoining Margaret fraction. This lode has been explored by open-cuts and short adits. It cuts black argillaceous and quartzitic sediments of the Slocan series, strikes north 65 degrees east, and dips 45 degrees or more southeast. The productive part was about 300 feet long and 7 to 12 inches thick. In this the ore formed streaks of galena and oxidized products from $\frac{1}{8}$ inch to 1 inch wide occurring, principally, in a gangue of quartz and calcite.

Production to March, 1911, is reported as 41·393 tons, yielding 6,032·06 ounces silver and 18,664 pounds lead. In 1914, 6 tons were shipped, averaging 140 ounces in silver to the ton and 25 per cent lead; this ore was won by lessees.

FAIRMONT

The Fairmont property, owned by W. Valentine of Silverton, is at the head of Silverton creek and is accessible from Silverton by 8 miles of road and 4 miles of trail.

The underlying rocks are mainly coarse-grained, porphyritic granite of the Nelson batholith. Locally this carries small bodies of more basic, probably differentiated, material and to the northeast and southwest of the property is in contact with other, larger bodies of granite and granodiorite of finer grain and more uniform texture.

The workings, located at an elevation of about 6,600 feet, have explored two parallel lodes known as the Upper or Fairhope and Lower or Fairmont, respectively. The lodes strike about north 25 to 30 degrees east and dip 50

degrees southeast. The Fairmont lode has received most attention. It is a strongly fissured and brecciated lode traceable, it is stated, for 1½ miles on the surface. In an open-cut 300 feet above the main adit, the lode is 12 feet wide and comprises about 6 feet of gouge and crushed wall-rock, several stringers of quartz, and, on the foot-wall, a 4-foot quartz vein carrying zinc blende, galena, considerable pyrite, and some argentite. The ore minerals occur in streaks and disseminations. High values in both silver and gold are reported to have been obtained, though the average content is stated to be about $1 in gold and 10 ounces in silver to the ton. An incline adit below the open-cut was caved at the time of visit, September, 1927.

The lower adit on the Fairmont lode is a 1,200-foot drift along which the lode is remarkably straight. Mineralization is concentrated along certain parts of the lode. Some ruby silver was noted near the portal and near the face a vein of quartz 2 feet wide carries pyrite and a little galena and blende.

FERRY No. 2 AND JEANETTE CLAIMS

A little prospecting has been done in the vicinity of Rosebery, particularly to the south of Wilson creek on the summit and northern slope of the ridge between Wilson and Dennis creeks where work was done many years ago on two Crown-granted mineral claims, the Ferry No. 2 and the Jeanette. The Ferry No. 2 is owned by the Slocan Lake Mining and Development Company, Dominion Bank Building, Vancouver, B.C.; the Jeanette has reverted to the Crown. The trail to these properties can still be followed for 2,000 feet above Wilson creek, but is completely obliterated over the remainder of the distance. There are no records of shipments from these claims, but apparently a little silver-lead ore was discovered in vein quartz. The location is not unfavourable for mineral discoveries as the hill slopes are underlain by sediments of the Slocan series, including some limestone strata, and the whole is penetrated by porphyritic dykes and a tongue of Nelson granite. Farther down the hill a little surface stripping has been done and one or more short adits run to investigate certain irregular veins of quartz in this tongue of granite. These veins carry, here and there, a little galena and pyrite, but nothing of commercial significance was noted.

FISHER MAIDEN GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 68; 1904, pp. 177-178; 1926, p. 257; and other years.

The Fisher Maiden property consists of the Troy and St. Helena Crown-granted claims on the lower northern slope of the valley of Silverton creek, at an elevation of about 4,300 feet or 2,500 feet above Slocan lake. It is accessible by road 8 miles up Silverton creek from Silverton. The claims were staked in 1892, and are owned by the Fisher Maiden Troy Mining Company, % A. L. Prickett, W. 825-7th Avenue, Spokane, Wash. When visited in September, 1927, the mine was being operated under lease and bond to George Long and Nate Tucker of Silverton.

First shipments, amounting to 50 tons of silver-lead ore, were made from this property in 1894. This ore carried an average of 230 ounces in silver to the ton and 10 per cent lead. The next and largest shipments amounted to 295 tons and were made in 1903. Altogether up to the end of 1910, shipments amounting to 636 tons are recorded. The ore as a whole carried an average of about 95 ounces in silver to the ton and 7 per cent lead. Following this period of production, little work was done until recent years when work has been concentrated on a second lode developed by new workings. Production from these included a shipment of 81 tons of silver-lead ore in 1927.

The underlying rock is chiefly coarse-grained porphyritic granite of the Nelson batholith. This is intersected by a few basic dykes.

The old workings, now mostly inaccessible, include five adits distributed over a vertical distance of 475 feet. The lowest or No. 5 level is about 30 feet above Silverton creek and is 500 feet long. From it a winze was sunk for an unknown depth on the lode. Above this level about 1,125 feet of drifts and crosscuts are reported to have been run. These workings explore a fissure lode striking from north 20 degrees west to northeast and dipping at an average angle of 75 degrees to the west. The lode varies in width from a few inches to 10 feet, the wider parts being largely filled with gouge and crushed granite. A basic hornblende-biotite dyke follows parts of the lode and may have had some influence on the position of the ore-bodies. On levels Nos. 4 and 5 the main ore shoot had lengths of 100 and 50 feet, respectively, with the basic dyke forming the hanging-wall and granite the foot-wall. This shoot extended for a maximum height of 170 feet above No. 5 level. It varied from 6 inches to 8 feet in thickness and was composed of a series of overlapping lenses of vein matter carrying from 6 inches to 1 foot of ore. On No. 1 level the ore shoot yielded 50 tons. Levels 2 and 3 have shown but little vein matter. Mineralization is much mixed in the winze sunk below No. 5 level.

The main shoot contained throughout important amounts of zinc blende. Argentite, ruby and native silver, and galena were the more valuable constituents in this and other ore shoots developed by the old workings. The gangue minerals were quartz and calcite.

The new work is on the Troy claim and along a mineralized sheared and brecciated zone in the Nelson granite striking north 60 degrees east and dipping steeply to the northwest. This zone lies about 600 feet downstream or southwest of the other lode, but should intersect it towards the northeast about 600 feet up the slope of the valley. Work on this zone includes four adits over a vertical distance of 180 feet and about 1,500 feet of drifts and crosscuts. The zone varies up to about 60 feet in width and where investigated possesses a well-defined hanging-wall whose continuity, however, is interrupted by cross-faulting. The position of the foot-wall is less certain, nor has sufficient work been done to outline the lode structure as a whole. Within the shear zone different fissures strike at various angles, though mostly in a general northeasterly direction, and dip, some to the northwest and others to the southeast. These fissures carry from 1 to 2 feet of ledge matter composed chiefly of quartz, but containing galena and zinc blende, and lesser amounts of argentite, native silver, and, probably, other silver-bearing minerals. Some calcite and a

little barite are associated locally with the quartz gangue. A little stoping had been done on a couple of these fissures at the time visited. The possibilities of finding other pockets or bodies along fissures seemed particularly good.

GALENA CLAIM

The Galena Crown-granted claim is on the summit of the divide at the head of the south fork of McGuigan creek and east of Payne mountain (*See* Figure 1). It is owned by the Silver Cord Mining Company, % A. C. Stewart, 525 Seymour Street, Vancouver.

On this claim, at an elevation of about 7,500 feet, a tunnel 490 feet long has been driven through the ridge, along a vein-lode striking north 55 degrees east and dipping 52 degrees southeast. The lode cuts metamorphosed argillites of the Slocan series intruded by many quartz porphyry dykes and sills. It carries vein matter composed chiefly of zinc blende and siderite. It extends northeast into Antoine basin in the vicinity of Antoine mine.

An attempt was made years ago to pick up the Galena lode by a long crosscut from the No. 4 level of the Last Chance mine (Figure 3), situated at an elevation of 6,685 feet on the Carpenter Creek slope. At 1,590 feet from the portal this crosscut intersected a shear zone, presumably the downward continuation of the Galena lode. This shear zone was drifted on to the southwest for 534 feet and, for much of this distance, was well defined and carried small bunches of vein matter consisting of zinc blende associated, here and there, with a very little galena. The average dip along this drift varies between 70 and 75 degrees southeast. To the northeast of the crosscut a little tunnelling was done, but nothing of interest discovered, though the possibilities in this direction were not exhausted.

GALENA FARM MINE (CURRIE GROUP)

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 68; 1904, p. 174; 1925, p. 245; 1926, pp. 255-256; 1928, pp. 290-291.
Rept. of Zinc Commission, 1906, pp. 271-272.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 193-194.

The Currie group is owned by Galena Farm Consolidated Mines, Limited, % Jas. Anderson, Stock Exchange Building, Vancouver, B.C. The group comprises the Currie, Grover, Peerless Revised, and Kate Crown-granted claims, $1\frac{3}{4}$ miles, by road, south of Silverton and a mile east of and between 700 and 900 feet above Slocan lake.

In the mid-nineties a considerable amount of galena float was discovered in the vicinity of the lode outcrop and from there to the shore of Slocan lake, near the mouth of Gold creek. In consequence of the considerable area covered by such float the mine received the name "Galena Farm." At an early date the property was secured by C. W. Callahan for English investors, who organized Galena Mines, Limited, of London, England. Operations by this company were not successful and the property lay idle for a number of years. It was subsequently acquired and successfully operated during the period of the war by Patrick Clarke of Spokane. A mill, operated by waterpower from Gold creek and with a rated capacity

of 100 tons a day, was erected in 1916. After the war and up to 1925 production was due chiefly to small scale leasing operations. In 1925 the property was leased by Porcupine Goldfields Development and Finance Company and exploratory work carried on for a short time. In 1926 a lease was obtained by Messrs. Johnson, Matthews, Jones, and Walton of Silverton. A year or so later the property was acquired under terms of a lease and bond by W. L. Sheeler, J. Johnson, and associates, who remodelled the old mill and continued production until March, 1929, when the property passed into the hands of the present owners.

The productive periods include the years 1915 to 1919 and 1922 to 1930. Total production to the end of 1926 is recorded as being over 58,000 tons of ore, averaging about 6·5 ounces in silver to the ton, 4 per cent lead, and 5 per cent zinc. The mill in June, 1928, was turning out 50 to 55 per cent zinc and 60 per cent lead concentrates. The principal mine workings (*See* Figure 6) are a vertical shaft 220 feet deep, a crosscut adit 160 feet below the outcrop, and three main levels at approximately 50, 100, and 125 feet, respectively, below the outcrop. Access to the mine is either by the crosscut adit, which is the main working level, or by stopes leading to the surface 130 feet to the south of the main shaft. The shaft is inaccessible, but it connects underground with the 100-foot level and with the 200-foot level at which an old crosscut 300 feet long is reported to have been run north from the shaft. Mine cars are hauled from the main level to the concentrator about 300 feet north of the portal. The main crosscut, on the 160-foot level, was driven in a southerly direction and at 550 feet from the portal encountered a lode referred to as the "Noonday" (*See* Figure 6). Two hundred and ten feet farther along the crosscut a drift was run to the southeast to explore the main lode at this depth. Beyond the entrance to this drift the crosscut was continued for 115 feet without encountering vein matter.

The rocks outcropping on the Currie group are chiefly granitic types forming part of the Nelson batholith near its northern contact with sediments of Slocan series. Surface exposures are, however, limited both in number and extent, and underground the mine workings have exposed lenses and belts of metamorphosed quartzitic and argillaceous sediments of the Slocan series. A belt of these sediments about 80 feet thick forms the hanging-wall rock of the "Noonday" vein-lode. The belt strikes north 70 degrees west and dips 40 degrees northeast, and not unlikely forms part of the much larger body of sediments exposed about 1,000 feet farther east along the banks of Gold creek at and below Noonday mine. Elsewhere the workings on Galena Farm mine have exposed irregular inclusions of sediments along or close to the main lode. To some extent at least these sediments appear to have influenced the course of fissuring followed by both the Main and Noonday lodes.

The lode system on the Currie group is thought to occur in the western continuation of the zone of shearing and brecciation developed at Van Roi and Hewitt mines. At Galena Farm mine the main lode has a known length, on the 100-foot level, of about 900 feet. It is claimed that this lode was traced on the surface in the early years for 1,600 feet and that in places it carried from 12 to 14 feet of milky white quartz associated with siderite, fragments of slate and granite, and some galena and zinc blende.

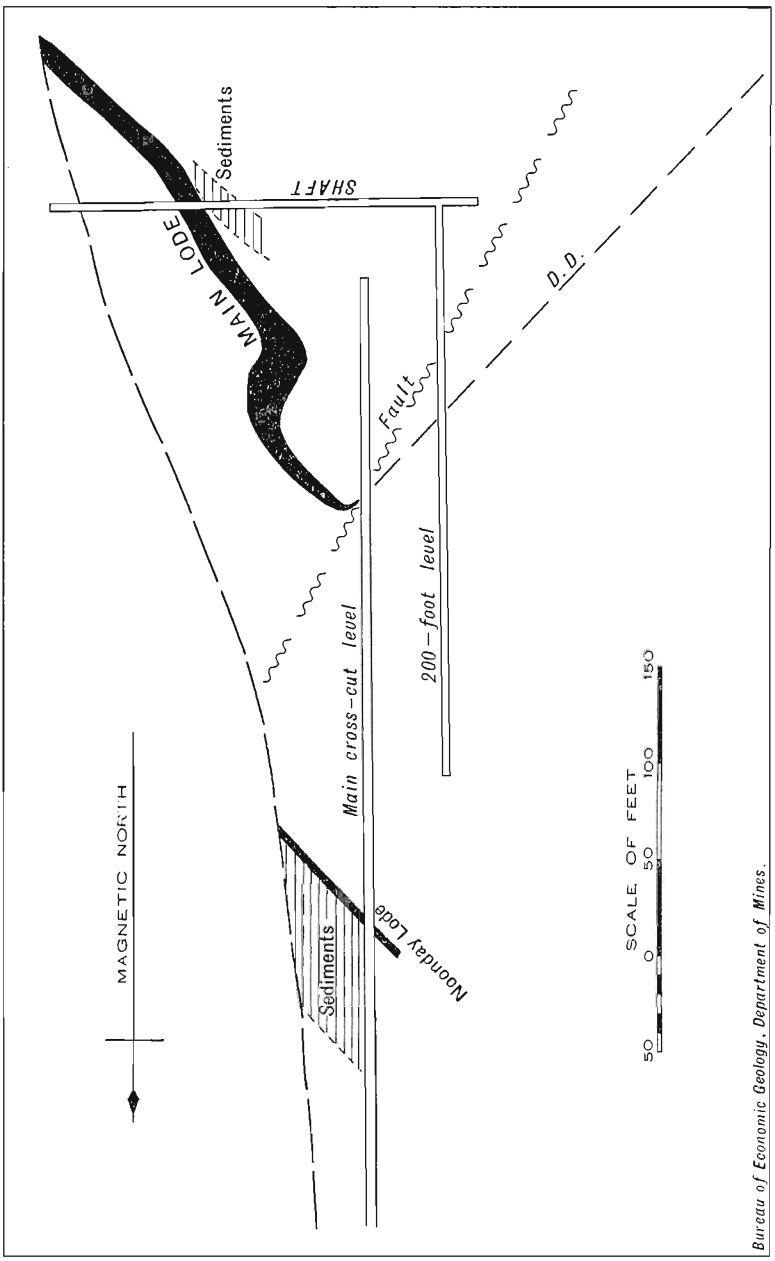

Figure 6. Diagrammatic vertical section, Galena Farm mine.

98270—4½

The lode has a general strike of north 55 to 60 degrees west and a general northeast dip at an average angle of about 50 degrees.

The hanging-wall is mostly well defined but the foot-wall has been determined by the grade of the mineralization rather than by any marked break. Though the lode has a general northeasterly dip, the angle of dip varies greatly and the ore-bodies, as they extend down the dip of the lode, flatten and then rise in low arches 15 or 20 feet high whose northern limbs steepen and continue downwards with the usual northerly or northeasterly, steep dip (*See* Figure 6). The arch-like structures are accompanied by, and are partly the result of, slipping that occurred in late or post-mineral time. The lode narrows in the lower workings and is lost a few feet before reaching the main crosscut level, owing apparently to the presence of a fault striking about north 75 degrees west and dipping at a low angle (28 to 30 degrees) to the south (Figure 6). A crosscut driven for 300 feet north from the main shaft at the 200-foot level is reported to have failed to pick up the downward continuation of the lode. Diamond drilling from the surface and from the 160-foot crosscut level likewise failed to find vein matter in the foot-wall country. This exploratory work led to the belief that the Main lode had been displaced by the strong fault encountered in the 160-foot crosscut level and that its continuation below the fault plane was the "Noonday." The latter is parallel to the Main lode, and if it is the faulted continuation of it the fault is a normal fault with an apparent displacement of about 160 feet. But if the two lodes are one and the same, the amount of movement along the fault must have been much greater than 160 feet, as is indicated by the character of the hanging-wall rocks of the two lodes. The Noonday lode, where intersected by the main crosscut level, has a belt of sediments forming the hanging-wall, whereas the hanging-wall rock of the Main lode is granite. As the main belt of sediments lies east of the workings a correlation of the Main and Noonday lodes implies that the block holding the Main lode moved from west to east, a point to be kept in mind in view of the possibility of finding further ore mineralization on the Noonday lode west of the present workings at a place opposite the ore-bearing section of the Main lode prior to faulting. On the other hand, for reasons given on a later page, it is not improbable that the Main and the Noonday lode are two distinct lodes, in which case no reason exists for supposing ore might occur farther west along the Noonday lode.

Most of the development work on the Main lode has been done east of the crosscut, and much of the ground from the 125-foot level to the surface and over a length of about 350 feet has been stoped out. The vein matter in this section formed one continuous ore shoot raking, in general, slightly to the east. Work in this direction on the various drifts was in each case terminated on entering a faulted, broken, and highly oxidized zone in which recent deposits of rounded boulders, including fragments of silicified wood, occupy an old stream channel that extends below the 125-foot level and follows a nearly north-south course along the broken zone referred to above, the excavation of the channel evidently having been influenced by this zone of weakness in the underlying rocks. Until the summer of 1928 no attempt had been made to explore the course of the Main lode through and beyond this broken zone. In 1928, how-

ever, the operators extended the 100-foot level easterly for 150 feet beyond the old face. This work passed through the channel deposit and encountered a width of about 100 feet of broken, oxidized rocks including metamorphosed sediments and altered intrusives of doubtful composition, all with a heavy coating of iron oxide. Beyond the broken ground a more solid formation was revealed. A scattered mineralization was encountered in crossing the broken zone and the ledge matter has been faulted along a series of slips which offset it for a few feet, in some cases to the north and in others to the south. Values are considerably impoverished within the zone of oxidation, but beyond it several feet of good mill feed have been encountered. This discovery has been most encouraging as it opens up an entirely new block of ground whose possibilities give a new lease of life to the property.

Towards the west at points above the main crosscut, and on and above the 100-foot level, a shear cuts across the granitic rocks with a steep dip to the west and has offset the vein-lode a few feet to the north. Recent work to the west of this fault, and above the 100-foot level, has revealed good concentrating ore in the hanging-wall section of old stopes. The 100-foot level has been extended for 320 feet west of the fault and at the face shows several feet of sheared and broken wall-rock cemented by quartz containing bunches and streaks of zinc blende. About midway along this westerly drift a little stoping has been done above, and a winze sunk for 30 feet below, the level on a width of about 5 feet of vein matter carrying disseminated zinc blende.

In addition to the above-mentioned fault, other steeply dipping and nearly north and south fractures were observed in the upper workings, but these show little evidence of displacement. They strike nearly at right angles to the slips that cross the arched parts of the lode. These slips dip southerly at angles of from 30 degrees to nearly perpendicular and in each case are reverse faults with a pronounced movement to the west.

The vein matter is quartz associated with a varying proportion of ore minerals. It forms a series of roughly parallel veins separated by varying widths of brecciated wall-rock. The ore minerals are chiefly zinc blende and galena. A little siderite and, locally, considerable fluorite are present. In places the vein matter is strongly brecciated. The country rock, particularly the granite, associated with the vein matter, is mostly altered and partly replaced by the mineral-bearing solutions. In the main ore shoot lenses and streaks of mixed galena and sphalerite up to 4 or 5 feet thick were encountered, but in general the ore is of concentrating grade requiring fine grinding to separate the lead and zinc minerals. The fluorite is evidently one of the later if not the last of the ore and gangue minerals to be deposited as it coats and includes fragments of the others. It is, however, involved in the slipping that produced the arches in the main lode and is abundant towards the tops of these arches. Some native silver has been reported as occurring in Galena Farm ore.

The Noonday lode has been explored for over 400 feet on the crosscut (160-foot) level, mostly to the east of the crosscut. The east drift is accessible (1928) for only about 60 feet from the crosscut. The lode receives its name from the assumption that it may be the western extension of the lode developed on the adjoining Noonday property. In Galena

Farm workings this lode is marked by more or less shearing along the contact of a belt of sediments, already referred to, with underlying granitic rocks of the Nelson batholith. Very little ore mineralization was observed along the section of the lode open for examination. A little stoping has been done above the level to within a few feet of the surface. Some mill feed is reported to have been encountered in these operations, but mineralization has nowhere been found to be encouraging.

Galena Farm mine is remarkable for the amount of ore recovered from its comparatively shallow workings. These workings are not yet exhausted and encouraging discoveries have recently been made towards both the eastern and western ends of the main drifts. Nor has the full width of the main lode been investigated, the foot-wall country still presents possibilities above the 160-foot or main crosscut level.

The main lode appears to narrow rapidly below the 125-foot level and where, above the big fault, it approached most closely to the 160-foot level, would probably not average over 3 feet in width. It is possible that it may never have extended, in minable widths, much below the main crosscut level. If it did, an obvious interpretation of the available information is that the Noonday lode is its faulted continuation, as stated on a preceding page. That this may not be the case is, however, possible, as is indicated by the following considerations. In the accompanying sketch (*See* Figure 6) neither the 200-foot crosscut, the drill hole DD, nor the main crosscut 160-foot level encountered any mineralization (except the Noonday lode) that might be regarded as being a continuation, below the fault, of the Main lode. If the Noonday lode is a continuation of the Main lode the fault is a normal fault. There is, however, little to suggest that the fault is normal. The degree of shearing and brecciation accompanying the fault rather suggests that it is a thrust fault. If so, the continuation of the Main lode should be sought in the opposite direction from the Noonday lode, that is, south of the point of intersection of the fault and main crosscut, and beneath the fault. If the fault is a thrust the lode should have been picked up either in the 200-foot crosscut or by the drill hole, unless the thrust was so great as to have displaced the vein beyond the depth reached by the drill hole, or unless the shearing and brecciation along the fault obscured the lode where it was cut in the crosscut and in the drill hole. The first possibility would require heavy expenditure to investigate. The second possibility, however, could be tested by a comparatively short drill hole because the lode, if present, cannot lie far below the 200-foot level. A diamond drill hole sunk from the main crosscut level well out in the foot-wall of the fault, say 75 feet north of and parallel with the existing drill hole, would encounter the continuation of the Main lode, if present, within a comparatively short distance.

GEM CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1925, p. 244.

The Gem claim is on Carpenter creek above Cody and is owned by Hervey P. Jackson, of Paulson, B.C.

The property is interesting in that the production, amounting to 59 tons of silver-lead ore, has been won as float from the bed of Carpenter

creek. Boulders and nodules of waterworn galena of all shapes and sizes were found in the creek gravels at the foot of an old slide from the north slope of Carpenter Creek valley. The float is well rounded and much resembles ordinary creek boulders and pebbles. No doubt it came from some ledge on the hillside, a ledge still being searched for. The galena ore averaged about 81 ounces in silver to the ton and 70 per cent lead.

GREAT WESTERN CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1,058; and other years.

The Great Western Crown-granted claim is near the head of the south fork of McGuigan creek, at an elevation of about 5,900 feet. It is accessible by a branch trail from the Washington mine. It was located in October, 1891. The claim is owned by the Standard Trust Company, Vancouver, B.C.

Records of production are incomplete. In 1893, 30 tons were on the dump. In 1906 some 36 tons were shipped to Trail. In recent years the property has been worked under lease by Bruce Kirk of New Denver.

On this property a lode striking nearly north and dipping 35 to 55 degrees west traverses a belt of slaty rocks of the Slocan series which trend northwesterly and dip about 60 degrees southwest. The sediments are intersected by a few small dykes and sills of quartz porphyry.

The workings comprise five adits extending over a vertical range of 400 feet. They are partly inaccessible.

The lode is a strongly sheared, mineralized zone several feet wide in which the rocks show much slickensiding and are very carbonaceous. In part the lode lies beneath a porphyry dyke. Within it vein mineralization forms shoots of irregular shape and unproved dimensions. The ore includes galena, zinc blende, and pyrite in a gangue of quartz and siderite. In places as much as a foot of clean galena has been encountered, carrying nearly 2 ounces in silver to 1 per cent of lead.

GREENHORN AND HOME RULE CLAIMS

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1,059; 1904, p. 139; 1928, p. 288.

These two Crown-granted claims are on the northern side of Carpenter Creek valley about 2½ miles by trail above Cody. The Home Rule claim was staked in 1895 and is owned by Roderick Dewar of Sandon. The Greenhorn claim is the property of Theodosia and John McNeil, % John McNeil, 832 Pender Street East, Vancouver, B.C.

The claims lie within an area of Slocan sediments intersected by a few dykes of quartz and feldspar porphyry. The sediments are chiefly blocky and banded argillaceous types, but include some limy and also more quartzitic beds. The general structure is synclinal with low northerly and southerly dips and a strike of about north 70 degrees west.

Workings, comprising several adits and open-cuts, cover a vertical range of about 800 feet and are chiefly on the Home Rule claim in the vicinity of the boundary between it and the Greenhorn claim. They explore two or more veins occupying well-defined fissures intersecting the sedimentary rocks.

At an elevation of about 5,600 feet on the Home Rule claim, a lower adit, 120 feet long, drifts on a vein-deposit striking north 80 degrees east, dipping very steeply to the southeast, and raking to the east or into the hill. The vein matter is as much as 10 inches or more wide; it consists essentially of fragments of galena enclosed in quartz gangue and contains many fragments of wall-rock. In places there are short, narrow lenses of clean galena. A little siderite and chalcopyrite were also observed. Some stoping has been done above the level and at 40 feet from the portal a 30-foot shaft shows 6 inches of clean galena at the bottom. The lode in which the vein matter occurs is displaced a few feet to the north by a couple of faults. It outcrops below the portal and contains, at one point, 6 inches of cube galena carrying a little pyrite and chalcopyrite. This galena is reported to carry less than an ounce in silver to the per cent lead.

Forty feet below the portal is an adit on the Greenhorn claim. This was caved in 1925, but is probably on the same lode and is stated to have 6 inches of ore in the face.

About 150 feet above the portal of the lower Home Rule adit another lode outcrops in the bottom of the bed of a small creek. This lode strikes north 75 degrees east, dips southeast, and is composed of 2 feet of brecciated vein matter in which, however, little or no ore minerals were observed. To the west of the creek the lode appears to have been faulted down the hill and may be represented at another exposure about 300 feet below, where an open-cut on the Greenhorn claim, to the west of the small creek, exposes a vein of brecciated quartz carrying galena from which, it is reported, several tons of ore have been shipped. The lode here strikes north 80 degrees east and dips 75 degrees southeast.

To the east of the creek and 550 feet above the lower Home Rule adit is the upper adit on this claim. It is a crosscut for 60 feet to where it intersects a lode striking north 65 degrees east and dipping 60 degrees southeast. The lode is 4 feet wide and is composed of gouge and brecciated quartz. No ore mineralization was observed, but the adit had just reached a porphyry dyke beyond which ore had been found in an outcrop above. At 50 feet above this adit an open-cut and short adit expose the same lode which, near the portal, includes a lens of brecciated vein matter 3 feet wide containing considerable galena. Other outcrops of this lode have been investigated in the vicinity of this short adit and it may be the northeasterly continuation of the lode encountered in the creek bed below.

Work done to 1925 on this property has been mainly prospecting and has, on the whole, provided encouragement for further exploration. A small production has been won from such work but the returns are incomplete. In 1915 it is recorded that 2 tons were shipped from the Home Rule claim and ran 74 ounces in silver to the ton and 56 per cent lead.

GREY COPPER CLAIM

Reference: Rept. of Zinc Commission, 1906, pp. 259-260.

The Grey Copper Crown-granted claim was staked in 1891. It is on the northern side of the valley of Carpenter creek below the Reco-Good-enough property and to the west of the Bluebird group (*See* Figure 1). It

is owned by W. V. Papworth, R. S. Lennie, and S. J. Towgood, % W. V. Papworth, Kaslo, B.C.

The workings comprise five adits at elevations of from 5,500 to 6,000 feet. The upper four are closely spaced within a vertical range of only 100 feet. These adits are driven northeasterly on a lode outcropping for several hundred feet down a steep, bare gulch. The lode strikes north 48 to 88 degrees east, averaging probably 55 degrees, dips southeast at from 45 to 70 degrees, and, in the vicinity of the workings, cuts across Slocan sediments and a dyke of quartz-feldspar porphyry about 1,000 feet wide. The lode is well defined and persistent, varies from 3 to 6 feet in width, and carries a paystreak averaging from 1 to 2 feet wide.

Production returns are incomplete. In 1906 some 1,000 tons of ore were reported to have been blocked out and sampling indicated a content of 42·6 per cent zinc, 18·8 per cent lead, and 33·2 ounces in silver across a width of 2 feet in the lower of two adits driven on the lode at that time. The only recorded shipments, amounting to 37 tons, were made in 1917. This ore carried an average content of 80 ounces in silver to the ton and 50 per cent lead.

HARTNEY GROUP

Reference: Rept. of Zinc Commission, 1906, pp. 208-209.

The Hartney group, comprising Hartney, August Flower, and Edith Crown-granted claims, is the property of Thos. Avison, New Denver, B.C. It is on the west slope of Idaho peak, about 4 miles by road from New Denver and 2,320 feet above Slocan lake.

The Hartney vein was discovered in 1897 and developed until 1901, when the first and largest shipments were made. These amounted to 146 tons and carried an average of 52 ounces in silver to the ton and 32 per cent lead. Up to the end of 1917, total shipments amounted to some 264 tons, averaging 59 ounces in silver and 32 per cent lead. The ore as mined contained considerable zinc blende.

The vein, in 1906, was developed by five adits, aggregating 1,500 feet of drifts and crosscuts, and by 510 feet of raises and winzes. The lowest working is 510 feet below the outcrop. The vein intersected massive argillites and pyritic, carbonaceous, slaty sediments on a nearly east strike and a dip of from 65 degrees north to vertical. It varied in thickness from 1 inch to 2 feet, and was widest near the surface, all the levels entering harder rocks in which the vein tightens. The vein, as mined, consisted of a mixture of galena and zinc blende in a gangue of quartz, calcite, and siderite containing fragments of crushed wall-rock. A little pyrite was observed coating vugs in the ore. Both zinc blende and galena carried important silver values. The best ore raked with the slope of the hillside and, in places, was mostly galena.

HEWITT-LORNA DOONE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1893-1928.
Report of Zinc Commission, 1906, pp. 219-225.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 194-195.

The Hewitt-Lorna Doone Group, comprising the Prior, Burnside, Lorna Doone, Lorna Doone fraction, Hewitt, Crow fraction, Penobscot,

Tranquillity, Rincon, Rincon fraction, and Mole Crown-granted claims, and possibly other claims, is owned by Galena Farm Consolidated Mines, Limited, Vancouver, B.C. The property occupies the northern end of a spur from Eightmile ridge south of Silverton creek and is accessible by road 6 miles from Silverton. The mine workings are connected by a 5,270-foot aerial tramway with the Hewitt concentrator on the north bank of Silverton creek, 3½ miles from Silverton and 870 feet above Slocan lake. The tramway leads to No. 6 tunnel at about 4,500 feet elevation or 1,900 feet above the mill. A surface tram connects No. 6 with No. 2 level 432 feet above. At intermediate stations along the aerial and surface tramways connexions are made with the other main levels.

Important vein exposures were discovered in 1892, since which time the property has been worked at intervals by several individuals and companies. In the early years the Hewitt group, extending west from the summit of the divide, and the adjoining Lorna Doone group, extending east of this divide, were worked separately. The Hewitt group was first owned by Captain R. G. Tatlow, C. F. Yates, *et al.*, of Vancouver. In 1904 the property was leased to M. S. Davys. The Lorna Doone was first worked by Rathboure and Culver. The two properties continued to operate independently until 1907, when Hewitt Mining Company of New York was incorporated to acquire and operate both. In 1910 the Hewitt and Lorna Doone groups were acquired by Silverton Mines, Limited, of Spokane, Wash. The company erected a new mill, the present structure, in 1912. During the years 1917(?) to 1920 the property was operated under lease and bond by Clarence Cunningham, who owned the adjoining Van Roi mine. Subsequently, the property reverted to the previous owners, who reformed as a private company known as Hewitt Mines, Limited, with head office in Spokane, Wash. An irregular production, chiefly from leasing operations, was maintained until 1926, when the property was acquired under option by the Victoria Syndicate, who carried on an active campaign of development and exploration. More recently the property has been amalgamated with that of the Currie (Galena Farm) and Hazard groups under the present ownership.

Records of production are incomplete, but such as are available indicate that over 93,000 tons of ore have been mined from the Hewitt-Lorna Doone group and that this ore contained on the average nearly 14 ounces in silver to the ton, over 1 per cent lead, and 18 per cent zinc. No record was kept of zinc production until 1911 and the years following, so that the average zinc content, as stated, is less than it should be. Much of this ore was concentrated at the company's mill before shipment. Development commenced on Hewitt group in 1896, but there are no records of shipments until 1900, when an unknown amount of rich silver-lead ore carrying 600 ounces in silver to the ton and 20 per cent lead was produced. In 1901 and 1902, 2,670 tons were shipped. This ore averaged nearly 59 ounces in silver to the ton and less than 1 per cent lead. The Hewitt shipped no ore in 1903, but in this year the Lorna Doone produced 20 tons carrying 200 ounces in silver to the ton and 17 per cent lead. Altogether, Lorna Doone is credited, up to the time of its amalgamation with Hewitt group in 1907, with a production of 341 tons, carrying on the average 134 ounces in silver to the ton and 4 per cent lead. The years

1904 to 1908, 1910 to 1920, and 1923 and 1926, were all productive. The largest tonnage mined for any one year is attributed to 1915, when 25,224 tons gave an average return of 7·2 ounces in silver to the ton, 0·6 per cent lead, and 2·75 per cent zinc. Much of the ore produced since 1909 has been concentrated before shipment. Shipments prior to that time were largely of hand-sorted ore carrying high values in silver. In 1904 and 1905 about 800 tons from the south vein-lode assayed 150 ounces silver, 6·5 per cent lead, and about 12 per cent zinc. In 1906, 119 tons contained 15,675 ounces silver and 10,768 pounds lead. In 1907, 657 tons carried 88,036 ounces silver. In 1908 some 408 tons obtained in driving Nos. 6 and 7 levels gave 44,511 ounces silver and 65,737 pounds lead. In 1910 the initial work of Silverton Mines, Limited, included a production of 127 tons from No. 7 level carrying altogether 15,127 ounces silver and 9,219 pounds lead. In 1911, 5,326 tons of crude and milling ore carried 68,500 ounces silver, 190,000 pounds lead, and 258,000 pounds zinc. The zinc concentrates in 1911 ran from 70 to 90 ounces in silver. Altogether, up to the end of 1910, 18,500 tons were mined, of which 5,209 tons were hand-sorted and gave net returns of $222,663.25, nearly all in silver; 36 tons were lead concentrates which ran 207 ounces silver, 65·2 per cent lead, and 8 per cent zinc; and 185 tons of zinc concentrates shipped to Bartleville smelter ran 43 ounces in silver to the ton, 20 per cent zinc, 2 per cent lead, and 20 per cent iron.

The strongly fissured, mineralized zone within which the ore deposits at Hewitt mine have been found is developed by nine adits and tunnels, including, from top to bottom, Lorna Doone and Nos. 1, 2, 3, 4, 6, 7, 8, and 9, respectively. Of these Nos. 2, 3, and 6 extend completely through the hill. Lorna Doone and Nos. 4, 7, 8, and 9 adits were driven from the east slope of the ridge and No. 1 adit from the west slope. In addition, there are a number of intermediate levels in the more productive parts of the mine. No. 9 level lies over 1,300 feet below the apex of the mineralized zone, where it crosses the divide 140 feet above the portal of Lorna Doone adit. A crosscut 223 feet below No. 9 adit starts from a point on the northern flank of the ridge, overlooking Silverton creek, 865 feet west of the portal of No. 8 adit. It has been driven towards the zone of mineralization and is in 420 feet. This crosscut should reach its objective at about 1,800 feet from the portal, but is not being advanced at present (1928). The fissure zone, which may be referred to as the Hewitt lode, has a maximum explored length on this property of over 3,000 feet.

The mine workings are mostly in sediments of the Slocan series close to the northern contact of the Nelson batholith. A tongue from this batholith is encountered in the upper workings on and above No. 4 level and, towards the centre and western side of the ridge, forms a large part of the country rock below the hanging-wall of the fissure zone. At no point examined does this tongue form both walls of the zone, although from the location of outcrops it seems probable that it does so in the more westerly, now inaccessible, upper workings. The sediments are mostly an assemblage of compact quartzites, calcareous quartzites, quartzitic and calcareous argillites, and argillites. Some rather slaty beds are present. The sediments strike within a few degrees of north 77 degrees east and dip northwest at about 70 degrees. They are intersected by a few, light

grey, felsic sills and dykes which, in the vicinity of the lode, are much altered and in places underground are difficult to distinguish from the sediments. The granitic rocks are coarse grained, carry a large percentage of hornblende, and, in general, have about the composition of hornblende granodiorite and quartz diorite.

The vein system at Hewitt mine occupies a strong zone of shearing and fissuring striking nearly east and dipping northerly at an average angle of 70 degrees. The maximum width of this zone, as developed in the upper workings, is about 100 feet. To the east it has been picked up by workings on the adjoining Vancouver group (*See* description of Van Roi mine) where it has been explored over a vertical range of 1,200 feet above the lowest or No. 9 tunnel at 3,250 feet elevation. Over 1½ miles to the west of Hewitt mine workings, and more than 1,500 feet lower down the slope of the hill, the same zone is believed to be present on Currie group ground (*See* description of Galena Farm mine). As developed on different levels at Hewitt mine this zone is composed of from one to four lodes, in each of which important vein deposits have been found (*See* Figure 7). These lodes are marked by lines of fissuring and shearing and have been followed underground for distances of from 50 to over 3,000 feet. They are composed largely of country rock crushed to gouge or brecciated and cemented by quartz. Locally ore minerals are important constituents and have provided several important ore shoots. The principal lode may be referred to as the " North " lode. It has proved to be more persistent than the others, is the only lode that has received any considerable attention below No. 3 level, and has provided the bulk of the ore from this mine. Below No. 4 level, except for an occasional dyke or sill, this lode lies entirely within sediments. Above No. 4 level and towards the central and western parts of the levels a tongue of quartz diorite forms considerable parts of the foot-wall. This " North " lode is the hanging-wall component of the fissure zone and in strike and dip coincides nearly with the attitude of this zone. In these respects it resembles the North lode of the adjoining Van Roi mine and may be the westerly continuation of that lode. The workings on the two mines are, however, separated by an interval of a few hundred feet of broken and faulted ground across which the lode has not been traced.

Other lodes (*See* Figure 7) developed at Hewitt mine include the " South " or " Main South " lode, which has been worked from above level No. 2 down to No. 3 level and over a length of about 250 feet. It has a general southwesterly to westerly course and may be regarded as the foot-wall component of the fissure zone. A " West " lode between 50 and 100 feet long, and striking a few degrees east of north, connects the " South " lode on Nos. 2 and 3 levels with a fourth or " Main " lode which runs nearly parallel with, and 50 feet or less to the south of, the " North " lode. The " Main " lode is developed for a maximum length of about 450 feet on Nos. 2 and 3 levels. It is thought to merge with the north lode both to the east and west along these levels and also below No. 3 level. On Nos. 2 and 3 levels an important body of ore was discovered at the junction of veins occurring in the Main and West lodes. The South lode, as developed, lies mostly along the contact of granitic and sedimentary rocks. The West and Main lodes lie partly in this intrusive and partly in

adjoining sediments. Irregularities in the attitude and breaks in the continuity of the South, West, and Main lodes contrast with the persistence

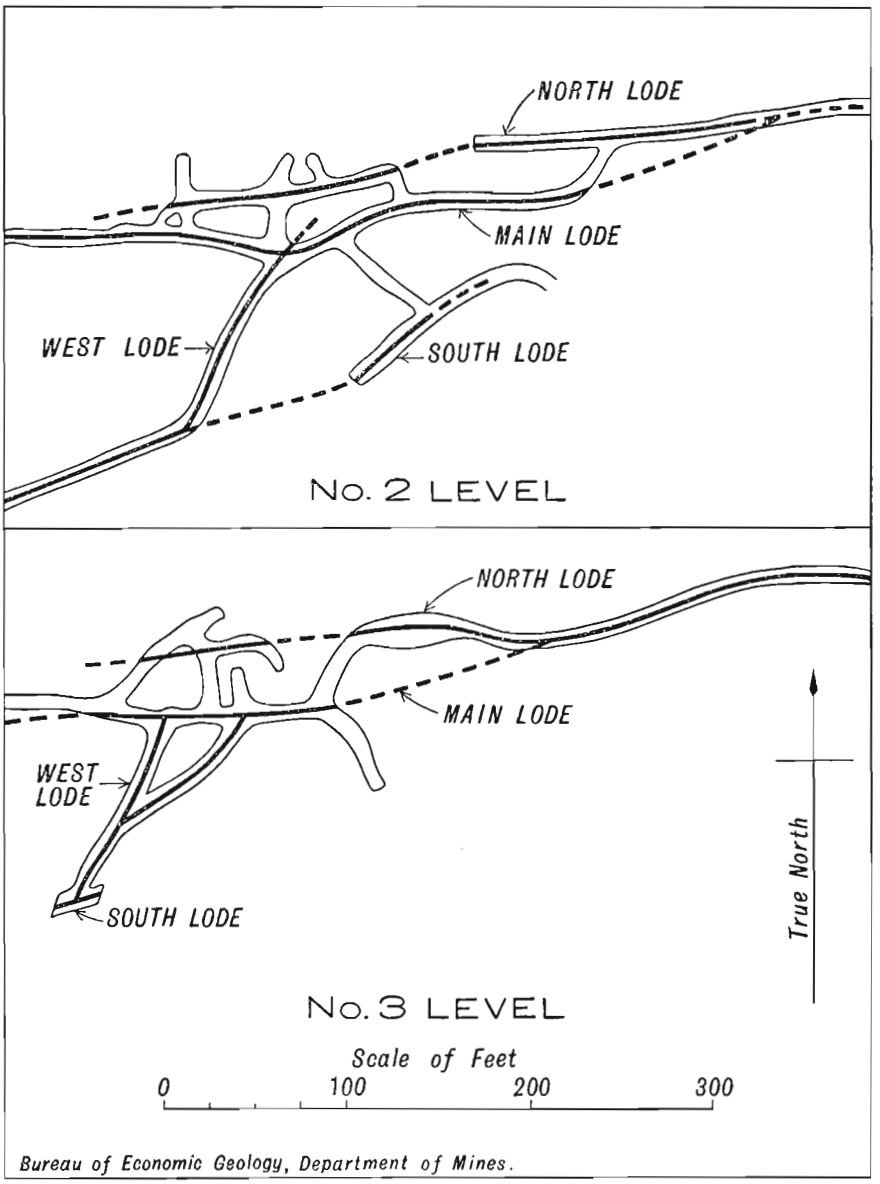

Figure 7. Plan of parts of Nos. 2 and 3 levels, Hewitt mine, showing positions of lodes.

and regularity of the North, whose occurrence is marked by stronger shearing and fissuring, to which the formation of the other lodes is apparently only incidentally related. The Main lode as developed above No. 3 level

seems to be a branch of the north lode which it joins both laterally and in depth. What appears to be an analogous lode to the Main lode has been developed between Nos. 7 and 8 levels in the more easterly mine workings and produced a large tonnage of ore from what is known as the Cunningham stope.

Much of the ore hitherto produced at Hewitt mine has come from ore shoots lying directly beneath the summit of the divide, along a stretch of about 450 feet. The uppermost shoot was stoped from the surface and for a short distance below the Lorna Doone tunnel. It was over 50 feet long and 70 feet high and averaged about 3 feet in thickness. An ore shoot on the South lode was over 100 feet long on No. 2 and 50 feet long on No. 3 levels and was stoped to a height of over 50 feet above No. 2 level. Above No. 3 level the West was stoped, as is reported, to a height of 250 feet with an average width of 2½ feet. The North and Main stopes had an aggregate length of 700 feet on No. 2 and 590 feet on No. 3 levels, with an average stoping width of about 10 feet. Where veins on the North and Main lodes joined on No. 3 level, the ore was 16 feet thick at the sill but was separated above by a horse of granitic rock. This ore assayed 20·7 to 26 ounces silver to the ton, 3·5 to 4·5 per cent lead, and 9·1 to 20·7 per cent zinc. Below No. 3 level the main shoot on the North lode extended to No. 7 level 450 feet vertically below, had an average length of about 150 feet, a maximum thickness of 32 feet, and an average thickness of 7 feet. Average samples of the ore between Nos. 4 and 6 levels gave about 16 ounces (13 to 30) silver, 2½ per cent (0·6 to 6·8) lead, and 7½ per cent (5·2 to 8·2) zinc. The highest grade zinc ore in the mine was discovered on this shoot on No. 5 level, where some of the ore ran over 20 per cent zinc. East of this shoot and joining it below No. 4 level, another ore-body was stoped from 100 feet below No. 4 to 100 feet or more above No. 2 level and included, above No. 3, ore from both the North and Main lodes. This composite shoot had a length of about 150 feet, an average thickness of over 5 feet, and carried, in aggregate, about 16 ounces silver to the ton, 7 per cent zinc, and 2 to 3½ per cent lead. Stoping has been done on the North lode directly east of these main ore shoots, above No. 3 level and over a length of 200 feet or more. In this direction intervals of pay ground were separated by shorter intervals of broken ground carrying but little mineralization. Very little has been done on these ore-bodies below No. 3 level except above No. 6 where some stoping has been done within 100 feet of the level.

A second important section of the mine, and one in which a large tonnage of high-grade ore has been discovered, occurs towards the eastern part of the mine workings within a length of 600 feet from the portal of No. 7 adit and within a block of ground extending from above No. 6 level down to No. 8 level, a vertical distance of over 500 feet. Three important ore shoots have been discovered in this block. One of these, situated almost vertically below the portal of No. 7 adit, has been stoped for over 150 feet above No. 8 level. A still larger body was developed above No. 8 adit by the Cunningham stope. This stope was over 200 feet long and extended to over 200 feet above this level. The ore lay in a branch of the North lode and had a maximum thickness of about 25 feet. A third shoot, developed above and below No. 7 level over a vertical range of 100 feet and an average

length of 85 feet, contained from 4 to 6 feet of milling ore and included some of the richest ore found in the mine.

The lateral boundaries of the several ore-bodies discovered in this mine have been determined, in the main, by fault planes or narrow widths of broken ground which in general strike and dip with the enclosing sediments. Most of the movement along these faults is pre-mineral, but slight displacements of the lodes have been noted at a number of points and, in most cases at least, are to the left, i.e. to the south facing west along the drifts. Many of these faults or "slips" were seen to carry more or less vein matter. The main ore shoots beneath the summit of the ridge contained much richer values in the upper levels, the ore from No. 3 level down being almost entirely concentrating ore.

The lode filling consists of brecciated rock cemented by dense white quartz or a grey, sugary, friable quartz with numerous vugs showing fine clusters of crystals. A banded, ribbon, or agate structure also occurs and alternates with bands and streaks of galena and blende. The ore minerals fill cavities, occur in specks, streaks, and patches, and form crusts on fragments of the wall-rock. In part the quartz is later than the ore minerals. Banded quartz usually occurs either on one wall or the other of the lodes and with these bands long, narrow paystreaks occur. Siderite is subordinate to quartz. It is more plentiful on Nos. 3 and 4 levels than lower down. Calcite is in very small amount. On the upper levels the ore was richer in and near the granite than elsewhere.

For the most part the ore is the "dry" type with quartz the predominant gangue mineral. It consists of steel and cube galena and pale and dark brown zinc blende in a gangue of quartz and siderite with, occasionally, a little calcite. Grey copper is generally present with both galena and blende. Pyrite and pyrrhotite are present in notable amounts in some of the ore-bodies and are stated to carry from 70 to 80 ounces in silver. Locally some very rich ore has resulted from the deposition in cross fractures of ruby silver, native silver, and grey copper. Ruby silver occurs in films and clusters of crystals, and native silver in leaf form and as mossy aggregates and in wire form associated generally with a little calcite. Stibnite also occurs in clusters of minute acicular crystals. Another mineral, a sulphantimonide of lead, resembling boulangerite, was observed in some of the ore specimens.

When last visited, in September, 1927, the property was being energetically developed with the object, in part, of investigating the downward continuation of previously worked ore-bodies and of exploring the various component lodes with the hope of picking up other ore-bodies either along the continuation of previously developed lodes or on other lodes of like character. Work in the upper levels was handicapped by the inaccessibility of much of the old workings. On No. 2 level a strong shear along the foot-wall of the mineralized zone (analogous to the "South" lode) was being investigated. About 6 inches of low-grade ore had been drifted on for over 50 feet and a raise 40 feet above the level had encountered some milling ore. A crosscut, 35 feet long, had been run from No. 4 level, 750 feet from the portal, to pick up the South lode at this depth, but had not reached its objective. No. 6 level had been opened by a branch tunnel around the south side of a caved section in the vicinity of the old

stopes in the western workings. In running this branch tunnel a nearly parallel lode was encountered and drifted on for about 150 feet. This lode lies about 70 feet south of the North lode and may represent either the South lode or a lode between this and the South and North lodes. Its course was marked by strong shearing and fissuring. The lode filling included upwards of 18 inches gouge on the foot-wall side and from 2 to 4 feet of vein matter, mostly quartz, on the hanging-wall. The quartz contained a spattering of galena and zinc blende and was associated with a little siderite. Near the western intersection of the branch tunnel with the main drift, and also about 300 feet farther west, some vein matter was discovered along what seems to be the western continuation of the North lode. An 80-foot raise at the more westerly point exposed several feet of lean vein matter which, however, semed sufficiently encouraging to warrant further development. No. 7 level had been extended some 360 feet to get under this showing, but at the time visited had not encountered any important mineralization. Nearer the eastern portal of No. 6, and within the limits of the other productive section of the mine, considerable development work was being done both above and below the level. An underhand stope had previously provided some rich silver ore and a raise was being run from No. 7 level to get under this shoot. About 100 feet above No. 6 a raise had encountered 5 feet of milling ore, chiefly zinc blende in quartz, in what seemed to be a foot-wall split of the North lode. On No. 7 level west, a winze 76 feet deep had been sunk near the hanging-wall of the North lode and had encountered good mill feed to this depth. No. 8 level was, consequently, being extended westward to get under this ore and had still 100 feet or so to go. On No. 8 level east, a crosscut had been run for 130 feet to the south to investigate the foot-wall country of the North lode, but had encountered nothing of interest. Two shorter crosscuts, run for the same purpose from an intermediate level below No. 7, had likewise been non-productive, nor did a long crosscut to the north from No. 8 level, 270 feet west of Cunningham stope, discover vein matter in this direction. No. 9 is a new level, 152 feet below No. 8, and was being projected to get under the ore-body developed by Cunningham stope on and above No. 8 level. It was 100 feet or more from this objective but near the face showed some 3 feet of quartz carrying a little galena and some blende.

Encouraging features on this property are the depth and strength of fissuring; the persistence of the hanging-wall or North lode, and the occurrence of high-grade ore down to the eighth level. Less favourable features are the abundance of dead work that must inevitably be done to carefully investigate the possibilities of the foot-wall country of the North lode. It is this part of the lode system, particularly within the limits of the central and eastern productive sections of the mine, that seems to provide chances of finding further ore-bodies. The main or "North" lode is also worthy of further investigation on No. 9 level east. Its possibilities above this level, both in the central and eastern sections of the mine, are by no means exhausted, as evidences of ore mineralization discovered in recent exploratory work have shown.

IDAHO-ALAMO GROUP

References: Ann. Repts., Minister of Mines, B.C., 1892, p. 531; 1893, p. 1,056; 1896, p. 54; 1904, p. 182; 1917, p. 159; 1918, p. 168.
Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 28.

The Idaho-Alamo group comprises about twenty-six Crown-granted mineral claims and fractions and in 1927 was owned by Cunningham Mines, Limited. More recently the Idaho, Alamo, and Queen Bess mines have been amalgamated to form the property of a new company, Consolidated Queen Bess Mines, Limited, Alamo, B.C. The property includes Idaho and Alamo mines situated in adjoining basins at the head of Howson creek (*See* Figure 8). The workings lie between elevations of 5,450 and 6,700 feet above sea-level and are accessible by a well-graded road from Alamo up Howson creek for a distance of about 5 miles. An aerial tramway about 8,300 feet long leads from near this road at an elevation of 4,800 feet to the company's mill at Alamo, at an elevation of 2,450 feet. From the upper terminal a branch aerial tram connects with the portal of No. 6, the lowest Idaho tunnel. Other branches lead to the portals of Nos. 5 and 10 adits of the Queen Bess mine on the east side of Howson creek (Figure 8). Ore from Alamo mine is taken by road to the main tramway.

The Alamo and Idaho mines have not been actively worked for many years. Their principal period of production commenced shortly after discovery in the early nineties. Alamo mine was operated in its early years by Alamo Mining Company of Spokane. In 1894, a mill, the first in Slocan, was built on the site of the present mill at Alamo. This mill had a capacity of about 50 tons a day. Prior to 1904 an amalgamation was effected between Alamo and Idaho mines, and the combined group was acquired by Scottish Colonial Gold Fields, Limited. From 1908 to 1916 the property was worked under lease. The group was then taken over by Clarence Cunningham and subsequently incorporated with other properties of the present owners.

Records of production are not complete and have not been kept entirely separate for each mine. In 1892 development began on the Idaho lode and 15 tons of ore were mined. In the following year Alamo produced 20 tons of 60 per cent lead ore carrying 200 ounces in silver to the ton. In the same year Idaho shipped a like amount, for which no values are assigned. In 1894 Alamo is credited with 40 tons of ore of similar calibre to that produced in 1893. In the same year 275 tons from Idaho averaged 185 ounces in silver and 68 per cent lead. Idaho produced nothing in 1895, but Alamo is credited with 7,300 tons of 100-ounce ore. In 1906, 20 tons of 102 ounces silver and 53 per cent lead ore from Alamo (?) included 2,861 pounds of copper. In 1922, shipments totalling 642 tons averaged 45 ounces in silver, 16 per cent lead, and 28 per cent zinc. In 1926, lessees working on No. 2 level Alamo mine produced 64 tons of 37-ounce silver ore carrying 3 per cent lead and 20 per cent zinc. These shipments in 1922 and 1926 are the only ones containing appreciable zinc values. Altogether a total production of 25,789 tons (returns incomplete) is recorded from the two mines to the end of 1926. The total gross valuation of this ore was over $825,000. About $400,000 have been distributed in dividends.

The Idaho-Alamo group covers a large area and includes within its boundaries a variety of rock types both sedimentary and intrusive. The sediments are massive and banded quartzites and quartzitic argillites, black slates, and more calcareous strata of the Slocan series. These have a general anticlinal structure dipping both to the northeast and southwest at various angles. The structure is complicated by faulting and cross-folding with consequent great variations in attitude. Penetrating these sediments are porphyritic intrusives chiefly in the form of dykes, but, towards the northeast and northwest limits of the property, including at least three elliptical stocks of diorite or quartz diorite, the largest being over one-half mile in maximum diameter. These stocks lie beyond the principal workings of both Idaho and Alamo mines, but are probably connected at no great depth and have noticeably metamorphosed the sediments about Idaho mine.

At Idaho mine the workings develop three lodes known as the Idaho, Cumberland, and St. John, respectively (Figure 8). Of these the Idaho is most important. It has been explored by six main adits giving a vertical range of about 800 feet below the outcrop. These adits are numbered from No. 1 at elevation of 6,039 feet to No. 6 at 5,450 feet. Workings also include an old shaft between Nos. 2 and 3 adits and several intermediate levels, mostly short, but including one over 700 feet long between Nos. 5 and 6 adits. Levels Nos. 1 and 2 and Nos. 3 to 6 are connected by raises and stopes. The lode has a maximum explored length of over 2,500 feet. To the southwest, beyond Idaho ground, this lode passes into Silver Bell property and is thought to continue across the summit of the divide between Howson and Silverton creeks, and on the Silverton Creek slope lines up closely with the main branch of the Standard lode on the Tiger, Echo, and Alpha claims. On Idaho ground the lode cuts across rocks very similar to those encountered at Alamo mine on an average and fairly uniform strike of about north 45 degrees east. It dips southeast at about 55 degrees. The lode forms a strong shear or fracture zone varying in width from less than a foot to 25 feet. The principal tonnage was obtained in part from stopes between and above the upper two levels and in part from the surface about the portals of Nos. 1 and 2 adits. The deposit at the surface was worked by scooping up the surface soil which, for a depth of 3 feet or more, carried about 200 ounces silver per 15 tons of soil. This surface ore has been attributed to an accumulation of disintegrated vein matter from the Alamo vein outcropping in the high bluff above Idaho basin rather than to disintegration of the underlying Idaho vein. The main shoot on the Idaho lode was up to 10 feet thick and included 2 feet of clean galena on the hanging-wall side. Besides this clean ore a large tonnage of milling ore was mined. Operations on and below the third level have, on the whole, met with only inferior results, and this in spite of every evidence of a strong lode carrying, down to the lowest level, a heavy filling of calcite gangue. Some stoping has been done from the lower levels and traces of ore mineralization are yet to be seen. In 1913 two intermediate levels from a winze sunk from No. 5 level disclosed heavy calcite bands which when stoped yielded two bands of ore, each 6 inches wide, lying on either side of a 1-foot vein of calcite. The block of ground extending from here to No. 3 level has considerable prospective value.

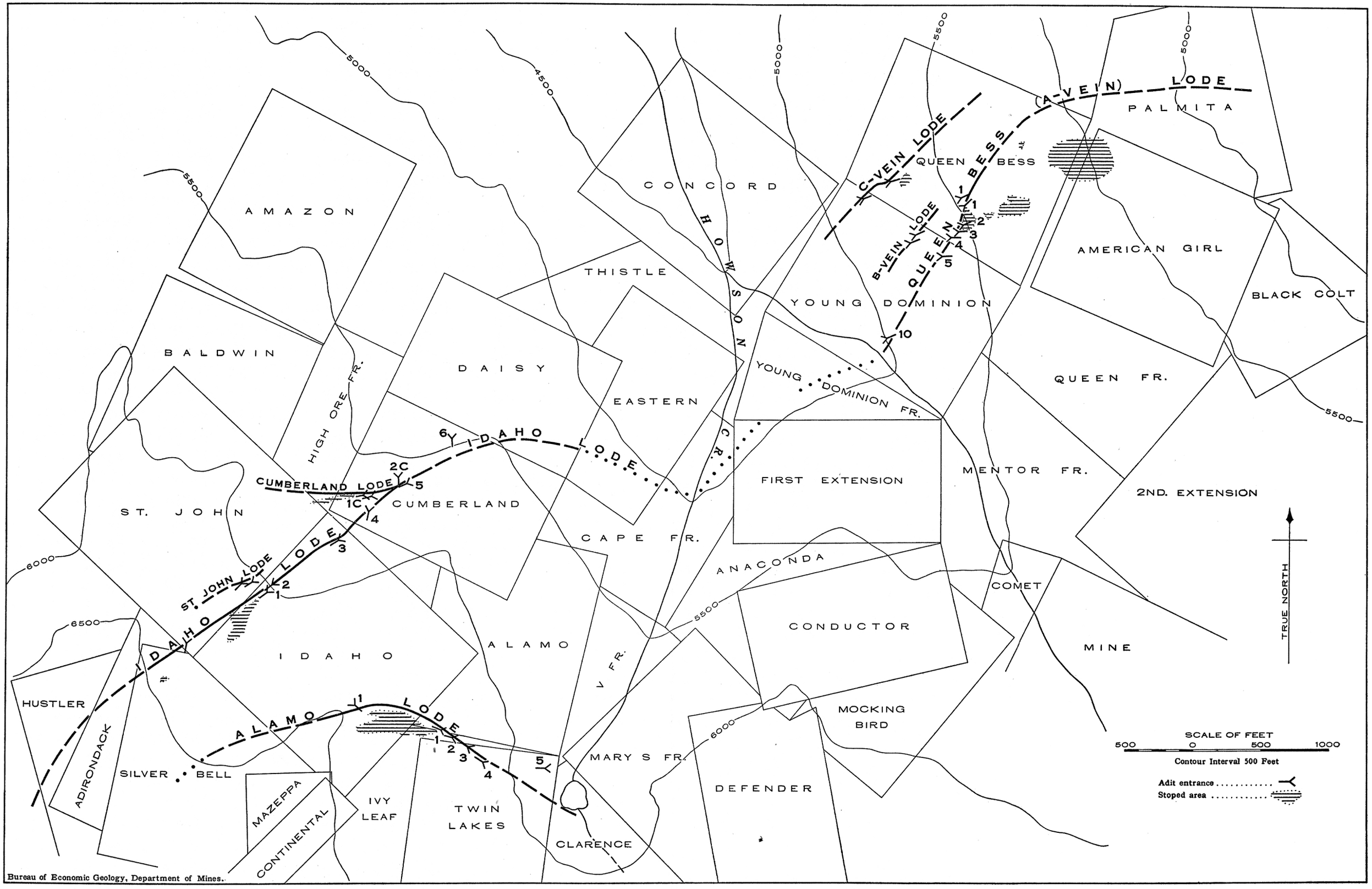

Figure 8. An area in the vicinity of the head of Howson creek showing claim boundaries and lode systems.

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The Cumberland lode lies nearly parallel to the Idaho lode on No. 6 and the east end of No. 5 (Idaho) levels. Farther west it swings more to the west and in this direction is developed by two adit levels above No. 5 Idaho (No. 2 Cumberland). The lode has been explored over a maximum length of about 1,450 feet. It holds much the same type of mineralization as the Idaho lode. From the uppermost Cumberland adit a narrow vein had been, in 1896, stoped for 350 feet and below the level a streak of galena 4 to 10 inches wide had been mined. A likely locality for future exploration is on No. 6 level a short distance east of the crosscut to the lode. Here, it is stated, ore carrying up to 6 or 8 inches of clean galena was exposed along the floor of the drift over a length of about 40 feet.

Ore minerals at Idaho mine include galena, zinc blende, grey copper, and ruby silver. The gangue is principally calcite, but quartz and some siderite are present and locally constitute the chief vein matter which, commonly, has a brecciated appearance with fragments of ore minerals and country rock comented by a gangue of calcite, siderite, or quartz. Clean galena ore from Idaho lode assayed 185 ounces silver to the ton and 60 per cent lead. Concentrates from Cumberland lode ore ran 65 ounces silver and 55 per cent lead. Idaho lode concentrates assayed 106 ounces silver to the ton and 55 per cent lead.

Little was learned concerning the third or St. John lode. It lies about parallel to and from 150 to 200 feet northwest of Idaho lode and is explored by two short adits north of the upper workings on Idaho lode. These workings are inaccessible. On the surface the lode is said to have contained a vein carrying galena, zinc blende, and ruby silver, with siderite, calcite, and quartz. An attempt was made to pick it up by a long crosscut from No. 3 level about 200 feet below the lowest or No. 2 St. John adit. No evidence of its existence at this depth was obtained although the crosscut appears to be well past the expected intersection.

The more recent work on Idaho mine has been largely the pushing forward, several hundred feet, of the lower levels to get under the ore shoot developed in the upper workings. Apparently these levels have some distance to go before reaching the objective.

At Alamo mine the Alamo lode has been developed by five adits over a vertical range of about 750 feet below the apex. A sixth adit was started in the bottom of the basin about 90 feet below No. 5, but is blocked. No. 1 is 240 feet below the outcrop. Nos. 1 to 4 are connected by raises and stopes. No. 5, 213 feet below No. 4, is a crosscut for 350 feet and a drift for the next 650 feet. Nos. 1 to 4 average about the same total length as No. 5 but drift on the lode from their portals in Alamo basin. The lode is developed below the point where it crosses a narrow, steep hogsback rising between two tributaries of Howson creek. Excellent natural conditions are thereby provided for tunnelling. No. 1 adit has two portals, one from Idaho basin reaching, by a crosscut 110 feet long, the lode about midway along the main drift from the other portal in Alamo basin.

The lode has a curving strike from north 70 degrees west to south 70 degrees west. The dip averages about 60 degrees south, but varies greatly and towards the east, in the vicinity of the portals, even reverses for a short distance and is steeply north. In the more easterly workings

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the dip is generally quite steep but towards the west it flattens locally, to as low as 30 or 35 degrees. The lode is a strong, mineralized fissure or fissured zone along the course of which the country rocks have been much crushed and brecciated. It varies in width from a few inches to over 9 feet and in its more productive parts had a filling composed in part of ore minerals, including at one point between 8 and 9 feet of solid galena, and in part of quartz, siderite, calcite, and crushed country rock. Most of the available ore has been worked out. The principal shoot extended from the surface to 50 feet or more below No. 4 level and had a maximum length, between Nos. 1 and 2 levels, of about 500 feet. The shoot pitched in general towards the east and the length decreased downward to less than 200 feet on No. 4 level. Much of the ore in this shoot was clean galena carrying a varying proportion of grey copper. The shoot also provided a considerable tonnage of mixed and concentrating ore. Below No. 4 level the vein matter pinches to a few inches. On No. 5 level the lode is well defined and contains much vein quartz, but has shown only traces or small lenses of lead and zinc minerals. One lens of such ore carrying zinc blende, galena, and pyrite is exposed in No. 5 level over a length of 25 feet and is up to 6 inches thick. A winze sunk for 30 feet on this showing has, it is stated, encountered ore carrying good values in zinc.

To the west of the main ore-body, towards the face of Nos. 1 and 2 drifts, these levels cut across much porphyry and follow a faulted zone in which little mineralization has been found. There is even some doubt as to whether this zone represents the main lode, although, on No. 1 level at least, much vein quartz was encountered in the drift.

The principal ore mineral in the main ore shoot was galena, both coarse cube and fine grained. This was mixed with a minor proportion of zinc blende which is the more abundant mineral in the lower workings. Grey copper was a conspicuous constituent of the higher grade ore and a small amount of ruby silver was associated with the galena throughout the mine. Pyrite and chalcopyrite were also present, the latter, locally, in amounts rather unusual for ores of this district. Quartz was the most abundant gangue mineral. It was associated with a small proportion of siderite and calcite.

If future work is undertaken it might well take the form of exploring the lode below No. 4 level and on No. 5 level in places lying along the downward projection of the main ore shoot. Investigations should also be made towards the faces of Nos. 1 and 2 levels to prove the position of the main lode in this section of the mine. The main ore-body lay east of the point where the lode swings from north 70 degrees west to south 70 degrees west to coincide more nearly with the bedding of country rocks and strike of the porphyry dykes. It is noticeable that the hanging-wall of the lode in the more productive section of the mine is commonly porphyry, whereas farther west the lode cuts across considerable porphyry. It might be well to keep this feature in mind in any exploration of the block of ground below No. 2 level, east of the turn in the lode, with the view to identifying the continuity of the particular porphyry dyke or dykes beneath which the ore, particularly in the upper levels, occurred. At present the possibilities of this mine appear to lie above rather than below the lower levels. Natural facilities for deeper tunnelling exist, should important discoveries be made in the vicinity of or above No. 5 level.

IVANHOE GROUP

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 29.
Ann. Repts., Minister of Mines, B.C., 1896, p. 56; 1904, p. 189.

This property, comprising Ivanhoe and Elgin Crown-granted claims, is owned by the Minnesota Silver Company, Limited, % W. S. Schulze, Virginia, Minn., and is situated in Ivanhoe basin at the head of the west fork of Sandon creek. It is accessible by road and trail from Sandon.

The property was located about 1893 and was worked fairly steadily up to 1905, after which year it lay idle until 1913 when operations were resumed and continued until 1921. Since this time little if any work has been done within the property limits. In 1900 a 100-ton mill was erected at Sandon on the site of the present Silversmith concentrator. It was connected to the mine workings by a Riblet aerial tramway 8,500 feet long with a drop of 2,300 feet. This mill was burned in July, 1915, and subsequently rebuilt by the Rosebery-Surprise Mining Company, who acquired an option on the Ivanhoe property in 1919. This option was allowed to expire in the following year and in 1921 Silversmith Mines, Limited, took over the Ivanhoe mill and remodelled it.

The first production recorded is in 1895 when shipments of 150 tons, carrying 100 ounces in silver to the ton and 60 per cent lead, were made. Shipments to January, 1900, amounted to 400 tons of similar ore. The year of heaviest production was 1904 when 12,900 tons of concentrating ore was extracted. This ore, as mined, ran about 9 ounces in silver to the ton and 6 per cent lead. Some zinc ore was included with the ore mined in 1919 and 1921, but records of zinc production are incomplete.

The mine is developed by eight levels over a vertical range of about 600 feet below the surface. Nos. 1, 2, 4, and 8 are crosscut adits driven from the northern slope of the divide. No. 8 adit reaches the Ivanhoe lode at 1,310 feet and No. 4 adit reaches it at about 500 feet. The upper workings are partly inaccessible. The longest levels are No. 4 and No. 8. The former extends 735 feet east and 2,560 feet west and southwest of the crosscut, including in the latter direction an extension of 1,100 feet into the adjoining property of the Canadian group. No. 8 level drifts about 500 feet west of the crosscut and 1,940 feet east and also passes into Canadian ground for 810 feet (in 1927). The other levels are comparatively short.

The underlying rocks are chiefly sediments of the Slocan series. These are intersected by narrow dykes, mostly of quartz and feldspar porphyry. The general structure of the sediments along the summit of the ridge in the vicinity of this property (*See* structure section IJ, Figure 3, of Memoir 173, in pocket) is, apparently, synclinal, the beds striking from north-northwest to northwest and dipping at moderate angles to the southwest and northeast. For several hundred feet below the summit the strata are of various types interbedded with one another and including limy, argillaceous, and quartzitic members. Below this zone lies a considerable thickness of more massive, grey, quartzitic argillites prominently exposed near the portal of No. 8 adit. The general structure is broken by numerous faults and shear zones, of which that traversed by the Ivanhoe lode is a prominent example.

The Ivanhoe lode is a strongly sheared and fissured zone 20 feet or more in width. The strike changes from a few degrees south of west within the productive section of the mine to more nearly southwest where it extends towards and into Canadian ground. The productive section extended for about equal distances on either side of No. 4 crosscut and on No. 4 level had a maximum length of about 750 feet. Much of the ore was won from above this level, though fair sized stopes extend to about 90 feet below within a stretch of 280 feet. The average dip from No. 1 to No. 8 level is 52 degrees to the south. Within the productive section, ore mineralization was followed for long distances on both hanging- and foot-wall sections of the lode and, judged from mine plans and cross-sections, has been mostly stoped out above No. 4 level. Stopes above No. 3 level are almost continuous over a length of 600 feet. Most of the ore was produced between Nos. 2 and 4 levels. The lode is filled in part with crushed and slickensided wall-rock and in part with vein matter, the latter including up to 5 feet of clean and concentrating ore. The walls of the lode are smooth and marked by heavy gouge so that substantial timbering was a necessity. The principal ore minerals are argentiferous galena and zinc blende. Within the productive area the gangue minerals, siderite and quartz, were present in minor amounts. Much of the ore produced was a concentrating ore requiring reduction from 6 or 7 to 1. The lead concentrates assayed 55 to 58 per cent lead and 85 to 90 ounces in silver to the ton, and the zinc concentrates averaged about 45 per cent zinc.

Much of the ground below No. 4 and most of it below No. 6 intermediate level yet remains to be explored. In view of the great width of the lode and the occurrence of vein matter carrying ore shoots in different sections, and particularly along foot- and hanging-walls, exploratory work necessitates much crosscutting in order that important mineralization may not be overlooked.

LEADSMITH (NOONDAY) GROUP

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1056; 1926, p. 250; and other years.

The Leadsmith property comprises Noonday, Bolander, Baby fraction, Fourth of July, and Grey Eagle Crown-granted claims, situated between the two forks of Cody creek, and is accessible by road from Sandon. It is owned and operated by Leadsmith Mines, Limited, Spokane, Wash.

The property, formerly known as the Noonday, was operated in 1893 by G. J. Atkins and Company and later by Noonday Mines, Limited. Production commenced about 1893, in which year it is recorded that 100 tons of clean ore lay on the dump and would run 115 ounces in silver a ton and 78 to 80 per cent lead. A shipment of 20 tons in 1894 yielded 75 ounces in silver to the ton and 70 per cent lead. Further shipments were made from 1906 to 1923. Total recorded production amounts to about 371 tons, averaging about 44 ounces in silver to the ton and 42 per cent lead. In one year a shipment of 15 tons also included 17 per cent zinc.

The underlying rocks are chiefly sediments of the Slocan series. These include banded, limy, tuffaceous, and cherty argillites, and some more slaty

beds. They are intruded by dykes and sills of quartz feldspar porphyry. The general trend of the sediments at the mine is north 25 degrees east and the dip is southeast at about 60 degrees.

The mine workings include four adits over a vertical range of between 500 and 600 feet below the outcrop. Production has been entirely from the upper three levels, and mostly from Nos. 2 and 3 adits. Recent work on No. 4 level, 300 feet below No. 3, has included a crosscut 736 feet long intersecting the Noonday lode at 685 feet from the portal, and at the time visited, September, 1927, some 1,200 feet of drifting southwest of the crosscut.

The Noonday lode as developed in these workings is a strongly sheared, mineralized zone conforming in part with the structure of the enclosing sedimentary rocks, but, in general, appearing to angle slightly across them on a northeasterly strike. In the upper levels the lode averages from 2 to 3 feet wide and on the lowest, or No. 4 level, though pinching in places to a few inches, probably averages 5 feet. It is largely filled with crushed wall-rock, but, in the productive parts, carried lens-like masses and wide ribs of gangue and ore minerals, the latter occurring in both disseminated and banded forms. The two walls of the lode are generally well defined but may dip at different angles, being influenced in this respect by the structure of the wall-rocks, and, as a result, the lode swells and pinches in a somewhat irregular fashion.

Most of the ore has been won from above No. 2 level, which includes about 800 feet of drifting and is now partly inaccessible. The main shoot on this level was 100 feet long and carried as much as 4 inches of clean galena and 3 feet of milling ore. The drift on No. 3 level is 700 feet long. Some stoping has been done above this level and at the northeast face a winze has been sunk on 2 feet of interbanded calcite and ore minerals. At the opposite face the lode splits around a wedge of porphyry. The walls of the lode on this level are well defined, the hanging-wall dipping 70 degrees and the foot-wall 45 degrees to the southeast.

Vein matter is largely of coarsely crystalline calcite associated in places, and particularly in the lower workings, with siderite. The ore minerals are principally argentiferous galena with which is associated a little zinc blende and a trace of pyrite. They occur as disseminated masses, streaks, veinlets, and bands in or alongside the gangue. The galena is partly sheared and steely, but also forms masses of fine or coarse cube. Gangue and associated ore minerals form bands or long lenses up to 3 feet thick, and are best developed in the upper levels. Drifting on No. 4 level has exposed some disseminated mineralization and pockets of fair looking ore, but no extensive bodies. The more recent work on No. 4 level has been of an exploratory nature and room exists between Nos. 3 and 4 levels for important mineral deposition.

The crosscuts on Nos. 3 and 4 levels have intersected a number of fissures in addition to the main lode. They vary up to a few inches in width and in some cases carry a little vein matter.

L. H. GROUP

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Hurst, M. E.: Geol. Surv., Canada, Ec. Geol. Ser. No. 4, pp. 75-76.
Keffer, F.: Private report.

The L. H. mine belongs to A. R. Fingland, Silverton, B.C., and the estate of Chas. Brand. It is at the head of Vevey (Fingland, or L. H.) creek between 2½ and 3 miles by wagon road south of the main Silverton-Slocan highway. The branch road leads off from this highway about 3 miles south of Silverton.

The property includes seven Crown-granted claims and fractions with an area of 323 acres and a millsite on Slocan lake at the mouth of Aylwin (Eightmile) creek. Most of the development work has been done towards the centre of the group on the L. H. and C. B. claims, between elevations of 5,200 and 5,600 feet.

This property was staked in the early nineties and developed by the present owners until 1911. It was then taken over on bond by the British Columbia Copper Company who, after continuing operations for two years, permitted their option to expire. No development work has been done since that time.

The workings are situated towards the centre of an irregular outcrop of highly metamorphosed rocks forming a large roof pendant in coarse-grained Nelson porphyritic granite. The metamorphosed rocks vary from types that clearly are altered argillaceous and quartzitic sediments to others that seem to be igneous and are believed to be sedimentary, possibly tuffaceous. The sediments are dominantly massive, siliceous, bedded rocks of sugary texture and commonly purplish cast. Under the microscope some specimens were seen to be composed almost entirely of granular quartz, whereas others carried abundant reddish brown biotite, in small flakes, and a little secondary feldspar. The rocks of igneous appearance vary from massive crystalline rocks to others that are distinctly banded, and being intimately associated with undoubted sediments are possibly of like origin. The more abundant representatives of the massive type in the mine workings have the composition of quartz diorite and under the microscope are seen to be somewhat granular and to consist of unaltered minerals, the whole appearance suggesting recrystallization. Small dark green crystals of amphibole (probably hornblende) are scattered through the rock which otherwise is composed chiefly of clear feldspar and quartz with occasional more cloudy and rather conspicuous crystals of feldspar having about the composition of albite or albite-oligoclase.

The above formations are intersected, in the mine workings, by small dykes of two readily distinguishable types. One type includes fine-grained, holocrystalline, acid rocks composed of quartz, orthoclase, and albite-oligoclase, and varies from granite to micropegmatite in texture. The other, referred to at the mine as "aplite," is soft, highly altered, light grey, and its original constituents, except for scattered grains of quartz, are unknown. Wisps of sericite, much cloudy, probably kaolinitic, products, and calcite form the bulk of the rock.

The rocks at the L.H. mine have been fractured and mineralizing solutions have noticeably silicified the rocks in the vicinity of the fractures. The lines of fracturing correspond in part with a well-defined jointing striking about north 75 to 80 degrees east and dipping southeast at angles varying from 50 degrees to vertical. Along some of the fractures subsequent movement has been pronounced and narrow dykes located along or near such fractures have been involved in the deformative movements. Other lines of fracture and movement strike more nearly north 25 degrees east to northeast and mostly dip about 65 degrees southeast, though a few incline in the opposite direction.

The mineralization encountered in the mine is peculiar. The values are essentially in gold which occurs either free or combined with sulphides including abundant pyrrhotite, arsenopyrite, and pyrite and lesser amounts of chalcopyrite. Arsenopyrite is generally supposed to carry the best values. Quartz is almost the only gangue mineral. Small stringers of native arsenic and calcite have been found in an ore-body near the portal of No. 1 adit and nodules of the arsenic are reported to carry as much as 1,000 ounces of silver to the ton.

Mineralization of the sort indicated above follows a zone of fracturing and faulting. The zone varies from 20 to 45 feet in width, strikes nearly east, and dips north at about 55 degrees. Within it the rocks have been silicified and otherwise altered, and have been impregnated with ore minerals. These processes are irregularly developed and the limits of the ore-bodies are rarely defined by well-marked walls. In places the ore is in the form of quartz lenses filling fractures 1 to 2 feet wide and carrying disseminated ore minerals. Quartz also forms many small stringers in the ore and furnishes some guidance to exploration. More commonly, however, vein quartz is not conspicuous, but occurs impregnating the wall-rocks and is associated with varying proportions of ore minerals. In general the more silicified rocks carry the higher values, but either quartz or ore minerals may be present almost to the exclusion of the other. Vein quartz without visible ore minerals is mostly low in gold, and neither does clean arsenopyrite carry the highest values. The better ore consists of highly silicified wall-rock impregnated with a generous proportion of sulphides, preferably arsenopyrite, which may occur either massive or in disseminated grains. Values are quite variable and range from a few cents to over $100 to the ton.

The mine workings include three adits and comprise 1,700 feet of development work. The lowest or No. 3 adit, 170 feet long and 250 feet below No. 2 level, has not reached the mineralized zone. Most of the work has been done on Nos. 1 and 2, which are 90 feet apart vertically and are connected by a raise. A raise also extends for 40 feet above No. 1 level.

No. 2 adit, from a point a short distance in, is continued as a drift running easterly along a well-defined fissure in the foot-wall of the ore-bearing zone. This fissure for most of the length of the drift is occupied by a narrow, altered dyke dipping steeply south. Crosscuts to the north have picked up the main mineralized zone which has been proved to have a maximum width on this level of at least 45 feet. The better values were found towards the centre and western half of the 300-foot drift.

No. 1 adit parallels the hanging-wall of the ore zone and is about 300 feet long. From this drift four crosscuts have been run towards the foot-wall and one, at the face, into the hanging-wall of the zone.

The ore-bodies as a whole are low grade and ill defined so that estimates of tonnage are difficult to make. A program of careful and systematic sampling carried out by F. Keffer, in charge of operations for the B.C. Copper Company, led him to conclude that developments indicated over 33,000 tons of ore of an average value of $5.25 a ton in gold. If an extension of No. 3 adit should locate ore at this depth, 250 feet below No. 2 adit, the tonnage of possible ore would, of course, be greatly increased.

LONDON HILL GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 66.

The London Hill group consists of four (?) Crown-granted claims and lies near the summit of London ridge northwest of Bear lake. It is accessible by a trail, 3 miles long, from Giegerich station. The property is owned by H. Giegerich of Kaslo.

Production commenced in 1893 when 3 tons of ore yielded 585 ounces of silver. Up to the end of 1912, shipments of 66 tons of "dry" ore are recorded. This ore averaged 161 ounces in silver to the ton, ranging from 45 to 267 ounces.

The mine workings, including three adits, explore a lode on either side of the summit to a depth of 254 feet. The lode contains irregular lenses of quartz up to 4 feet thick and comprises a zone of fissuring in slaty and thinly bedded sediments of the Slocan series intersected by quartz porphyry dykes. The quartz is mineralized with grey copper and other rich silver-bearing minerals. At the summit of the ridge, vein quartz outcrops in a porphyry dyke, is stained with copper carbonates, and carries grey copper and pyrite.

LONE BACHELOR CLAIM

The Lone Bachelor Crown-granted claim is part of the Victor group belonging to Dacy Petty, Sandon, B.C. It is on the southwestern slope of Carpenter creek between Three Forks and Sandon and is accessible by trail from either of these towns.

An initial recorded production of 267 tons was made in 1905 and ran 114 ounces in silver to the ton and 55 per cent lead. Total production to the end of 1923 included 1,068 tons which carried, on the average, 110 ounces in silver to the ton and 48 per cent lead. Some of this ore also carried appreciable gold. Shipments of 35 tons of zinc ore made in 1923 assayed 46 ounces in silver, 6·6 per cent lead, and 31 per cent zinc.

The workings comprise four adits ranging from 4,100 to 4,350 feet above sea-level and situated about 1,000 feet above the railway along Carpenter Creek valley. The adits represent over 3,000 feet of lineal work. Except for the uppermost level they are mostly inaccessible. They have explored a lode striking north 35 to 65 degrees east and dipping steeply southeast. It intersects massive and slaty, argillaceous, quartzitic, and limy sediments of the Slocan series and quartz porphyry dykes. The

sediments strike northwesterly and dip at low and moderate angles both to the northeast and southwest. The lode is a fissured zone as much as 5 or 6 feet wide composed of crushed fragments of wall-rock, gouge, and, more locally, vein matter. The vein matter included paystreaks that varied from an inch or less to 1 foot in width and followed the hanging-wall of the lode. The ore was composed chiefly of galena, but, particularly in the lower levels, was associated with varying amounts of zinc blende. The gangue was chiefly calcite.

LOU DILLON

The Lou Dillon property is situated towards the head of Silverton creek on the lower, east side of the valley. It is accessible by road up Silverton creek for about 8 miles to the Fisher Maiden mine, from where a trail leads for 2 more miles up the valley to the Lou Dillon workings.

The property is underlain by coarse-grained, porphyritic hornblende granite of the Nelson batholith, intersected by occasional dykes of finer grained biotite granite.

The mine workings include a drift adit and one or two crosscut adits and explore a mineralized fault-fissure lode striking northeast and dipping southeast at from 65 degrees to vertical. The lower adit is at an elevation of about 5,200 feet. It is a crosscut for 275 feet, at which point the lode was encountered and was drifted on for 18 feet northeast and 72 feet southwest. In these drifts the lode is composed of crushed wall-rock and gouge but carries streaks up to 4 inches wide of quartz, siderite, and a little calcite cementing the brecciated rock fragments. About 30 feet above, a drift adit, 156 feet long, follows the lode which at the face is 3 feet wide. At this level the lode contains as much as 2½ feet of ribbon quartz carrying galena, zinc blende, pyrite, and an unidentified silver-bearing mineral. The quartz also forms lenses a few feet long and up to 6 inches thick along the hanging-wall of the lode. A little stoping has been done on these. In one small stope a 2- to 4-inch band of pyrite and quartz assayed 25 ounces in silver and 60 cents in gold to the ton.

LUCKY JIM GROUP

References: Rept. of Zinc Commission, 1906, pp. 200-206.
Ann. Repts., Minister of Mines, B.C., 1927, p. 272; 1928, pp. 283-84; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 195-196.

This property is owned and operated by the Lucky Jim Lead-Zinc Company, Limited, with head office in the Yorkshire Building, Vancouver, B.C. A large interest in the property was acquired in 1927 by the Victoria Syndicate and subsequently this company has been actively engaged in construction, development, and exploratory work. The property originally comprised twelve Crown-granted claims and fractions aggregating about 350 acres. In 1926 five more claims were added to the group on the southeast side. The entire group extends southeasterly up the slope from the railway at Zincton where the mine buildings and concentrator are situated and where a short spur line leads to the bunkers at the foot of the tramway to the upper mine workings.

The Lucky Jim mine has had a checkered history. Periods of depression and financial difficulties have succeeded others of active production and comparative prosperity. The original discovery was made in 1892 and for several years thereafter the property was worked irregularly, chiefly for silver-lead ore. In 1903 it was taken over by G. W. Hughes and developed into the most important producer of zinc ore in the district, and was notable for the quantities of easily sorted high-grade zinc ore that were mined. The disastrous fire of 1910 destroyed most of the surface equipment, including a new tram line. Financial difficulties of this period were followed by a number of years litigation and the accumulation of a considerable debt. In 1927 a concentrator with a rated capacity of 200 tons a day was erected at Zincton, where also the mine camp has been completely reconstructed and an efficient power plant installed. Mining and milling costs were reduced and are said to have been about the lowest yet attained in the district.

Records of production in the early years are incomplete. In 1893 and 1895 an aggregate tonnage of 110 tons carried an average of 67 ounces in silver to the ton and 60 per cent lead. The Zinc Commission reports that during the years 1896-1899, 5,641 tons of concentrating ore were produced from which 1,600 tons of zinc blende averaging 50 per cent zinc was sorted out. The remainder, a zinc-lead product, was sold to the Pilot Bay concentrating and smelting works. The 1,600 tons of zinc ore assayed about 6 ounces of silver a ton, 3 per cent lead, and 50 per cent zinc. In 1907 and 1909 a production of 5,830 tons of zinc ore is credited with an average content of 49 per cent zinc. Recorded production to the end of 1926 reached over 46,000 tons and included altogether nearly 122,000 ounces silver, nearly 2,000,000 pounds of lead, and over 22,000,000 pounds of zinc. In 1927, 9,727 tons, and in 1928, 44,378 tons, of concentrating ore were produced, the mill-feed in 1923 being reported to have averaged about 10 per cent zinc, 1½ per cent lead, and 1½ ounces in silver to the ton.

There are four main adits (Nos. 3, 4, 5, 6) and several shorter adits and other workings, giving altogether a vertical development of about 1,200 feet between the collar of the shaft on the outcrop of the uppermost or "Big" fracture and the portal of the lowest or No. 6 adit. Until recently No. 5 adit, 450 feet above No. 6, has been the main working level and ore from the mine was dropped by aerial tram from near the portal of this level to the bunkers on the railway spur a few feet below the portal of No. 6 tunnel. It is understood, however, that this arrangement has been somewhat modified to avoid the dangers of snowslides in the winter, the ore now being fed from the tramway to the top of a 90-foot raise from a short adit at the railway grade. Most of the development work has been, and most of the production has come from, above No. 5 level. Recent explorations farther into the hill along and above No. 4 level established important ore reserves.

The rocks are chiefly Slocan sediments and comprise a belt of limestone and calcareous sediments lying between thinly banded quartzitic and argillaceous rocks, the latter including carbonaceous, slaty, and more compact beds that on either side of the limestone belt are commonly heavily impregnated with pyrite. The sediments strike north 40 degrees west and dip southwest at angles varying from 40 to 80 degrees. They

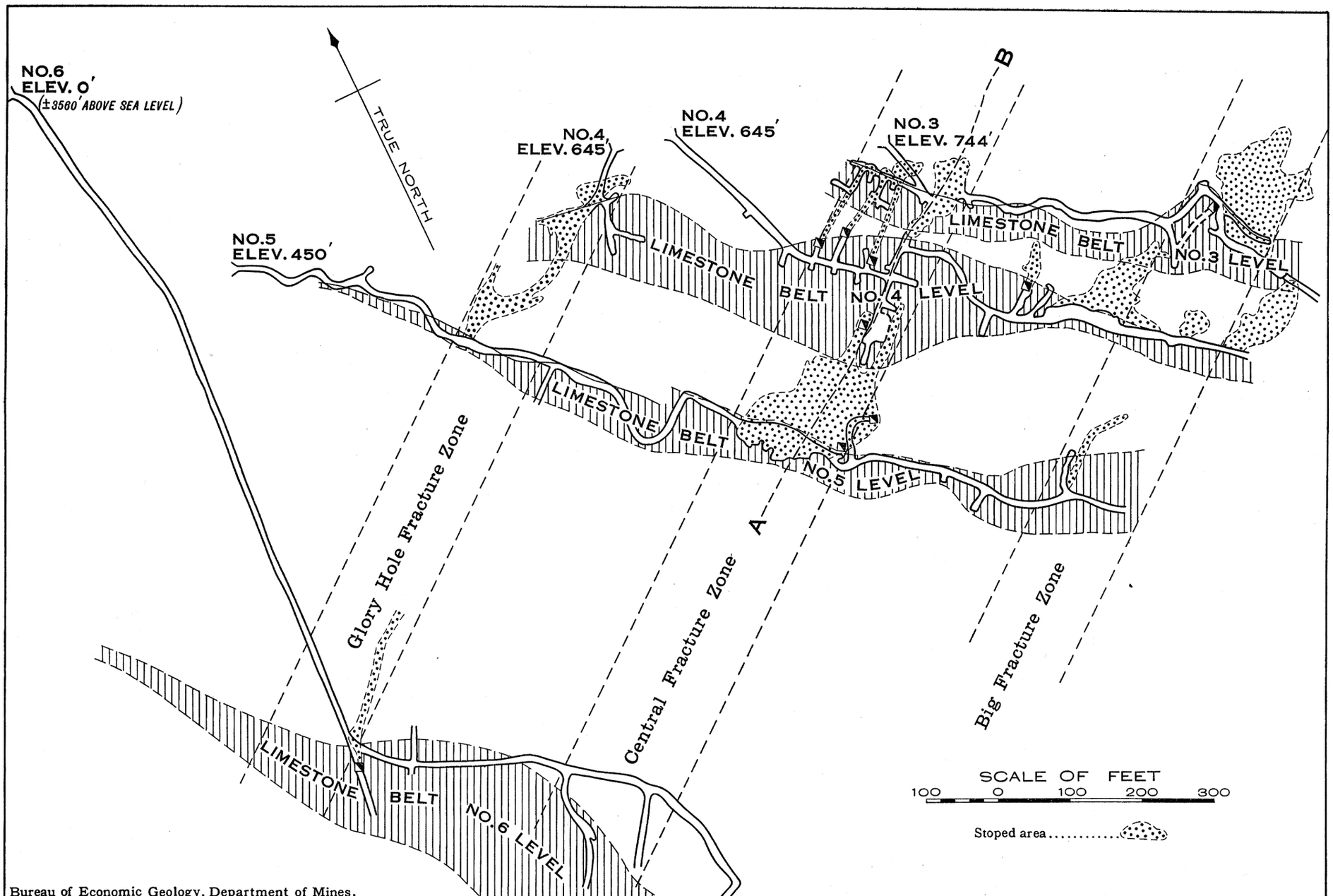

Figure 9. Plan, in part, of Nos. 3, 4, 5, and 6 levels, Lucky Jim mine, showing positions of principal ore shoots. They are either tabular or chimney-like bodies almost entirely confined to the limestone belt and dip with it southwest at high angles. (*See* vertical section along line AB, Figure 10).

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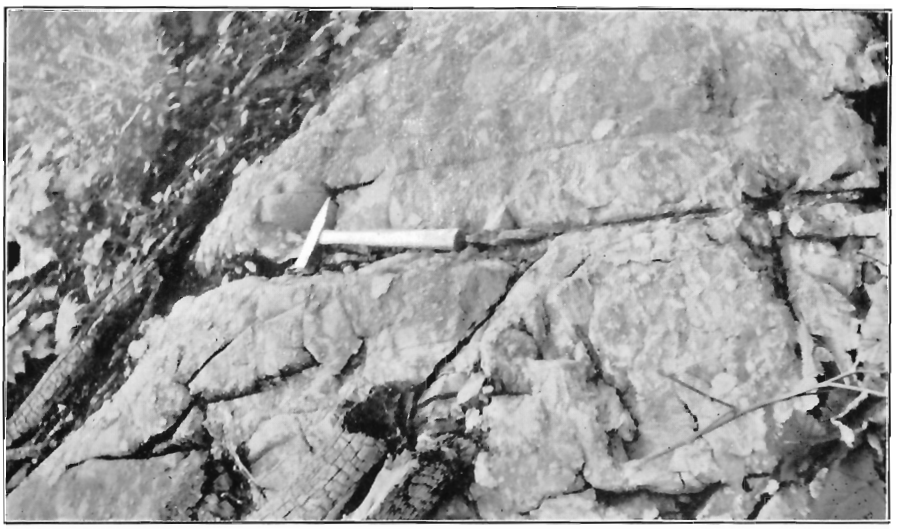
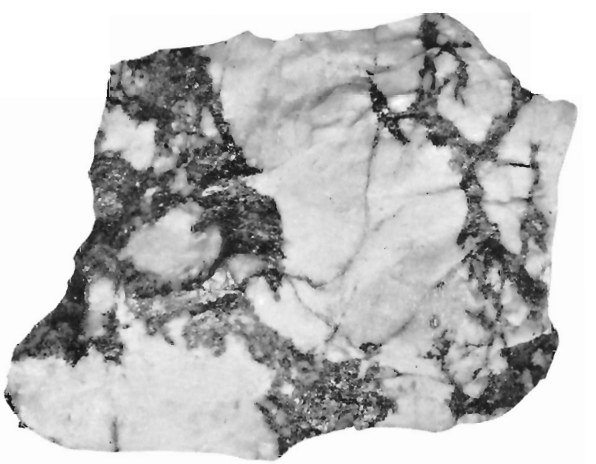


A. Outcrop of limestone "conglomerate" at Lucky Jim mine.



B. A specimen of typical "dry ore" from McAllister mine: quartz (light) and grey copper (dark). Natural size.

are cut by a large number of acid porphyry intrusives, chiefly in the form of sills. In a distance of 600 feet along the railway spur to the east of the ore bunkers, eighteen such sills are exposed. They range up to 15 feet thick, but average less than 5 feet. A few small dykes of more basic composition are also present and have been encountered in developments underground. One such dyke or sill, a few inches thick, runs about midway along the limestone-bearing belt. This belt is composed chiefly of light to dark grey, massive limestone. It varies from a few feet to over 100 feet in thickness and pinches and swells in an irregular manner. On either side the limestone grades into less calcareous argillaceous rocks or is sharply defined against pyritiferous and carbonaceous slaty beds in which very little carbonate is present. The irregular shape of the limestone band and the variation in the characters of the adjoining strata are attributed to movements of the strata, movements to which the limestone has accommodated itself largely by flowage between layers of more resistant material. The foot-wall part of the limestone belt exhibits flowage to a marked degree, with the result that thin interbands of quartzitic, argillaceous, or less calcareous materials and small porphyritic intrusives have been broken and incorporated in the more plastic limestone mass so as to give the whole a decidedly conglomeratic appearance (*See* Plate I A).

The ore-bodies at Lucky Jim mine are the result chiefly of replacement of limestone and occur where access for the mineralizing solutions effecting the replacement has been provided by remarkably straight, persistent, and nearly parallel fractures and fissures that cross the limestone belt with a strike of north 50 to 55 degrees east and a steep dip to the southeast. The individual fractures and fissures vary in width from mere cracks along which little or no mineralization is evident to a foot or more. Along the wider fractures subsequent mineralization and replacement of the wall-rock has obscured the original dimensions. These fractures and fissures correspond to a well-defined system of jointing, present in both the limestone and adjoining rocks. Along the more prominent fissures some movement has occurred and is indicated by offsets in the limestone contacts and by grooves along the walls. The grooves run at varying but generally low angles to the southwest. The less prominent fractures are innumerable but have proved economically important only within certain zones in which groups of major fractures or fissures have developed. Three such important zones of fractures are recognized and within them occur the important ore-bodies. These zones, in order from northwest to southeast, are the Glory Hole fracture zone, the Central or Main fracture zone, and the Big or New fracture zone (*See* Figure 9). The zones are 125 to 175 feet wide and are 275 to 300 feet apart. Early operations were mostly confined to the Glory Hole and Central fracture zones, but production from 1926 on has been from work in the vicinity of the Big fracture zone. Production of the earlier period came chiefly from irregular, somewhat chimney-shaped ore shoots (*See* Figures 9 and 10) in limestone on either side of a particular fissure or within narrow zones of closely spaced fractures or fissures. More recent production has come from replacement bodies developed along the strike of the limestone body, as on and above No. 4 level in the vicinity of the Big fracture zone.

The ore extracted from the Glory Hole fracture zone extended from the surface above the portal of No. 4 adit to No. 5 level, and was chiefly clean zinc blende of which a large tonnage was readily sorted out. At the surface the outcrops of the ore-body were partly oxidized and formed a conspicuous surface feature.

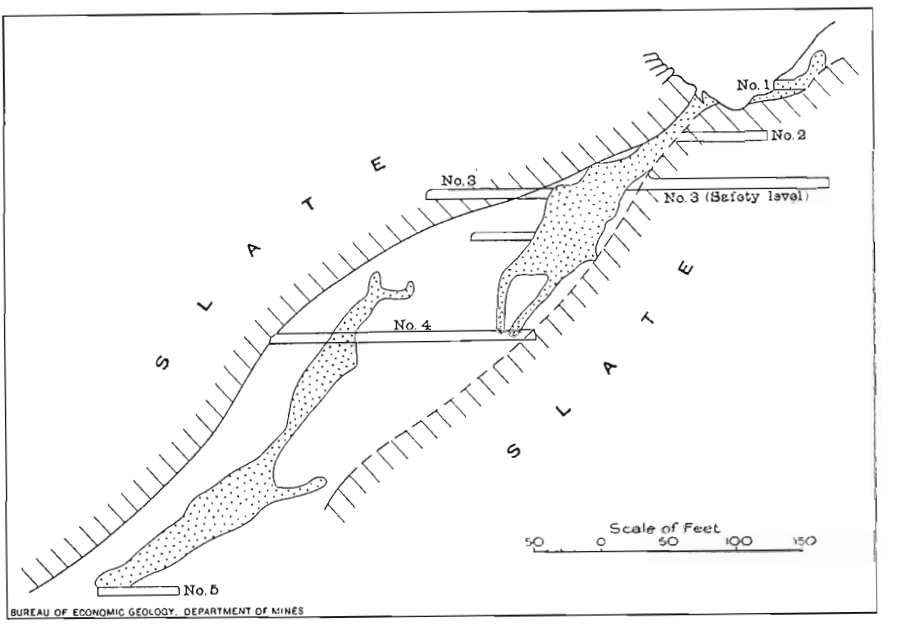


Figure 10. Vertical section, in part diagrammatic, Lucky Jim mine, showing two of the principal ore shoots (represented by pattern of dots) and boundaries of the limestone belt (indicated by pattern of sloped ruling).

The Main or Central fracture zone is about 150 feet wide, within which distance it includes four important fissures. Above No. 4 level four distinct ore-bodies corresponding in position to these fissures have been mined out. These ore-bodies were irregular in outline and somewhat chimney-shaped. They varied up to about 50 feet in diameter, being limited in their breadth by the width of the limestone belt and in their length by the distance to which replacement processes were effective outward from the walls of the fissures. The main fissures persist to and below No. 5 level, in the vicinity of which replacement has been more extensive, spreading from fissure to fissure and thereby developing an almost continuous ore shoot occupying nearly the entire width of the fissured zone (Figure 9).

The Big fissure zone was first picked up in small operations at the surface where several short adits and a shaft discovered such encouraging evidence of important fracturing and mineralization that No. 4 adit, 430 feet below, was extended to get under these showings. This work resulted in opening up the largest mineralized zone in the mine. In what is known as the Larson stope, extending for 200 feet above No. 3 level, the ore maintained an average width of 10 feet over a length of 150 feet. In this stope

considerable high-grade lead ore was encountered, though at depth, as in the vicinity of No. 4 level, the percentage of galena materially diminished. On the lower level mineralization was continuous over a length of 320 feet and an average width of 8 feet. The replacement of the limestone over this distance was facilitated in part by the means of access for the mineralizing solutions provided by the Big fracture and by a great number of closely spaced minor fractures on either side, and in part by the occurrence along the hanging-wall of a narrow but extremely persistent sill of feldspar porphyry which apparently formed an efficient dam to the rising metalliferous solutions. A similar or the same sill occurs along the hanging-wall of the Larson stope and has also been noted above the large ore-bodies in the main fracture zone in the vicinity of and above No. 5 level. The Big fracture zone persists to No. 5 level where it has been recently (1927) intersected and some mineralization encountered.

The ore shipped in the early years from Lucky Jim mine was largely clean zinc blende. Subsequent operations included the production of large quantities of concentrating ore in which zinc blende was the most important constituent, though associated with an appreciable proportion of galena and more or less pyrite. Silver is associated with the galena in about the proportion of 1 ounce silver a ton to the per cent lead. Pyrite becomes more abundant in the lower levels where it is intimately associated with the zinc blende. In the upper levels it was locally abundant, but tended to occur more or less separately from the zinc ore. Lead values have increased as development work has advanced up the hill. Other minerals include pyrrhotite and, locally, a very little arsenopyrite.

The replacement of the limestone by the sphalerite has in places provided small nests of galena and zinc blende in which the latter forms beautiful clusters of crystals.

The principal gangue mineral, calcite, occurs in limited amount. In places the ore is cut by veinlets of this mineral. A little quartz is also present and is particularly noticeable in the more recent upper workings within the Big fracture zone.

Since 1927, when the mine was last visited by the writer, much development work has been done and is referred to in some detail in the B.C. Minister of Mines report for 1929, pages 301-303. Work of particular interest has included an active campaign of long-hole drilling amounting in the aggregate, for 1929, to 5,644 feet. This work, according to Mr. Richmond, proved to be decidedly worth while in that it not only eliminated a large amount of what would otherwise have been dead work but assisted greatly in developing a reserve estimated, at the end of January, 1930, to amount to from 150,000 to 200,000 tons of ore containing approximately 15 per cent zinc with very low values in lead and silver.

LUCKY THOUGHT GROUP

References: Ann. Repts., Minister of Mines, B.C., 1911, p. 134; and other years. Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 196-197.

The Lucky Thought group, comprising about eight surveyed claims and fractions, is the property of the Consolidated Mining and Smelting Company. It is on the lower southern slope of Silverton Creek valley about 4 miles by road from Silverton.

The property was located in December, 1910. It was subsequently operated under bond to, and later acquired by, the present owners who about 1923 leased to M. S. Davys of Kaslo. In that year a two-bucket aerial tram line, consisting of a single span 1,140 feet long, was installed between the portal of No. 4 adit (fifth level) and the Hewitt mill where a large part of the ore was concentrated before shipment to Trail. When visited in 1925 the property was being operated under sublease.

Production commenced in 1914 and in that and the following four years amounted to 1,744 tons carrying an average of 38 ounces in silver to the ton and 11 per cent lead. The initial shipments in 1914, of 36 tons of high-grade silver-lead ore, assayed 119 ounces in silver and 46 per cent lead. In 1924 and 1925 nearly 6,400 tons were mined, of which about one-third, produced in 1924, carried chiefly silver and lead, whereas the 1925 product yielded over twice as much zinc as lead and averaged 6 ounces in silver to the ton. Between April, 1924, and July, 1925, lessees shipped some twelve cars of zinc and four cars of lead concentrates, the former averaging about 7 per cent lead, 39 per cent zinc, and 39 ounces silver, and the latter 48 per cent lead, 11 per cent zinc, and 75 ounces silver.

The property is explored by four adits over a vertical range on the vein lode of about 500 feet. Prior to October, 1916, all stoping was done between Nos. 2 and 3 adits. Since that time No. 4 adit, 250 feet below No. 3, has been driven and an intermediate level established 130 feet above. Most of the ore shoot has been stoped out above this intermediate level.

The workings develop a strongly sheared, mineralized zone cutting blocky argillaceous sediments of the Slocan series on a strike of north 65 degrees east and a northwest dip of about 60 degrees. The hanging-wall is well defined and mostly marked by a thick gouge. The lode has been drifted on for a maximum length, on No. 3 level, of 1,000 feet. The productive length on this level is about 250 feet and represents a maximum for these workings. Within this length vein matter containing bodies of clean and concentrating ore occurred across a width of from one to several feet. Sphalerite, galena, and grey copper are the important ore minerals. The blende is generally most abundant; the grey copper is erratic in distribution and mostly associated with the lead ore. Some very rich pockets of galena carrying grey copper have been discovered.

MADISON GROUP

This group, comprising Argenta, Madison, Marden fraction, and Great Eastern Crown-granted claims, is on the northern side of Carpenter Creek valley between Sandon and Cody and is accessible from Sandon by a trail of 1½ miles. The property is owned by Slocan Sovereign Mines, Limited, % Jas. W. Duncan, 22 St. John Street, Montreal.

Nothing has been done on this property for a great many years. The only recorded production, amounting to 20 tons, was made in 1898. Three tons are also reported to have been shipped to Trail in 1911.

The old workings develop two lodes known as the "Argenta" and "Madison," respectively. These are parallel, about 400 feet apart, and strike north 35 degrees east. Each is opened up by three adits. The north-westerly or Argenta lode carried dry ore.

MAJESTIC AND UNEXPECTED CLAIMS

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 85; 1904, p. 202.

The Majestic and Unexpected Crown-granted claims are on the northeastern side of Carpenter Creek valley, about 2 miles directly north of Sandon. They are accessible from Sandon by the Payne wagon road and a trail. The claims are owned by Eleanor Bourne, Revelstoke, and Chas. French, Prince Rupert, B.C.

The property has been worked at intervals since 1904, the heaviest production being in the years 1904 to 1907, inclusive, in which period 220 tons of silver-lead ore were mined. The total recorded output amounts to 241 tons, carrying an average content of 60 ounces in silver to the ton and 67 per cent lead.

The rocks are Slocan sediments represented by massive to more or less platy, grey argillites striking north 65 degrees west and dipping 35 degrees northeast.

The principal workings include four adits of about equal length and aggregating over 1,000 feet of tunnelling. These adits range from 5,500 to 5,700 feet above sea-level. They explore a fault-fissure lode striking north 55 to 75 degrees east and dipping southeast at an average angle of 50 degrees. The upper three levels are connected by raises and stopes. The lode varied from a few inches to several feet in width and carried an important ore shoot which extended from No. 3 to No. 1 levels. The ore shoot maintained a fairly constant length of about 60 feet and raked to the southwest. It has been picked up in a raise above No. 4 level. Much of this ore-body has been stoped out. It carried an abundance of both coarse cube and gneissic galena but very little zinc blende.

A parallel lode outcrops about 150 yards northwest of, and 50 feet below, the portal of No. 3 adit. At this outcrop the lode strikes north 75 degrees east, dips 62 degrees southeast, and includes from 6 to 8 inches of oxidized ledge matter carrying a little sulphide mineralization.

The massive wall-rocks, the size of the main lode, and the character of the mineralization on this property encourage further exploration.

MAMMOTH GROUP

References: Ann. Repts., Minister of Mines, B.C., 1922, p. 202; 1923, p. 227; 1926, p. 256; 1928, pp. 291-92.

The Mammoth group, comprising about eleven claims held by location, is on the northern side of Silverton Creek valley in the upper basin of Arison (Buffalo) creek. It lies east of the Standard group and is accessible by a newly constructed road from the Standard mine. The group is owned by Western Exploration Company, Limited, Silverton, B.C.

The property is one of the more recent discoveries and has been developed so successfully as to encourage exploratory work in the district. The original discovery was made in May, 1921, and was worked for a short time under option by the Standard Silver Lead Mining Company. The discovery, made on the western of two ridges lying between small, steep gulches tributary to Arison creek, was a well-defined lode, dipping at a low angle to the south. Developments here discovered some good

ore, but not in attractive quantity, and the option was allowed to expire. Subsequently, the lode was sluiced off farther to the east on a nearly parallel ridge and mineralization of more substantial character was revealed. The property was optioned to Porcupine Goldfields Development and Finance Company, under whose direction mining and development continued until early in 1927. A small tonnage of silver-lead-zinc ore was produced. On the relinquishment of this option the property was acquired by the present organization and extensive plans were made to place the property on a more permanent producing basis.

The group is underlain by sediments of the Slocan series intruded by dykes and sills of quartz and feldspar porphyry and by tongues of hornblende diorite and quartz diorite from the Nelson granite. The sediments comprise a variety of argillaceous, quartzitic, and calcareous types which are mostly massive but are associated with some more slaty beds. These sediments vary greatly in both strike and dip (*See* structure section GH, Figure 3, of Memoir 173, in pocket) and are locally brecciated, sheared, and disrupted by faults.

Production commenced in 1926 when operations yielded 42 tons of silver-lead-zinc ore. In 1927, 340 tons and in 1928, 286 tons were extracted. One car of lump lead ore, in 1927, carried 203·9 ounces in silver to the ton, 6·7 per cent zinc, and 57·5 per cent lead. Zinc concentrates of that year carried 57·5 ounces in silver, 52·9 per cent zinc, and 5 per cent lead, whereas lead concentrates averaged 400·9 ounces in silver, 13·7 per cent zinc, and 56·9 per cent lead. Milling ore was reported to carry 72·7 ounces in silver to the ton, 20·9 per cent zinc, and 8·8 per cent lead.

The principal workings are on the more easterly of the two ridges mentioned above and include five adits ranging from 4,900 to 5,800 feet above sea-level. These workings develop, principally, a lode known as the "Mammoth" which has apparently persisted over this vertical range. This lode is a mineralized shear zone averaging from 30 to 40 feet wide and has been traced by surface and underground workings over a length of about three-quarters of a mile on this property. It strikes north 75 degrees east and in the above workings dips southeast at angles varying from 40 to 65 degrees. It is intersected in the uppermost or No. 1 adit by another lode which is thought to be the northeasterly extension of the Buffalo lode from the adjoining Buffalo group (*See* description of this group). The principal production to 1928 has come from workings on No. 2 level.

No. 1 adit, 170 feet long, was driven northeasterly along the so-called Buffalo lode, and encountered the Mammoth lode 145 feet from the portal. At the intersection a pocket of milling ore about 7 feet thick was encountered. The Mammoth lode is offset slightly at this intersection.

No. 2 adit, 165 feet below No. 1, opens out on the east side of the ridge near the bottom of the gulch and drifts westerly along the lode for about 600 feet. The lode on this level has been investigated by several crosscuts towards foot- and hanging-walls. Mineralization proved fairly continuous over a length of 400 feet and consisted of streaks, bands, lenses, and disseminations of ore and gangue minerals associated with an abundant filling of crushed and broken wall-rocks. One shoot about 150 feet long and 4 feet wide carried good concentrating ore and included a

paystreak of galena varying up to 1½ feet in thickness. The chief gangue mineral is quartz. Much of the available ore has been stoped from above this level. The adit is provided with a safety crosscut to the lode on this level.

No. 3 adit is 134 feet below No. 2 and opens on the west slope of the ridge about 1,000 feet from No. 2 portal. This adit is a drift running easterly along the lode for 250 feet (October, 1928), towards the face of which considerable stoping had been done and as much as 1 foot of nearly clean galena encountered. The level, however, is not far enough in to get under the ore-body developed in and above No. 2 level.

No. 4 adit was started at a point 52 feet below No. 3 and follows a shear zone which is thought to be an extension of the Buffalo lode but in which little mineralization is apparent. The adit runs northeasterly for 450 feet to where it intersects the Mammoth lode at a point below and about midway between the portal and the face of No. 2 level. Since visited, about 500 feet of drifting, all told, has been done on the Mammoth lode on each side of the adit intersection. This work is reported to have encountered ore mineralization over most of this distance. A raise along the foot-wall of the lode connects with No. 2 level 186 feet above. Concerning the mineralization on this level Langley says in his report for 1928:

"On account of the nature of the ore occurrences, a great many samples would have to be taken to arrive at a definite opinion as to the average width and value, but, judging by the assay plan of samples taken in the course of development, a mill-feed of from 15 to 20 ounces in silver to the ton, 3·5 per cent lead, and 10 per cent zinc across a width of from 3 to 5 feet may be expected."

The lowest or No. 7 level was started as a crosscut from a point 533 feet vertically below No. 4 and is reported to have intersected the downward continuation of the Mammoth lode at 475 feet from the portal. Concerning the character of the lode at this intersection Langley states,

"When examined, the vein at the point of intersection showed a strong width and similar characteristics to those prevailing in the upper levels, except that the ore was confined to a narrow streak of massive zinc blende and galena. Considering that this level is about 720 feet on the dip of the vein below No. 4, the possibilities are good for the development of an important ore-body. Since the property was visited it is reported that subsequent drifting on this level has opened up a strong width of ore."

In addition to the above principal workings, a tunnel and an adit were driven in the early years of development to investigate the Mammoth lode to the west of the gulch on which No. 3 adit opens. The upper of these, the tunnel, lies about 70 feet above No. 3, is about 300 feet long, and opens out also on the west side of the western ridge. This tunnel drifts along parts of both hanging- and foot-walls of the lode which averages about 10 feet in width. A vein carrying good lead ore was encountered over a length of 75 feet on the hanging-wall (?) side, in which distance the vein matter lies mostly on top of a fine-grained dyke rock. A 15-foot shaft and short intermediate level a few feet below the main adit were driven to investigate this ore-body, which varied from 1 inch to 3 feet in width and carried from 14 to 60 per cent lead, and from 17 to 401 ounces in silver to the ton. Some 21 tons of ore are reported to have been shipped from these workings in 1923 and to have carried 80 ounces in silver to the

ton and 14 per cent lead. Another adit 125 feet below this tunnel opens out on the east side of the westerly ridge. It was driven for 150 feet in hanging-wall rocks of the lode and encountered nothing of economic interest.

The Mammoth lode is remarkable for its strength and the maintenance of paying values to the very considerable depths to which it has been explored. Attempts have been made to correlate it with the lode system developed by Standard mine workings, and some interesting conjectures have arisen in this connexion. The course of the Mammoth lode is very like that of the "I-vein" in the Standard mine workings and on its westerly course should, if persistent, carry through to Standard property in the vicinity of the I-vein lode.

The Mammoth lode is a notably strong shear zone with, in general, well-defined foot- and hanging-wall sections, in either of which vein deposits containing valuable ore deposits may occur, though developments to date indicate more mineralization in the foot-wall side. Frequent crosscutting is essential in exploring this lode and is especially necessary to investigate parts of either wall that are opposite to ore mineralization in the other. As on the Standard property, intersecting mineralized fissures favour accumulation of ore at their intersections with the Mammoth lode.

The ore minerals are chiefly galena and blende. The former occurs in both coarse cube and fine-grained, steely and gneissic forms. Under the microscope it was observed to carry disseminated grey copper and, less commonly, other silver-bearing minerals. The blende occurs in both coarsely cleavable and dense masses and in part is intimately associated with galena. Deformation subsequent to deposition has resulted in much fracturing of the blende and development of well-defined, gneissic structures in the galena that flows around disrupted fragments of the zinc blende.

MARION CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1900, p. 827; 1904, p. 202.

The Marion Crown-granted claim, property of Jas. Anderson, Stock Exchange Building, Vancouver, B.C., lies between the California and Hartney groups on the northwest slope of Idaho peak at an elevation of 3,200 feet above Slocan lake. It is accessible by road and trail from New Denver.

Records of production are incomplete. The first shipments were made in 1899, when 19 tons carried an average content of 106 ounces in silver to the ton and 53 per cent lead. In 1900 over 100 tons were reported sacked at the mine. Shipments to Trail from 1904 to 1909 amounted to 64 tons. No production has been recorded since 1909.

The underlying rocks are massive argillites, carbonaceous slate, and quartzites of the Slocan series intersected by a small stock of hornblende diorite.

The workings include three adits aggregating about 400 feet of lineal work and develop two (?) small fissure veins. The north vein strikes north 78 degrees east, dips 60 to 85 degrees south, and has been opened by two drift adits. On the upper level an ore shoot of high-grade galena from 6 to 10 feet long and 1 inch to 2 feet thick was encountered. On No. 2 level mineralization was continuous for 100 feet from the portal

and included both clean and mixed ore. A third and lowest adit intersects a vein by a crosscut 48 feet long. This vein strikes north 80 degrees west and dips south at angles varying from 55 degrees to vertical. Drifting on this vein encountered some galena, and mixed galena and blende.

MASCOT CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1923, p. 227.

The Mascot claim is owned by A. Waddell and is under option to J. Johnson, of Silverton. It is on Tributary creek 2 miles from and about 2,000 feet above Sandon. The claim was staked in 1895 and one or two small ore shipments have been made. One ton shipped in 1913 carried 52 ounces in silver and 30 per cent lead.

The property is underlain by argillaceous Slocan sediments and is thought to include a part of the western continuation of the Hope lode from the adjoining Ruth-Hope property. Attention has been mostly confined to this lode, though one or two others have been recognized on the claim. Work comprises two adits representing over 800 feet of tunnelling. In the upper adit, about 125 feet long, pockets of silver-lead-zinc ore were encountered along the lode which has a low dip to the south. The lower adit is 50 feet below. It is a crosscut which, at 160 feet from the portal, encountered a little ore mineralization along the foot-wall of a slip which was drifted on westerly for 156 feet. Very little mineralization being discovered in this distance a crosscut was driven from the end of the drift to pick up the main lode, but so far as is known has not reached it.

McALLISTER GROUP

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 182; 1920, p. 125; 1922, p. 148; 1924, p. 197; 1925, p. 241; 1926, p. 252; and 1928, p. 289.

The McAllister group, comprising the Silver King, Silver Queen, Rowse fraction, and Ridgeway Crown-granted claims and the Province surveyed claim is owned and operated by Slocan Silver Mines, Limited, Alamo, B.C.

The group is on the upper eastern slopes of the valley of Kane creek and is accessible by road and trail from Three Forks. An aerial tram 4,000 feet long connects the mine workings with the road up Kane creek at a point 3½ miles from Three Forks.

The property was staked about 1902. Early in 1919 it was acquired by R. A. Grimes, of Revelstoke, who organized a company of Regina people to carry on development and production. In 1922 the Standard Silver-Lead Mining Company acquired an interest in the property on the condition of driving a long crosscut tunnel (No. 6) to explore the main lode at an additional depth of 350 feet. In 1924 this company took complete charge of development and has since retained a controlling interest. Records of production indicate that the first shipments, amounting to 21 tons, were made in 1903. This ore carried an average of 254 ounces in silver to the ton. An additional production of 60 tons is recorded to the end of 1910, one shipment of 7 tons carrying 276 ounces in silver to the ton and 13 per cent lead. No further production is recorded until 1920 when 31 tons of high-grade silver ore was extracted, followed in 1922 by

a shipment of 29 tons averaging 473 ounces in silver to the ton. The heaviest production is recorded in 1925 and 1926 when a total of 6,677 tons of lower grade material, averaging 44½ ounces in silver, were shipped. Owing to the low price of silver the property was closed in 1926 but was reopened in 1928 when further shipments, amounting to 5,266 tons of 39-ounce ore, were made.

The rocks underlying the property were chiefly Slocan sediments which in this vicinity include massive quartzitic strata and more argillaceous and slaty types, and some limestone (*See* cross-section AB, Figure 3, of Memoir 173, in pocket). The strike varies from about northwest to north and most of the dips are to the southwest or west at an average angle of 40 degrees. These sediments are intersected by a number of prominent dykes or sills of quartz porphyry that appear to conform rather closely with the strike of the sediments.

The mine is developed by six levels over a vertical range of 400 feet below the surface. Levels Nos. 1, 2, 3, and 5 are adits reaching the main lode by crosscuts varying in length from a few feet in the case of No. 1 to about 2,000 feet in the case of the lowest and main working adit, No. 6. Nos. 4 and 5 are 250 and 150 feet, respectively, above No. 6. Most of the work has been done and all of the production has come from above No. 5. The different levels include altogether 6,000 feet of drifting and crosscutting.

These workings develop a quartz-filled fissure having an average strike of north 36 degrees east and dipping southeast at angles varying from 35 to 60 degrees. The vein averages about 3 feet in width and has been explored for a maximum length of 1,600 feet on No. 3 level. About equal amounts of drifting have been done on each of Nos. 2, 4, and 5 levels, and altogether amounts to over 2,000 feet. The most productive and most regular part of the vein occupies a nearly central position in the mine workings and occurs where the vein angles across a belt of massive quartzitic rocks about 600 feet wide. Northeast of this quartzitic belt the vein enters a wide belt of more slaty argillaceous rocks and becomes more difficult to follow, less productive, more subject to slips, and tends to fray out. In the opposite direction very similar conditions obtain except that there the slaty rocks form a comparatively narrow belt, 100 feet or so wide. Beyond this belt a succession of more massive strata, including some limy members, are interbedded with narrow bands of slate and the whole appears more favourable for the development of fissues than the rocks northeast of the quartzite belt.

The lode matter consists of quartz and crushed wall-rock. Large fragments of wall-rock lie in the quartz gangue and are very conspicuous in the drift on No. 4 level. The quartz carries high-grade silver-bearing minerals, pyrite, and, more locally, a little galena and blende. In the productive parts of the lode the vein has a width of from 3 to 9 feet. On No. 4 level it had an average width of 4½ feet. The ore minerals are in part distributed irregularly through the quartz and in part concentrated in small, rich shoots at intervals along the vein, the positions of the ore-bodies being governed to some extent by the positions of cross fissures which intersect the main vein at an angle of about 30 degrees, and in the vicinity of which the ore mineralization is generally most pronounced. Intervening parts of

the vein carry some mineralization. Average values along No. 4 level are reported to have amounted to 38 ounces in silver and, in 1,000 feet of drifting on No. 3 level, to have shown between 30 and 40 ounces of silver to the ton.

Most of the ore has been stoped out above No. 2 adit and much of the high-grade ore extracted down to No. 4 level. Recent production has been from operations between the fourth and fifth levels. The latter level has been run on a small high-grade streak in the hanging-wall rocks of the main vein. A raise from No. 5 level follows this streak and is connected with No. 4 level which follows the main vein by a crosscut 40 feet long. The character and continuity of the main vein in the lower levels have not been investigated. It is uncertain whether it was encountered in No. 6 crosscut, though a small vein of quartz was intersected about 170 feet from the face. At this depth, however, the lode has, apparently, passed through the quartzite belt favourable to vein formation in the levels above.

The ore at McAllister mine is typical of the dry ores of the district (*See* Plate I B) and in particular of those of a belt of country lying northwest of the valley occupied by Carpenter and Seaton creeks. The values are almost entirely in silver. The principal ore mineral is grey copper, but pyrite, chalcopyrite, galena, blende, and two or more polysulphide minerals of less certain identity have been observed in specimens of the ore. These minerals form disseminations, streaks, and solid masses in the vein quartz. Carbonates or sulphates of copper and manganese oxides occur in certain parts of the ore-bodies to which oxygen-bearing waters have access.

Aside from the main vein a number of other quartz veins have been observed on this property but have not been explored.

MERCURY CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1902, p. 148; 1904, p. 202.

The Mercury Crown-granted claim is on the northeast side of Carpenter Creek valley to the north of Sandon, and is accessible by the Payne mine road near which the mine workings are located at an elevation of about 4,500 feet or 1,000 feet above Sandon. The claim is owned by H. T. Twigg, Robt. Cumming, and J. H. Drewery, Enderby, B.C.

The underlying rocks are chiefly black, rusty weathering Slocan slates intersected by small quartz porphyry dykes.

The mine workings include two short adits 70 feet apart vertically, driven below the Payne mine road and near the eastern boundary of the claim. Some open-cut work has also been done. The adits are connected by a raise and towards the face of the lower adit a second raise extends upward along the boundary of the claim for 75 feet.

These workings develop a shear-vein lode striking north 35 degrees east and dipping 55 degrees southeast. The lode varies in thickness from a fraction of a foot to 4 feet. The foot-wall is along or close to a porphyry dyke and a paystreak of ore has formed near this dyke. An ore shoot 40 feet long was encountered in the upper level and has been stoped out between the surface and a point 20 feet or so below the level. Another but smaller shoot was intersected towards the face of the lower adit and has been mostly stoped out. The main shoot had a maximum width of 22 inches.

The ore consisted of grey copper, gneissic and cube galena, blende, pyrite, and chalcopyrite in a gangue of siderite and quartz. Lean or barren parts of the lode consisted of a breccia of slate with siderite and vuggy quartz. The ore was high-grade silver-lead above No. 1 adit but became zincy very rapidly with depth. On its northeasterly extension the lode passes into the Redress claim.

Production commenced in 1902 when 21 tons of silver-lead ore averaged 229 ounces in silver to the ton and 46 per cent lead. Altogether, up to the end of 1915, records show a production of 193 tons, averaging 163 ounces in silver and 38 per cent lead.

METALLIC (MIDNIGHT) GROUP

References: Ann. Repts., Minister of Mines, B.C., 1918, p. 171; 1923, p. 228.

The Metallic group, comprising five claims held by location, is about ¼ mile by trail east of the Silverton-Slocan highway, about 3 miles south of Silverton. The property is owned by A. S. MacAulay and R. McFarlane of Silverton.

Production began in 1909 with the shipment of 1 ton of ore carrying 263 ounces of silver and 101 pounds of lead. No further shipments are recorded until 1922 and 1923, when 69 tons of silver-lead ore were produced, averaging 88 ounces in silver to the ton and 15 per cent lead. In 1926, 24 tons of low-grade ore was extracted. It carried an average of over 5 ounces in silver to the ton, over 3½ per cent lead, and about 9 per cent zinc.

The workings include two adits 65 feet apart vertically. The upper is 350 and the lower about 600 feet long. They are not connected.

The rocks in the vicinity of the workings are chiefly argillites of the Slocan series and form part of a roof pendant or inclusion in coarse-grained Nelson granite. The sediments are intruded by narrow, micaceous dykes and by highly altered, grey, limy dykes (?) of doubtful identity.

The workings explore a strong shear zone striking north 81 degrees east and dipping about 50 degrees northerly. It varies from a few inches to 10 feet in width and though mostly filled with sheared and crushed wall-rock also includes bunches, streaks, and long lenses of vein matter on which some stoping has been done. Veins from 4 to 5 inches wide occur fairly persistently beneath a heavy hanging-wall gouge and also, but to a less extent, above the foot-wall of the zone. The abundant gangue mineral is quartz, but considerable calcite is also present. The chief ore minerals are galena, grey copper, and zinc blende, with which are associated some pyrite and chalcopyrite. The vein quartz carries fragments of wall-rock and ore minerals and is veined with narrow stringers of calcite. Specimens of the ore much resemble specimens obtained from the Van Roi and Hewitt mines. Under the microscope the galena was observed to carry grey copper and a little ruby silver.

MILLER CREEK MINE

The Miller Creek mine is on Miller creek about ½ mile northwest of and accessible from the Wonderful mine. The workings lie on the New Springfield claim at an elevation of about 4,300 feet. The property com-

prising the New Springfield, Sampson, I.X.L. fraction, and Wonderful fraction, Crown-granted claims is owned by D. F. Kiser, Spokane, Wash.

The mine is credited with a production, in the years 1897-1903 inclusive, of 68 tons of silver-lead ore averaging 110 ounces in silver to the ton and 58 per cent lead. When visited in September, 1927, it was being worked under lease and some 60 tons of silver-lead ore were available for shipment.

The workings consist of four adits and a 40-foot shaft sunk from No. 2 level, and comprise over 2,000 feet of crosscuts and drifts, much of which is now inaccessible. The uppermost or No. 1 adit opens on the left bank of Miller creek and the others on the opposite side.

The workings explore a fissure-vein lode cutting slaty, Slocan argillites on a strike of about north 85 degrees east and a nearly vertical dip. The lode is, consequently, nearly parallel with the main lode at the Wonderful mine (*See* account of this mine) and lies about 1,500 feet north of it. The best ore was found in a shoot extending from No. 2 level to the surface, a vertical distance of about 45 feet. This shoot had a maximum length of 100 feet and has been mostly stoped out above No. 2 level. A shaft has been sunk for 40 feet below this level on the downward continuation of the shoot and is stated to have encountered a much higher proportion of zinc blende than was mined from above. The ore above No. 2 level was chiefly galena with some blende in a gangue of quartz associated with some siderite.

Neither No. 3 nor No. 4 level is under the ore-body developed by the upper workings, but both are apparently within a short distance of it. On No. 2, and particularly on No. 3, level, much work has been done in following a series of strong faults striking from north to northwesterly and dipping about 45 degrees to the east or northeast. These faults conform closely with the bedding of the enclosing rocks and have apparently offset the vein or otherwise terminated the mineralization at points about 80 feet east and 60 feet west of the main ore-body.

MINER BOY GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1893, p. 1061.

The Miner Boy group comprises four claims of which two, Miner Boy and Seattle, are Crown-granted and two, Redruthite and Tip Top, are held by location. They lie east of and adjoining the McAllister group and extend southerly over the summit of London ridge. The property is accessible via the McAllister mine or by trail from Bear lake, and is owned by T. Trenery, W. E. George, and J. Teir of Rosebery.

Little work has been done on this property for many years. The only recorded production was in 1893 and was of three tons of ore containing an average of 395 ounces of silver to the ton. In 1910, 15 tons are reported to have been shipped.

The underlying rocks are slaty and thinly interbedded argillaceous and calcareous sediments, and some more massive beds of the Slocan series intersected by several dykes of quartz porphyry.

The workings include several adits and explore showings of mineralized vein quartz on both sides of London ridge. The vein matter is very similar to that encountered at McAllister mine.

MINNEAPOLIS CLAIM

The Minneapolis Crown-granted claim is on the northwest slope of Payne mountain on both sides of the divide between Carpenter and McGuigan creeks. It is owned by Henry P. Jackson, Sandon, B.C.

So far as known no work has been done on this claim for many years and the workings are now partly inaccessible. There is no record of production.

The workings include three adits of which the lowest, 400 feet below the summit and on the Carpenter Creek slope, is caved at the portal. The next adit, 200 feet above, is about 150 feet long and is mostly a drift on a narrow fissure-vein lode cutting argillaceous and limy Slocan sediments on a strike of north 55 degrees east and a dip of 70 degrees southeast. The lode conforms with a system of joint fractures and is filled with gouge and a little oxidized matter in which, however, very little mineralization was detected. An open-cut on the summit and a 10-foot adit a short distance below expose a little oxidized vein matter along two or three joint fractures.

Though insignificant in themselves these showings occur in a section favourable to mineralization, and where even traces of vein matter should not be disregarded.

MINNESOTA CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 251.

The Minnesota claim, held by location, is owned by Al. Holmquist, Sandon, and is in Sunshine basin at the head of Howson creek about 3 miles, by trail, from Sandon.

On this property and towards the bottom of the valley some high-grade silver-lead float was found in the surface wash and an endeavour has been made to locate the ledge from which the ore came. Four adits have been driven for short distances into the hillside above and to the east of the discovery and over a vertical range of 150 feet, but have failed to locate the source of the float. The float may have come from the steep slopes at the head of the basin to the south. More might be learned by following the float towards its source or by carefully prospecting the numerous rock exposures rather than by the slower and more expensive plan of tunnelling.

MINNIEHAHA CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1924, p. 196; 1926, p. 250; and other years.

The Minniehaha Crown-granted claim is between the two forks of Tributary creek about 1½ miles from and 1,400 feet above Sandon. It is owned by Carnation Silver Lead Mines, Limited, of Vancouver, and is one of the claims of the Carnation group (*See* account of this property). When visited in 1927 it was being operated under lease and bond by the Victoria Syndicate.

Some work was done on this claim as far back as 1898 but the only recorded production, amounting to 99 tons of silver-lead-zinc ore, is referred to 1927.

The property is underlain by massive, argillaceous to quartzitic Slocan sediments which, in the principal workings, have a general northwesterly strike and a varying dip to the southwest. Farther down the hill, in the vicinity of the old workings, the strata curve to the northeast with very low dips. They are intersected by a few quartz porphyry dykes.

The workings comprise four or five adits and a considerable amount of surface work, distributed over a vertical range of about 500 feet. The exploratory work in more recent years was undertaken to discover a northeasterly continuation of the Carnation lode. The results obtained afford evidence that the property is another link in the claim of properties possessing a somewhat similar mineralization and extending from the Standard mine near Silverton to the Ruth-Hope property at Sandon. Surface trenching exposed an attractive showing at a point about 70 feet above the portal of the present main working adit. This showing is part of a shear or crushed zone from 15 to 20 feet wide striking north 35 degrees east and dipping 60 degrees southeast. It carried considerable quartz and calcite and, near the foot-wall, from 2 to 8 feet of oxidized matter containing bunches and disseminations of galena. The main adit, driven as a crosscut, intersected this lode at a distance of 125 feet from the portal. At this point the lode carried about 2 feet of calcite with some siderite and a little galena. Subsequent work consisted of attempts to follow this lode which proved most elusive as a result of both pre-mineral and post-mineral movements. The earlier movements provided channels for branch veins which cannot be differentiated from those occurring along the main lode, and the later movements have abruptly offset the vein matter or dragged it from its original position along strong shear zones. Small shoots of ore were discovered at different places including, near the face of the adit, a foot or more of nearly solid galena. This galena was notably banded or gneissic.

Though the lode structure is intricate, the discoveries to date have been encouraging and warrant further exploration, preferably at the surface.

MOLLY HUGHES GROUP

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 178; 1922, pp. 200-201; 1924, p. 198; 1928, pp. 283-284; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 198-199.

The Molly Hughes property, comprising Kinkora, Tryon, Real Idea No. 2, Molly Hughes, and Pinto Crown-granted claims, is on the northwest slope of Carpenter mountain and extends to Slocan lake between half a mile and a mile north of New Denver. In 1928 it was being operated by Pinto Mines, Limited, and in March of the following year it was taken over by Molly Hughes Mines, Limited, 318 Division street, Spokane, Wash.

The property has been operated by several individuals and organizations. Records of production are not complete. The earliest recorded was in 1928 and consisted of 23 tons of ore. In 1901, 21 tons yielded an average of 73 ounces in silver to the ton. Since that time the property has made shipments in twenty-one different years, the production to the end of 1928 aggregating over 1,850 tons. Up to the end of 1926 a total

of 1,471 tons carried an average of 111 ounces in silver and nearly $6 in gold to the ton. Shipments in 1928 included 316 tons of which two of the best carloads gave an average content of 165 ounces in silver and 0·495 ounce in gold to the ton, 1·75 per cent lead, and 2·45 per cent zinc.

The ore deposits are of the dry type and are peculiar to a number of properties on the western and southwestern flanks of Carpenter mountain. This section is largely underlain by porphyritic granite and granodiorite forming a large mass occupying a nearly circular area about 1½ miles in diameter. Small bodies of metamorphosed Slocan sediments occur within, and particularly around the border of, this intrusive mass which passes through the Molly Hughes claim towards the northwestern side of the group.

Most of the ore-bearing veins on the Molly Hughes group are in the intrusive rock and are quartz veins occurring in fault-fissure lodes which, where largest and best defined, show more or less crushing and shearing along their course. Three such veins have been partly explored by workings. Two, the Kinkora and Real Idea, are roughly parallel, strike north 50 degrees west, and dip at an average angle of 50 degrees northeast. The third or Molly Hughes vein lies to the east of the workings on the other two and strikes more nearly north and south.

Recent work has been confined to the Kinkora vein, which has been explored on three levels over a vertical range of about 150 feet. The vein on No. 2 level is reached by a crosscut adit 325 feet long. The portal of this adit is close to and only a few feet above the shore of Slocan lake. The lowest or No. 3 level is reached by a shaft sunk at the face of the crosscut to No. 2 drift. This shaft has been extended to the surface which it reaches alongside the Canadian Pacific Railway tracks. All of the workings on the Kinkora vein lie below the level of the railway (150 feet above lake level) and the drifts are nearly under the railway. The vein has been followed underground for about 900 feet in the granite. It varies from 3 inches to 8 feet in width and is composed of bands or irregular lenses of quartz associated with more or less altered wall-rock. The vein is intersected by a number of fault planes striking a few degrees east of north and dipping at high angles either to the east or west. The greatest displacement along any one of these faults is about 80 feet. The paystreak favours the hanging-wall or, as is most noticeable in No. 2 drift, there may be two paystreaks each varying from less than an inch to about 8 inches in width and occurring one on the hanging-wall and the other nearer to or at the foot-wall. The gangue is quartz either massive and white or showing ribbon and comb structure and discoloured by included matter. The ore minerals are grey copper, galena, chalcopyrite, and zinc blende. The important values are in silver and gold and are very erratic. Selected specimens are said to have assayed as high as 2,700 ounces in silver and $70 in gold. Three hundred and seventy-five tons, in 1910, gave 66 ounces gold, 26,000 ounces silver, and 3,000 pounds lead.

The long crosscut on No. 2 level would if projected about 600 feet farther strike the Real Idea vein, on which some development work has been done. This vein has been proved by open-cuts to extend eastward from the present workings for about ¼ mile. It shows up strongly in the

open-cuts but does not appear to be as well mineralized as the Kinkora vein. The third or "Molly Hughes" vein occurs on the claim of that name and strikes at about 40 degrees to the others. The old workings on this vein have fallen into disrepair and little can be seen.

MONITOR GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 53; 1902, p. 148; 1904, p. 181; and other years.
Rept. of Zinc Commission, 1906, pp. 198-200.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 199.

This property, consisting of eight Crown-granted claims and fractions, is at Three Forks on the lower slopes of Carpenter Creek valley south of the junction of Seaton and Kane creeks. The mine is owned by the Rosebery-Surprise Mining Company, New Denver, B.C., and in 1928 was being operated under lease by Geo. Gormley of Three Forks.

The Monitor vein-lode was discovered in 1895. In September, 1900, the property was acquired by an English organization, Monitor and Ajax Fraction, Limited, a company owning also the Ajax fraction claim adjoining the Last Chance group above Sandon. Both the Monitor and Ajax Fraction properties closed down about 1909 and subsequently their entire plants were wiped out by fire. Following a long period of idleness the property was acquired about 1922 by the Rosebery-Surprise Mining Company, owners until 1928 of the Surprise mine at Sandon. This company leased the Monitor mine to Geo. Gormley who has maintained a consistent production until recently.

Production began in 1895 with the shipment of a few tons of oxidized silver-lead ore. In the following year 107 tons were shipped and carried an average of 312 ounces in silver to the ton, and 30 per cent lead, as well as an aggregate of 19 ounces in gold. Shipments up to and including 1905 comprised 2,839 tons that yielded on the average 39 per cent lead, 115 ounces in silver, and about $5.60 in gold to the ton. The next shipments were made in 1909 and comprised 325 tons of zinc ore carrying 35 per cent zinc. Production commenced again in 1922 and up to the close of 1928 included 875 tons, of which 414 tons mined in 1925 and 1926 averaged 11·5 per cent lead, 13·7 per cent zinc, about 24 ounces in silver, and over $2 in gold to the ton.

The mine is developed by five adits over a vertical range of about 500 feet below the outcrop of the lode. The lode is a strong fissure zone cutting argillaceous, carbonaceous, and calcareous Slocan sediments and a number of quartz porphyry sills or dykes. It has a general strike of north 45 degrees east and dips southeast at an angle varying from 60 degrees to vertical. The lode varies in thickness from a few inches to 4 feet or more and has been drifted on for a maximum length of 1,300 feet. It is offset along its course by a series of faults which persist from the surface to the lowest level and have effected displacements varying mostly between 20 and 50 feet. A major fault near the faces of Nos. 2, 3, and 4 adits abruptly terminates the lode in this direction.

The lode filling commonly lies between smooth, slickensided walls, but is rather narrow in the lower levels. It is composed of more or less crushed country rock with lenses and veins of quartz, siderite, calcite, and ore.

The ore consists of galena (banded, steel, and fine cube), zinc blende, and pyrite. Above Nos. 1 and 2 levels the vein material included considerable oxidized ore which has been worked out. No. 3 level developed several ore shoots containing galena and zinc blende as the important ore minerals. On No. 4 level the ore carries a high percentage of pyrite and averages $4 in gold to the ton, but is low in silver. No. 5 level has shown ore carrying better lead and zinc values but has been extended for only a comparatively short distance. The crude ore prior to 1896 assayed $2 to $14 in gold, 142 to 304 ounces in silver, and from 37 to 55 per cent lead. One shipment of 19 tons gave $20 in gold, 367·6 ounces in silver, and 32 per cent lead. The oxidized ore (88 tons) averaged over $13 in gold, 128·4 to 323·8 ounces in silver, and 14 to 33 per cent lead.

The underground explorations indicate that the ore tends to bank up against the faults. It is probable that there has been some post-mineral movement, but much of the displacement along the faults may have occurred in pre-mineral time, in which case the rising mineralizing solutions have been guided into the disrupted segments of the lode between the fault planes. These planes are marked by more or less gouge and would themselves be comparatively impervious to the passage of the solutions. That the lode persists beyond the innermost major fault is almost certain, as it is strongly defined up to this fault on Nos. 2 and 3 levels. That ore will be found immediately past this fault if the lode continues is not so certain, but nevertheless further work in this direction seems warranted. This major fault has evidently caused a much greater displacement than the others as crosscutting on No. 2 level for 250 feet to the right and 140 feet to the left, on the far side of the fault, has failed to pick up the lode. Striæ on the hanging-wall of the fault on No. 3 level dip 70 degrees to the northwest indicating that the movement was in this direction. Probably the same holds true for the other faults. If, as seems most likely, the faults are normal faults, the throw of the fault is much greater than the apparent displacement. The fact that the faults conform closely with the bedding of the sediments has prevented any calculations based on stratigraphic succession from being used in interpreting the amount of throw.

Most of the available ore has been stoped out leaving the future largely dependent on the extension of the ore-bodies to greater depth or to the chance of picking up further ore in the lode beyond the main fault. In general the ore-bodies have tended to become leaner with depth, though the presence of appreciable gold encourages developments in this direction. No. 5 level, 210 feet below No. 4, has not been projected to get under the main ore-bodies developed higher up but has encountered some attractive mineralization in the vicinity of the crosscut intersection with the chances of developing a considerable tonnage in this section.

MOUNTAIN SCENERY GROUP

The Mountain Scenery and Silver Leaf Crown-granted claims are in the upper basin of Aylwin (Eightmile) creek, the workings lying at an elevation of about 6,200 feet. The Mountain Scenery claim is owned by F. F. Liebescher and H. C. Wheeler, Silverton, B.C.; title to the Silver Leaf claim has reverted to the Crown.

No work has been done on these claims for many years. The old workings include a shallow shaft, now inaccessible, and a number of open-cuts exposing a shear zone in porphyritic Nelson granite. The zone strikes north 65 degrees east and is several feet wide. It has been mineralized with vein quartz and siderite carrying a little galena and blende. Specimens of brecciated vein matter indicate that considerable movement has occurred along the shear zone subsequent to mineralization.

MOUNTAIN CON GROUP

References: Ann. Repts., Minister of Mines, B.C., 1900, p. 827; 1904, pp. 193-194.

The Mountain Con property comprises the Mountain Con and Castick Crown-granted claims and is owned by the Mountain Con Mining Company, % W. H. Yawkey Estate, 420 Lexington Avenue, New York city. It lies at the extreme head of Carpenter creek on the western slope of mount Carlyle and is accessible by trail from Cody. The workings are at an elevation of about 7,500 feet and are the highest of any productive mine in either Sandon or Slocan map-areas.

The property was located in the mid-nineties and held by a partnership of three who, prior to 1904, had optioned it to different parties whose efforts were unsuccessful in locating any appreciable quantity of ore. In 1904, explorations were continued by two of these partners, and resulted in the discovery of a shoot of very rich ore from which shipments of 200 tons in that year yielded an average of 338 ounces in silver to the ton and 28 per cent lead. Production in the following four years amounted to 115 tons containing 300 ounces of silver a ton and 22 per cent lead. Since that time work has been discontinuous and 140 tons have been produced, 120 tons of which were mined in 1915.

The claims lie in the heart of a large outcrop area of porphyritic granite of the Nelson batholith. This granite is intersected along the course of the Mountain Con lode by a lamprophyre dyke, composed of biotite, bronzite, feldspar, and a little quartz with secondary calcite, talc (?), and bastite.

The workings have a vertical range of 500 feet and include four adit drifts and a lowermost crosscut adit. Part of these workings were inaccessible when visited in 1926. They explore a vein-lode striking northeast and dipping 80 degrees northwest. The lode conforms with sheeted jointing in the granite, along some of which joints further fissuring and some shearing have occurred. The main vein is a quartz-filled fissure varying in thickness from a few inches to 2½ feet, and is associated with the narrow lamprophyre dyke mentioned above. The dyke occurs in places on the hanging-wall, and in places on the foot-wall, side of the vein and appears to have been intruded along the course of the fissure. Subsequent movement resulted in the shearing of the dyke and the deposition of vein matter.

The upper two adits, Nos. 1 and 2, were caved near their portal. No. 2 adit is about 300 feet below the outcrop of the lode where it crosses a narrow, steep ridge between the basins of Carpenter and Twelvemile creeks. No. 3 adit, about 70 feet below No. 2, is 138 feet long. Some

stoping has been done both above and below this level, but little ore mineralization was noted. No. 4 adit, about 75 feet below No. 3, is about 450 feet long. At 90 feet from the face, a raise has been made to an intermediate level 60 feet above. Within 150 feet of the portal some vein quartz 8 inches wide lying on the hanging-wall of the lode between granite and dyke rock carried an appreciable amount of galena and some siderite. The quartz is partly crystalline and drusy. The crosscut adit is about 300 feet below No. 4 adit. It was blocked with ice at 30 feet from the portal. Fragments of the basic dyke on the dump indicated that the crosscut reached the lode.

The lode is regular and persistent and the walls are well defined. The filling is vein quartz, ore minerals, and crushed wall-rock. Three or more ore shoots have been encountered. The Warner shoot outcropped at the level of No. 1 adit and pitched southwest with the hill. It only occurred at and near the surface and though high in lead was low in silver. The McLeod shoot was first encountered in No. 1 adit at 56 feet from the portal and has been stoped on No. 1 adit and on the intermediate level above No. 2. Its maximum length was about 400 feet and its thickness varied from a few inches to 2 feet. The pitch was apparently about 30 degrees to the northeast and the best ore followed the hanging-wall of the lode.

The ore was mainly argentiferous galena, either clean or mixed with quartz gangue. Other silver-bearing minerals and some zinc blende and iron sulphide are also present and picked samples carried very high silver values. Near the surface oxidation was pronounced.

MOWITCH GROUP

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 180; 1920, p. 125.

The Mowitch group comprises Mowitch, St. Clair, Rose Marie, Home Run, Grand Stand, and Ronald fraction claims, of which the first three are Crown-granted. The group is on the lower southern slope of Carpenter Creek valley between New Denver and Three Forks and is traversed by the motor road connecting Slocan and Kootenay lakes. The Mowitch is owned by Murdoch McLean and the other two Crown-granted claims by J. Cechelero *et al.*, New Denver, B.C.

Work has been carried on at intervals for a great many years. Records of production are incomplete. Some shipments were made about 1904, of which one carload ran 114 ounces in silver and $2 in gold to the ton. It is reported that several tons of silver-lead-zinc ore had been extracted from workings on the Rose Marie claim in 1920 and that 34 tons were shipped from the Mowitch claim in that year.

The workings comprise four adits and explore two vein-lodes intersecting Slocan sediments. The sediments are mostly massive beds varying from quartzite to limestone with intermediate argillaceous rocks (*See* cross-section CD, Figure 3, Memoir 173, in pocket). They strike northwesterly, dip steeply to the northeast, and are intruded by dykes of feldspar porphyry. The lodes may be referred to as the lower or "Mowitch" and upper or "Rosemarie".

The Mowitch vein-lode is developed by two adits, 110 feet apart vertically, and by a shaft sunk from the upper adit at 75 feet from the portal. It strikes north 40 degrees west, dips steeply to the northeast, and, consequently, conforms closely with the bedding of the wall-rocks which are massive, blocky, pyritized argillites. The lode is a well-defined, quartz-filled fissure varying from a few inches to about a foot wide and carries disseminated grey copper and a little galena. It has beeen stoped over much of the length of the upper adit and for a maximum distance of some 240 feet in the lower level. At 300 feet from the portal of the lower adit a raise presumably connects with the upper adit.

The Rosemarie lode has been investigated by two adits, of which the lower is about 225 feet above the upper adit on the other lode. It cuts across the bedding of the sediments, is from 3 to 6 feet wide, and is less well defined than that containing the Mowitch vein. It strikes about north 20 degrees east and dips at an average angle of 60 degrees southeast. The lode matter is crushed and broken wall-rock with bands and stringers of quartz, some siderite, and ore minerals. The latter include grey copper and more galena and blende than was noted in the Mowitch vein. Some pyrite is also present. The lower adit was caved at the time visited, but from material on the dump appeared to have encountered greater widths of vein quartz than are to be seen in the upper adit, 50 feet above.

NOBLE FIVE GROUP

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 29.
Ann. Repts., Minister of Mines, B.C., 1893, p. 1,054; 1896, p. 57; 1917, p. 161; 1925, pp. 242-244; 1928, pp. 284-286.
Rept. of Zinc Commission, 1906, pp. 256-258.

The Noble Five group, including the Noble Five, Knoxville, Bonanza King, World's Fair, Maude E, Deadman, Lucetta, and Wild Goose Crown-granted mineral claims, is owned and operated by Noble Five Mines, Limited, Nelson, B.C. The group is on the southern slope of Reco mountain northeast of Sandon and lies between the American Boy and Last Chance groups to the west and the Reco group to the east. It includes the workings of the Noble Five and Deadman mines (Figure 1), accessible by trails from Sandon and Cody.

The original group of claims, comprising the first five of those mentioned above, was located in 1891. It was staked for 5,000 feet along the course of the Noble Five lode and the two adjoining claims, Deadman and Wild Goose, were subsequently located along another or Deadman lode. Mining commenced in the spring of 1892. Operations in the early years were conducted by the Noble Five Consolidated Mining and Milling Company of Spokane. In 1896 a mill was completed at Cody. A lawsuit over apex rights with Last Chance people, following operations of the latter on Maude E ground, was settled in 1912 in favour of the Noble Five. The Noble Five property was acquired, about 1905, by the late Hon. James Dunsmuir under whose directions an expensive program of mining and surface improvements was carried out. The work included the projection of a 2,700-foot crosscut, at No. 18 level, to tap the Noble Five lode 1,000 feet below the lowest workings, on No. 8 level (*See* Figure 11); over

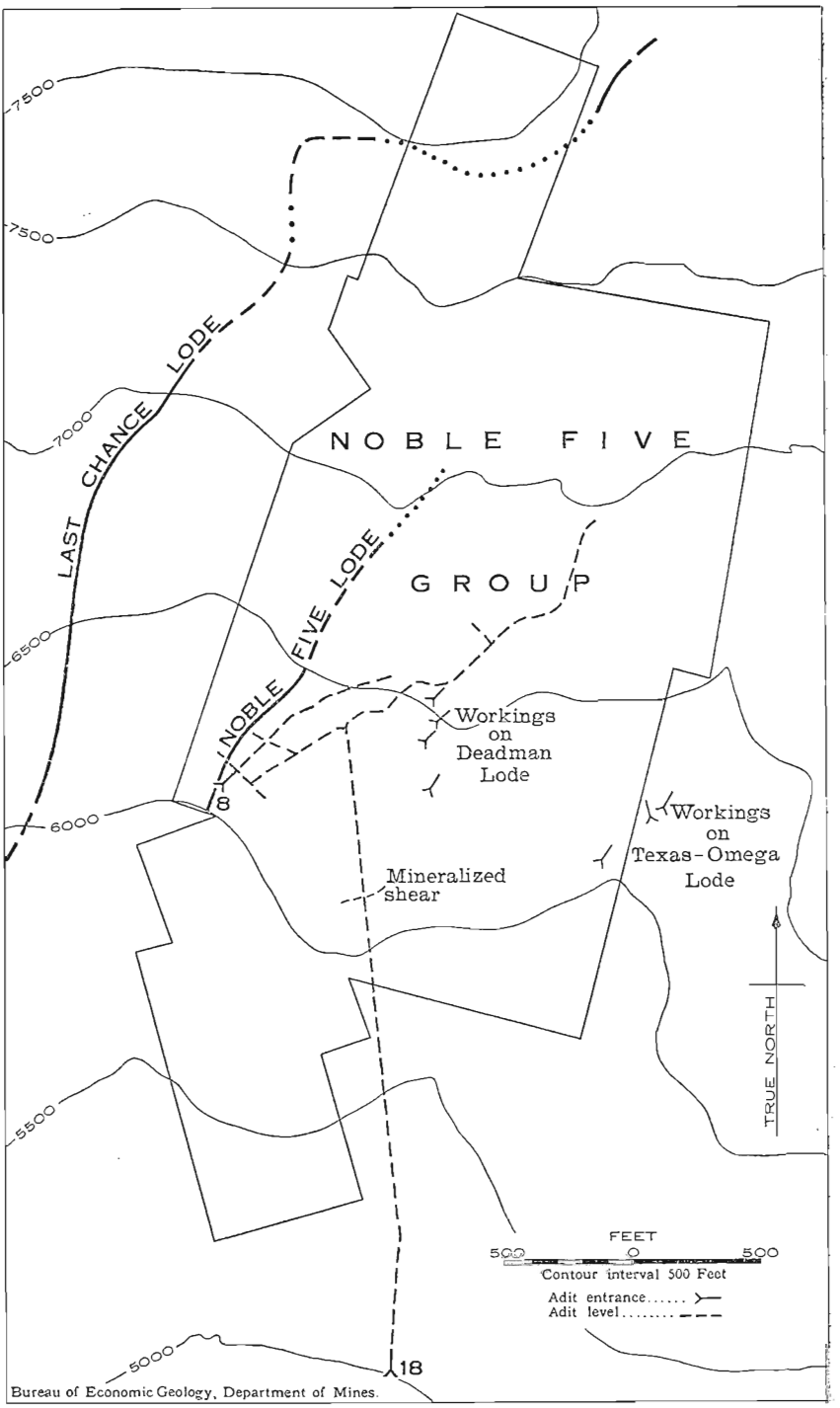


Figure 11. Positions of lodes with reference to workings on No. 18 level, Noble Five group.

2,000 feet of drift and crosscut on No. 18 level; the construction of a vertical shaft from near the face of the No. 18 crosscut to No. 8 level above; and the establishment of intermediate levels from this raise. A new mill was also constructed but ran for only three months when operations on the property were suspended owing to the death of the owner. In 1926 the former manager, Paul Lincoln, obtained a lease and bond on the property, operated it for a few months in the autumn and winter of 1926-27, and shipped some 148 tons of ore. In the following year he acquired the Noble Five and the adjoining Surprise property for the present company.

Records of production are incomplete. In 1893, 1894, and 1895, 1,050 tons shipped carried 150 ounces in silver to the ton and 70 per cent lead. In 1895 the Deadman had 300 tons ready for shipment. To the end of 1896 shipments included some twenty-six carloads of oxidized and clean lead, the former assaying 63 ounces in silver and 15 per cent lead and the latter carrying up to 255 ounces of silver a ton. The total value of these shipments is estimated at between $125,000 and $130,000. Shipments from 1911 to 1913 amounted to 256 tons. In 1913, 52·0175 net tons gave 4,144·74 ounces silver and 41,932 pounds lead. From the Deadman 104 tons of zinc were shipped, one car averaging 55·3 per cent zinc, 1 per cent lead, and 16 ounces silver a ton. In 1912 and 1913 shipments of 196 tons carried, on an average, 76 ounces in silver to the ton, 50 per cent lead, and 35 per cent zinc, these being the first years in which the zinc content of the ores was recorded. Subsequent production has amounted to 669 tons, of which 382 tons in 1922 were mostly zinc ore averaging about 3 ounces in silver to the ton and 35 per cent zinc.

The Noble Five lode has been developed (*See* Figure 11) by eleven adits, A and C, and Nos. 1 to 8, and the long Noble Five crosscut (No. 18 level). All the adits, except the lowest, are drift adits commencing on or close to the lode. No. 8 level is about 800 feet below the lode apex. All levels from No. 2 down are connected by raises and (or) stopes. The longest drifts have been run from the No. 18 crosscut and extend for 450 feet to the southwest and 1,450 feet to the northeast of the crosscut. Levels Nos. 4 to 8 average over 1,000 feet of drifting. From No. 4 level a crosscut over 700 feet long connects with a 120-foot raise to No. 4 level of Last Chance mine. Some early work was done towards the southern boundary of the Noble Five claim at an elevation of about 5,400 feet. Old maps show here an adit about 400 feet long with a winze 60 feet from the portal. These workings have since been obliterated by a big slide that came down the Noble Five gulch. The adit and winze were apparently driven to explore the Noble Five lode at depth.

A complete section of the rocks encountered in the underground workings is exposed by the long crosscut (No. 18 level) and drifts from it. These rocks are Slocan sediments intruded by numerous dykes of quartz porphyry and a few small, dark green, basic dykes. The sediments are strongly compacted, massive types, generally well bedded and in part well banded. They include argillites, quartzitic argillites, quartzites, and some limestone or otherwise limy beds. Distinctly slaty members are in the minority except towards the portal of the long crosscut where a broad belt of slates is encountered. The general strike of the sediments is north 38 degrees west and the average dip is 57 degrees southwest. The structure

along the drifts on No. 18 level is mostly regular, but along the crosscut minor folds are present and the beds are faulted. A large number of light-coloured, quartz porphyry dykes, in general closely following the strike of the sediments, occur at irregular intervals. They are most prominent in the drift running northeast from the crosscut and particularly so within 450 feet of the face of the drift, in which distance the rocks are mostly porphyry. Elsewhere along the drifts on both sides of the crosscut several dykes of porphyry as much as 100 feet wide were observed.

The Noble Five lode down to No. 8 level has a general strike of north 55 degrees east and dips southeast at from 55 to 70 degrees. For this depth it is a strong, fissured zone varying in thickness from a few inches to over 10 feet. Along the central and southwesterly parts of the drifts the lode was easily followed, but in the northeastern sections the lode structure is complicated by cross-fissuring, splitting, and by intersecting fissures. Towards the northeast faces of the levels the fissures weaken or end by swinging to follow the bedding planes of the country rocks and mineralization pinches to unproductive widths. Production in recent years prior to 1928 has come chiefly from between levels Nos. 6 and 8 to the northeast of the main raise connecting with No. 5 level. In this section an important block of concentrating ore is present from which further production is expected. On No. 8 level a stope 180 feet long beginning just east of this raise has been extended part way up No. 7 level. The lode here strikes about north 75 degrees east, dips steeply southeast, is between 2 and 3 feet wide, and is composed of concentrating ore carrying blende and a little galena in a gangue of siderite with fragments of country rock. This part of the lode is picked up on No. 7 level where a little stoping has been done on it. Along No. 7 level vein mineralization has been traced over a length of 150 feet, in which distance it varies in width from a few inches to 4 feet.

Small amounts of both clean and concentrating ore are to be seen in nearly all the old workings, but the greater part of the clean ore was taken out in the years 1909-12. Towards the portal of No. 6 level there is a small body of low-grade ore consisting of zinc blende in siderite and quartz with pyrite. On No. 8 level the lode walls are not well defined and the filling is largely of gouge.

In recent years work has been mostly on the lower crosscut level, No. 18. A great deal of work has been done there on a fracture discovered 120 feet south of the raise to No. 8 level. The fracture is small and tight and as explored is not encouraging. In the northeast drift two lenses of galena each 50 to 100 feet long and including a maximum of 6 inches of clean galena were found at distances of about 250 and 620 feet northeast of the crosscut. At each place a little stoping has been done and most of the ore has been taken out. The vein fracture at both ends of the ore-bodies is a mere crack difficult to recognize. The strike is north 50 to 55 degrees east and the dip about 70 degrees southeast. The position of the southwestern ore-body is offset about 7 feet to the southeast with respect to the other. It is uncertain whether the two ore-bodies occurred in the same fracture or in different parallel fissures. That they are a downward extension of the Noble Five lode as found in the upper workings has not been established. Such a correlation would require that below No. 8 level

the average dip was between 80 and 85 degrees, a dip much steeper than that of the lode in the upper levels and steeper than that observed in the vicinity of the ore lenses on No. 18 level. The strong fissuring observed on and above No. 8 level is missing in No. 18 drifts, but might be represented by a pyritized shear or fissure encountered in the crosscut 650 feet south of the face and where a little drifting has been done. The average dip of the Noble Five lode below No. 8 level if it connected with this shear zone would be above 55 degrees, an angle more like that of the main lode above No. 8 level and also about the same as that of the dip of the pyritized shear intersected by the crosscut. It is possible that the mineralization along the drift at No. 18 level is the downward continuation of Last Chance lode, whose average dip would then be about 55 degrees, only a few degrees less than the average dip of the Last Chance lode in the Last Chance mine. The fractures on No. 18 level, however, dip at a steeper angle than this and are not as strong as the Last Chance lode might be expected to be. There is, in fact, a distinct probability that the mineralized fractures on the northeast drift, No. 18 level, lie between the Noble Five lode above and to the east, and the Last Chance lode below and to the west. If such is the case, the Last Chance lode might be struck by extending No. 18 crosscut and the pyritized shear intersected by the crosscut might represent a downward extension of the Noble Five lode.

Since the Noble Five property was visited, the pyritized shear encountered in the long crosscut at No. 18 level has been further explored. The first results of this work are summed up by the resident engineer, A. G. Langley, in his report for 1928. This pyritized shear zone, known as the Deadman vein, had been previously explored by a short length of drift and the mineralization found to consist principally of iron sulphides. This drift in 1928 was continued through a porphyry dyke and entered a sheared zone with a well-defined hanging-wall of slate and porphyry on the foot-wall side.

"In driving along this hanging-wall, the foot-wall soon disappeared and the whole width of the drift was in ore of milling grade the width of which..... had not been determined. The structure, apparently consisting of bands of ore with narrow intervening bands of slate, crossed the drift at an oblique angle..... When examined (October, 1928) the drift was in ore for about 60 feet, with a strong showing at the face."

A later report[1] states that this ore-body,

"as at present developed is about 350 feet long. The ore-body varies considerably in width..... the mineral area at (its western extremity where first encountered) ..... being up to 20 feet wide. Going easterly the ore pinches and swells, with a good stoping width throughout the greater length of the ore-body."

Along the drifts to the northeast and southwest of the crosscut on No. 18 level, a number of fractures running northwesterly and dipping southwest carry some mineralization judged from a coat of red iron oxide marking their course. Other fractures follow the bedding of the rocks, and in some cases carry a foot or more of gouge. One such fault fracture crosses the drift 150 feet southwest of the crosscut. This fault strikes north 43 degrees west, dips 55 degrees southwest, and terminates the southwesterly continuation of the vein fracture drifted on from the crosscut.

[1] O'Grady, B. T.: B. C. Dept. of Mines, Bull. No. 1, 1929, pp. 45-46.

This fault may have offset the fracture some 120 feet to the northwest where somewhat similar vein matter, consisting of small stringers of zinc blende in quartz gangue, was picked up in a crosscut driven to the northwest of the main drift from a point 50 feet past the fault. Another strong fault striking north 30 degrees west and dipping 55 degrees southwest appears about 850 feet northeast of the main crosscut. This fault is marked by a foot of gouge. Along the crosscut a number of strong slips or shears strike northwesterly and dip at angles varying from perpendicular to 50 or 55 degrees either to the southwest or northeast. The occurrence of such faults introduces difficulties in tracing the several veins from the upper workings to No. 18 level. The difficulties are increased by irregularities in strike and dip, changes in the character of the veins at depth, and uncertainty as to the persistence of the lodes in which they occur. The long crosscut on No. 18 level, in addition to perhaps intersecting the Noble Five lode and, if the crosscut were extended, the Last Chance lode, should intersect the Deadman lode and the Texas-Omega lodes if these lodes continue to the depth of the crosscut. There is, however, little evidence that they do so continue.

The chief ore minerals in the Noble Five workings are galena and blende, the former being the more abundant in the upper workings. On the whole zinc blende increases relatively to galena as depth is attained. These minerals are associated with varying amounts of gangue and more or less crushed wall-rock. The chief gangue minerals are siderite and quartz. Pyrite is a common accessory mineral. Oxidation of the vein matter is pronounced in the upper workings and down to No. 6 level. In the uppermost workings, now inaccessible, some very high silver assays were obtained as a result of the presence in the silver-lead ores of native silver, ruby silver, grey copper, and argentite (?). Even in the lowest workings, specimens of galena obtained from lenses of lead-zinc ore in the drift northeast of the crosscut, No. 18 level, showed under the microscope minute areas of ruby silver, grey copper, and an unidentified mineral resembling bournonite. A specimen of this lead-zinc ore assayed by the Mines Branch, Ottawa, gave 35·81 ounces in silver to the ton, 24·80 per cent lead, and 36·56 per cent zinc. Four samples taken by A. G. Langley[1] from the same showings

"indicated the following average values over a length of 50 feet and a width of 7·5 inches: silver 60·4 ounces to the ton, lead 41·4 per cent, zinc 19·3 per cent."

The Deadman lode, on the Deadman claim, is roughly parallel and about 400 feet southeast of the Noble Five lode. It strikes north 55 degrees east and dips 45 degrees southeast. It has been developed by four adits and one intermediate level, the lowest being about 350 feet below the outcrop. The underground work aggregates over 2,000 feet of crosscut and drift. Prior to 1896 some 300 tons of high-grade silver-lead ore were mined from this lode between the surface and No. 2 adit. The ore-body had a length of 40 or 50 feet and a maximum width of 5 feet. During the years 1909-1912 further work was done. The lode is apparently offset to the southeast at irregular intervals along its course. Development work at depth encountered an increasing proportion of zinc

[1] Ann. Rept., B. C. Minister of Mines, 1925, p. 243.

blende. On No. 3 level a lens of nearly clean blende averaging 12 inches in thickness was exposed along the floor of the drift for over 100 feet. A winze sunk on this for 100 feet encountered ore all the way, but decreasing in width as depth was obtained.[1]

NOONDAY GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 69; 1904, p. 173; 1918, p. 171.

The Noonday, Curley, and Noonday fraction Crown-granted claims adjoin the Currie (Galena Farm mine) group on the east and are accessible by motor road from Silverton. They are owned by the Bank of Montreal, New Denver, B.C.

The workings are in the valley of Gold creek and comprise four adits driven at elevations varying from less than 100 to 200 feet above the bridge over Gold creek on the motor road between Silverton and Slocan.

The underlying rocks consist of patches or narrow belts of argillaceous Slocan sediments included in coarse-grained granitic rocks of the Nelson batholith.

The workings are mainly in the sedimentary rocks and are largely inaccessible. The upper two adits are each between 300 and 400 feet long and explore a lode striking north 68 degrees west and dipping at a low angle to the northeast. Above the upper adit a considerable shoot of ore was stoped to the surface in 1899 and yielded 600 tons of silver-lead ore averaging 125 ounces in silver to the ton and 25 per cent lead. Aside from this one shoot comparatively little ore mineralization has been discovered. The chief gangue mineral is quartz. The lode has been correlated with the so-called "Noonday lode" of Galena Farm mine about 1,500 feet west from the Noonday workings, though there is very considerable doubt as to the correctness of this interpretation. In the opposite direction, towards the face of the upper two Noonday adits, the lode is faulted and has not been investigated beyond.

OCEAN GROUP

The Ocean group, comprising Ocean, Lillian No. 4, and Reciprocity Crown-granted claims, is on the northeastern side of the valley of Carpenter creek, to the north of Sandon, and is accessible by the Payne mine wagon road. The Lillian No. 4 and Reciprocity claims are administered by G. B. Gerrard, % Royal Trust Company, Montreal; the Ocean claim is owned by A. Logan MacPhee, Kaslo, B.C.

The underlying rocks are argillaceous and mostly carbonaceous, rusty weathering, black, slaty sediments of the Slocan series intersected by many acid dykes and, on the Ocean claim, by a small diorite stock.

The workings include five or more adits, of which three (or more) are in a gulch leading to the Payne mine and were probably driven to investigate the continuation of the Payne lode. These adits are in slaty rocks and except for the lower one, which opens out onto the Payne road, are caved. This lower adit, so far as could be seen, encounters little of interest. Farther

[1] Report of Zinc Commission, 1906, pp. 256-257.

around the hill to the west a couple of short adits on the Ocean claim explore a mineralized shear zone in the diorite stock. A small shoot of silver-lead ore was discovered and in 1919 yielded 3 tons of ore which ran 105 ounces in silver to the ton and 60 per cent lead.

ORO CLAIM

The Oro Crown-granted claim is on the lower northern slope of the valley of Carpenter creek about a mile east of Cody. It is owned by J. M. Harris, Sandon, B.C., and when visited in 1927 was under lease to A. Stonier of Sandon.

Developments include an adit 95 feet long driven on a small shear zone in a large quartz porphyry dyke or narrow stock which intersects sediments of the Slocan series. The shear zone varies from a few inches to over 2 feet in width, strikes north 27 degrees west, and dips 55 degrees to the southwest. It is filled with crushed rock, gouge, and vein quartz. The latter is sparingly mineralized, but, so far as could be seen, neither carries nor is associated with important concentrations of ore minerals.

PAYNE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 60; 1897, p. 533; 1902, p. 147; 1904, pp. 186-189; 1905, p. 160; 1913, p. 126; 1914, p. 286; 1921, p. 134.
Rept. of Zinc Commission, 1906, pp. 194-197.

The Payne group is owned by Payne Mines, Limited, % C. B. White, New Denver, B.C. It consists of the Payne fraction, Maid of Erin, Mountain Chief, Two Jacks, Telephone, and Thursday fraction Crown-granted claims and crosses the summit of the ridge extending northwesterly from Payne mountain. It is most easily accessible from Sandon over a well-graded wagon road, but may also be reached by road and trail from the northeast or McGuigan side of the divide via the Rambler-Cariboo mine. The main and lowest adit, No. 15, is on the southwestern slope of Carpenter creek at an elevation of 4,850 feet or 1,350 feet above Sandon. This level lies 1,450 feet below the highest outcrop of the Payne vein and about 900 feet below the old Payne mine camp near the portal of No. 5 adit.

The Payne vein was discovered on September 9, 1891, and was the first location made in Sandon district. The property was sold by the original locators to Scott McDonald and S. S. Bailey, and later, about 1896, was acquired by A. W. McCune. After taking out a large amount of high-grade ore McCune sold out to the Payne Consolidated Mining Company of Montreal. This company built a concentrator with capacity of 110 tons a day. About 1909 the property was sold at auction. In 1911 W. E. Zwicky *et al.* secured a lease and bond on it for the present owners. The fire of 1910 destroyed or seriously damaged all the surface equipment consisting of mill, tramway, and pipe lines.

Records of production are incomplete. Up to 1905 shipments amounted to over 50,000 tons of silver-lead ore, averaging 120 ounces silver to the ton and 68 per cent lead, and some 6,000 tons of zinc blende, crude and concentrated. The aggregate value of this ore is estimated at about $5,000,000.

The mine is developed by seven adits and tunnels over a vertical range of 1,450 feet below the outcrop of the vein. Nos. 1 to 5 were run from the Carpenter slope, the upper three going through the ridge. No. 8 is a crosscut to the vein lode from the McGuigan side of the divide and No. 15, 600 feet below No. 8, is a long crosscut (about 3,400 feet) from the Carpenter slope and has been connected with the upper levels by a raise. In addition to these there are four intermediate levels, two (Nos. 6 and 7) above and two (Nos. 9 and 10) below No. 8. The various workings include over 10,000 feet of drifts.

The property is underlain chiefly by Slocan sediments striking from north 40 degrees west to north 65 degrees west. The rocks, commencing at the top of the ridge and extending down both flanks for several hundred feet, are largely massive, argillaceous, quartzitic, and calcareous beds possessing a general anticlinal structure disrupted by faults. Below the portal of No. 3 tunnel on the Carpenter slope these rocks pass under a broad syncline of black, carbonaceous and commonly rusty-weathering slates, and on the McGuigan slope below the portal of No. 8 adit are underlain by a belt of similar looking slaty rocks (*See* structure section EF, Figure 3, of Memoir 173, in pocket). The sediments are deformed and faulted and are intruded by quartz and feldspar porphyry dykes and sills. One such dyke forms the hanging-wall of the parts of the Payne lode explored on the sixth and seventh levels.

The Payne lode at the summit of the ridge strikes north 55 degrees east and dips at angles varying from 50 degrees to 70 degrees southeast. Near the outcrop there appeared to be several stringers and one main fissure vein, all of which conform closely with a strong system of jointing in the massive sediments. These veins appear to converge in depth and below No. 3 level the mineralization occupies one strong lode. Above this level most of the work was done on the most northwesterly fissure leaving the others relatively unexplored.

The Payne lode on the fourth and fifth levels has a length of about 1,600 feet. On No. 4 level, about 70 feet from the portal, the vein matter breaks up into a series of small stringers in the rocks of the slate belt outcropping on the southwest slope of the ridge. In No. 5 level the lode is more abruptly ended by faulting on reaching the same rocks. Much the same conditions exist at the southwest faces of Nos. 6, 7, and 8 levels where slaty rocks were encountered. These slates, however, are regarded as forming a narrower belt than those at the portals of Nos. 4 and 5 adits, and leave a large block of unexplored ground between the two belts. At the northeast faces of Nos. 5, 6, 7, 8, 9, and 10 levels and, it is reported, Nos. 3 and 4 levels also, the lode encounters another minor slate band along which it swings to the northwest for a short distance to end against a strong-looking fault or crush zone striking north 65 degrees west and dipping about 60 degrees northeast. Beyond this fault the lode has not been found or if it exists may not be mineralized and, therefore, has not been recognized. Possibilities in this direction are not exhausted and in view of the favourable character of the ground are worthy of further investigation.

Most of the ore above No. 5 level has been stoped out. It included a paystreak varying in width from an inch or so to 8 feet and probably

averaging 4 inches. Ore formed a continuous shoot from this level to the surface bounded at each end by faulted ground coincident with the presence of belts of slaty rocks. The shoot had a maximum length of about 1,250 feet on Nos. 4 and 5 levels. Below No. 5 it shortens to a few hundred feet and has been partly stoped out down to No. 8 level. A little stoping has also been done on Nos. 9 and 10 levels below No. 8. The lode is strong in all these lower levels but the vein matter consists of an increasing proportion of siderite and zinc blende, commonly interbanded, whereas in the main shoot above the ore was chiefly clean galena associated with quartz. The position of the main lode on No. 15 level is not certain, as mineralization has been encountered in at least two shear zones, either or neither of which may correspond with the lode above. At this low level the chief vein mineral is siderite. It forms masses up to 2 feet wide and carries a little disseminated blende.

The ore minerals are galena, zinc blende, and pyrite and the gangue minerals, quartz, siderite, and small amounts of calcite. The galena carries grey copper and other silver-bearing sulphides, the average shipping ore giving 120 ounces of silver to the ton and 68 per cent lead. Traces of tin are reported to have been discovered in the ore. The lead ore became mixed with siderite on No. 4 level and with blende on No. 5 level. Below No. 5 level siderite is the abundant vein material. On No. 8 level it is associated with bands of blende carrying a little galena and up to 8 inches thick.

The future of the property depends partly on the possibilities of the large tonnages of low-grade concentrating material in the vicinity of and below No. 8 level, and partly on discovering ore below No. 5 level southwest of the present workings.

QUEEN BESS GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 55; 1904, p. 189; 1926, p. 254. Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 200.

The Queen Bess group, comprising nine Crown-granted claims and fractions, is owned by Consolidated Queen Bess Mines, Limited, Alamo, B.C. The property is on the east side of Howson creek and is reached by a well-graded road, 4 miles long, extending up Howson creek from Alamo station. A good trail 6 miles long also leads to the property from Sandon. The main camp is at an elevation of about 5,100 feet or 2,700 feet above Alamo. The mine workings (*See* Figure 8) are connected with the company's concentrator at Alamo by an aerial tram which also serves Idaho and Alamo mines on the opposite side of Howson Creek valley.

The principal lode outcrops were discovered in 1892 and development commenced almost immediately. In its early years the property was operated by a local syndicate. About 1897 it was acquired by the Queen Bess Proprietary Company of England who controlled it until about 1903 when it was taken over by the Bank of Montreal. On January 1, 1904, the property again changed hands to Queen Dominion Mining Company, Limited, of Vancouver. Thereafter, little work was done on it for a number of years. In 1916 it was acquired on lease and bond by Clarence Cunningham who within a short time discovered the largest shoot in the

mine, a shoot which subsequently yielded a net profit of $1,250,000. Following the exhaustion of this important ore-body production dwindled, only small shipments having been made since 1922 and these largely the result of leasing operations above the uppermost or No. 1 adit.

The production of Queen Bess mine has been chiefly from the main lode or "A vein." The first shipment of 40 tons, made in 1893, carried 96 ounces in silver to the ton and 74 per cent lead. No production is recorded in the following four years, but in 1898 shipments of 1,700 tons yielded an average of 89 ounces in silver and 51 per cent lead. The next four years saw further important production, but following this period the property shipped comparatively little until the main shoot was discovered in 1916. From December, 1896, to December, 1902, the production of the main lode amounted to 6,283·64 tons averaging 69·99 ounces in silver to the ton and 48·8 per cent lead. Large shipments of oxidized ore reduced the average tenor. Between November, 1904, and November, 1908, the north lode or "C vein" produced 92·23 tons yielding 9,965·95 ounces silver and 109,438 pounds lead. Two small shipments gave 0·23 and 0·33 ounce gold to the ton. Altogether the property is credited with a production of 18,775 tons carrying an average metal content of 76 ounces in silver to the ton and 49 per cent lead.

The workings on Queen Bess mine are mostly on Queen Bess and American Girl claims and are on the east slope of Howson Creek valley between elevations of 5,000 and 5,600 feet. The property extends eastward across the summit of the long, wide, nearly flat-topped ridge between Howson and Carpenter creeks, and on the latter slope a little work has been done on the Palmita claim on what is probably the easterly continuation of the main vein zone developed at Queen Bess mine.

At least three lodes have been mined. Of these the main lode or "A vein" has produced the bulk of the ore. From the north lode or "C vein" a small tonnage has been shipped. Between these veins a third lode or "B vein" has been slightly developed.

The rocks are chiefly Slocan sediments comprising blocky argillites, quartzites, and slates. The sediments have a general strike of north 55 degrees west and, in underground workings on the main lode, show a general synclinal structure complicated about midway of the workings by a short anticlinal roll (*See* section EF, Figure 3, of Memoir 173, in pocket). The upper strata are mostly deformed, slaty types, whereas the lower beds are mainly massive, argillaceous and quartzitic rocks. The sediments are intruded here and there by porphyry dykes which so far as observed appear to have had little influence on ore deposition along the main lode. Strong faults are numerous. They strike, in the main, parallel with the sediments and across the trend of the vein-lodes. They appear to be of premineral age, but movement has also taken place after ore deposition so that the lodes are offset for distances ranging from a few inches to 100 feet or more. The throw in each case is to the right.

The main lode is developed by nine main levels over a vertical range of more than 500 feet below the uppermost (No. 1) adit or nearly 700 feet below the highest outcrop. Nos. 1, 2, 3, 4, 5, and 10 are adits and Nos. 6, 7, and 9 the principal intermediate levels. In addition, and in particular in developing the main ore-body, a number of other short intermediate

levels were run. All levels are connected by raises and stopes. The lode cuts across the strata on a general strike of north 45 degrees to 50 degrees east, dips southeast at an average angle of 40 degrees, and has a maximum explored length of over 1,700 feet. Development work disclosed a number of ore-bodies, now mostly worked out. Prior to 1916 work was confined to the section of the mine above No. 5 level and, mostly, below No. 1 level within a distance of about 780 feet of the portal. Within this block of ground the ore formed one composite shoot commencing at the portal of No. 1 adit and raking to the northeast. The shoot had a maximum length of about 200 feet along No. 4 level. Below No. 2 adit it included much lean and barren vein matter. A second ore shoot was first encountered on No. 5 level about 400 feet beyond the outer ore-body. This inner shoot pitched nearly with the dip of the lode, was worked down to No. 7 level, and for over 100 feet vertically above No. 5 adit. It had an average depth from top to bottom of over 250 feet and a maximum length of about 350 feet. It varied in width from 1 to 25 feet and included as much as 16 feet of clean galena. Besides ore minerals the lode matter included an abundance of crushed wall-rock and a variable but generally considerable amount of quartz. The high-grade character of this ore-body and the ease with which it was worked made it one of the most profitable shoots discovered in the district. This ore shoot is not entirely exhausted although the most profitable part of it has doubtless been removed. Below No. 7 level a winze sunk for 100 feet is stated to have encountered good ore, and above the old stopes a block of ground, extending for 200 feet or more to the surface, remains to be investigated.

Between the main shoot and the outer ore-body is an intermediate zone, several hundred feet in length, of comparatively barren ground. This zone is coincident with a general bend in the lode, first to a more northerly and then a more easterly direction, due to a flattening in the dip of the lode where it crosses softer, more slaty strata. On either side of the bend the lode is in firmer rocks where conditions were more favourable for mineral deposition.

The two principal ore shoots occurred in rocks that are mostly massive and the boundaries of the shoots are, in places, defined by strong faults or shear zones. These faults would tend to deflect the upward course of mineralizing solutions rather than allow them free passage. Each of the ore-bodies lies within a bend in the vein from an easterly to a northeasterly direction, a peculiarity of ore deposition not uncommon in Slocan.

Towards the face of No. 9 level, and over a length of about 250 feet, the main lode shows a mineralization somewhat different from that in the main ore shoot above in that zinc blende is an important constituent. Farther southwest, along No. 9 level, more zincy vein matter was found in a raise above the level. The stretch between these discoveries is in line with the downward continuation of the main ore-body, but here comparatively little mineralization was noted. Some investigation will be required in this section to prove whether the mineralized parts of the lode on No. 9 level are parts of two distinct ore-bodies extending downwards from the level or, as seems more likely, are downward continuations of mineralization present above No. 7 level.

The depth to which oxidation has extended in the main lode is rather remarkable. It is pronounced as far down as No. 5 level, is still strong on No. 7 level, and was observed on No. 9 level nearly 600 feet below the surface.

The chief ore mineral is argentiferous galena and the principal gangue is quartz. The galena occurs partly in gneissic or banded form in both upper and lower workings. In the main shoot the galena carried about 1½ ounces silver a ton to the per cent lead. Under the microscope the galena is seen to contain some ruby silver. Zinc blende is associated with the galena and in the lower workings is an important constituent of the ore.

The north or "C" lode lies about 500 feet northwest of and nearly parallel to the "A" lode. It has a general strike of north 60 degrees east and dips steeply to the southeast. This attitude is apparently controlled by a strong joint fracture in the enclosing rocks. The lode is developed by two adits about 150 feet apart vertically. The lower is about 200 feet below the elevation of No. 5 adit on the "A" lode and has opened the "C" lode over a length of 600 feet. The upper adit is only a few feet long. Some stoping has been done both above and below the lower level from which two winzes have been sunk, the second from the portal connecting with a short blind level. The vein matter varies up to a few inches in width and is chiefly galena associated with oxidized ore and quartz.

A little work has also been done on the "B" lode lying about midway between the "A" and "C" lodes. The workings include three or more short adits. They were not examined but are reported to have been run on a wide zone of brecciated rock carrying some vein matter and conspicuously oxidized at the surface. Very little evidence of ore mineralization was discovered.

RAMBLER-CARIBOO GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 62; 1904, p. 194; 1909, p. 113; 1911, p. 140; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 200-201.

The Rambler-Cariboo mining property has been recently acquired by Slocan Rambler Mining Company, Limited, Vancouver, B.C. The property includes the Rambler, Cariboo, Antelope, Best fraction, Jennie No. 3, Last Chance No. 4, Humphrey, and Keno Crown-granted claims in the basin of McGuigan creek. The main camp at elevation of about 5,000 feet is accessible by wagon road from Rambler station.

The property was first operated by the Rambler-Cariboo Consolidated Gold and Silver Mining Company. On July 31, 1899, it was taken over by Rambler-Cariboo Mines, Limited, a British corporation. The property at that time included five claims covering 175 acres. Prior to 1904 development had been confined to the upper eight levels, the lower five of which were connected with each other and with No. 3 adit level by a shaft 460 feet deep. Headquarters during this period were at the old upper camp at 6,000 feet elevation, where a mill had been constructed in 1901. Owing to difficulties encountered in operating the mine to the depth then attained a crosscut 4,523 feet long was driven from the valley of McGuigan creek 520 feet below No. 8 level. The crosscut was completed in 1906. This level, No. 14, was subsequently connected by a raise with No. 8 level, and Nos. 9, 10, and 12 intermediate levels run above it.

In 1912 a new mill with 75 tons daily capacity was constructed on Seaton creek at Rambler station and connected with No. 14 level by an aerial tramway 7,000 feet long with a drop of 1,600 feet. In 1919 the property was extended by the purchase of the Jennie No. 3 and Last Chance No. 4 claims along the western extension of the Rambler-Cariboo lode. These claims had been located in 1891 and have extralateral rights. Levels Nos. 8 and 9 were extended for a short distance into Jennie ground and towards the face of level 8 some good vein matter carrying as much as 8 or 10 inches of clean ore was discovered over a distance of 40 feet. In 1921 the company suspended operations. Since that time work has been carried on under lease with the result that comparatively little development has been done and the available ore reserves are mostly exhausted.

The mine has fourteen levels, of which Nos. 1, 2, 3, and 14 are adits. The lowest, No. 14, is about 1,300 feet vertically below the lowest lode outcrop and is 2,000 feet below vein outcrops on the summit of the ridge on the Best-Antelope hill.

The Rambler-Cariboo mine since 1893 has produced ore valued at about $2,300,000. During the period 1893 to 1906, inclusive, developments from the upper eight levels yielded about 14,500 tons of ore averaging: lead, 37 per cent; zinc, 14 per cent; and silver, 127 ounces to the ton. In 1914 some 1,300 tons of silver-lead concentrates were shipped. Total shipments to the end of 1924 include 153,364 tons carrying 3,104,230 ounces silver, 21,802,555 pounds lead, and 3,883,817 pounds zinc. Zinc production began in 1913 following the erection of the new mill on Seaton creek. Since 1919 the average annual production has fallen off greatly, operations being mostly by lessees working out the productive parts of the old ore shoots. The years of heaviest production included the periods of 1901 to 1904 and 1907 to 1916 inclusive.

The rocks underlying the property are Slocan sediments and later intrusives. Most of the sediments are compact, quartzitic, argillaceous, and, in part, calcareous varieties with some more thinly laminated, slaty beds. The predominant strike is very nearly north 65 degrees west and the average dip is 57 degrees southwest. Variations in strike from west to north 20 degrees west were observed. A comparatively large, somewhat elliptical quartz diorite stock outcrops on the Best-Antelope hill and occupies a central position in the underground workings. Dyke-like apophyses from this stock and a number of dykes and sills of quartz porphyry varying from a foot to over 100 feet in thickness are present. Some evidence of crushing, folding, and faulting was observed, particularly in connexion with the slaty and other less competent strata. In certain cases the movements appear to have offset the lode for distances of 50 feet or more. Probably much of the movement took place in premineral time.

The lode system has a general strike of north 40 degrees east but swings to nearly east and west in the more westerly underground workings. The dip is southeast at an angle which between levels No. 3 and 8 is nearly 80 degrees. Below No. 8 level it is less steep on the average and between Nos. 12 and 14 levels it appears to be as low as 50 degrees. A series of mineralized fissures, possibly of the nature of cross-fissures, strike from 25 to 45 degrees more to the east of north than the main lode

and good ore occurred in the vicinity of the points of intersection with the main lode. In addition there are several quartz veins following more or less closely the strike of the enclosing formations.

The main lode has been explored underground over a maximum length of about 2,000 feet. In this distance three important ore shoots were found, namely, the "main" shoot situated on either side of the boundary line between the Rambler and Cariboo claims; the "north" shoot lying entirely within the Rambler claim; and the "south" shoot some distance south of this claim. The main shoot extended from near the third to the eighth level, had a maximum length of about 150 feet, and raked rather steeply to the southeast. The north shoot extended from near the north end of No. 4 level to and probably below the ninth level and, if anything, raked to the northeast. It had a maximum stoped length above the eighth level of over 200 feet. The south shoot was best developed in the vicinity of levels 9 and 10 but continued down to or below level 12 and up to level 7, in which direction it came close to the northeasterly extension of the main shoot. The south shoot apparently raked to the southeast. It had a maximum length of about 160 feet. In addition to these three shoots a considerable body of ore was worked on the upper levels and stoped to the surface. This section of the mine is now inaccessible.

The ore-bodies seem to have been best developed in the more competent rocks, including the quartz diorite stock, quartz porphyry dykes, and the massive sedimentary beds. The slaty formations were less favourable and in them the more serious disruptions, faults, etc., most likely occurred. The main and north shoots and particularly the north shoot are now only partly accessible, but so far as could be ascertained they lay mainly in the quartz diorite stock. They included as much as 16 feet of ore containing up to 7 feet of clean galena. Between levels Nos. 3 and 6 the ore in the main shoot was exceptionally rich. The north shoot included lean as well as very rich ore. In it between levels 8 and 9, and over a length of 60 feet, clean ore averaged 18 inches in width on the hanging-wall side of the lode. The south shoot proved more composite in character than either of the others and towards the bottom, in the vicinity of level No. 12, included considerable zinc blende. This shoot was well developed between the seventh and eighth levels where for 80 feet or more it contained vein matter up to 16 feet thick including 4 feet of clean galena on the hanging-wall and 1 foot on the foot-wall. Below level 8 the ore formed a series of shoots with comparatively barren matter between. Rich lead ore carrying much grey copper was found as far down as level 12 where clean ore was in places 7 feet wide.

Recent mining work has been chiefly an exploration, on levels Nos. 9, 10, and 12, of the northerly extension of the south shoot. On the lower two of these levels there was evidence of what may be either a mineralized cross-fissure or a jog in the main lode from north 40 degrees east to north 70 degrees east. Some good lead ore was found along this "cross-vein" and further efforts should be made to prove its extent.

The first work to be done on this property was on quartz veins outcropping north and northeast of the upper camp, on both sides of the Best-Antelope hill. In the course of this work No. 1 crosscut adit was

driven and resulted in the discovery of the silver-lead deposits of the main lode, on which subsequent work was concentrated. Two of the quartz veins were explored by short adits about 500 feet above and 1,200 feet northeast of the old Rambler mill and about half-way up the slope of the ridge that on the south side is underlain by the stock of quartz diorite porphyry. These veins, about 200 feet apart, have been traced to the summit on a strike of about north 20 degrees east and a dip of about 45 degrees southeast. In the southeasterly adit which is 20 feet long, the vein consists of drusy quartz, which averages a foot in width, and is in part well mineralized with grey copper and jamesonite. The other adit, 75 feet in length, encountered some high-grade silver ore in a quartz vein having a width of from 2 to 20 inches and from which, it is stated, 18 tons of ore assayed 499 ounces of silver and $7.50 in gold to the ton and 2 per cent copper. On the north slope of the hill, on Antelope ground, work was done by lessees in the early nineties on quartz veins at three or four closely spaced localities. The rocks are chiefly metamorphosed, massive sediments striking north 60 degrees to 65 degrees west and dipping southwest at angles varying from 20 degrees to 60 degrees. Two quartz veins, which possibly are continuations of the veins on the south slope of the hill, strike north 5 degrees to 25 degrees east and dip southeast at angles varying from low to 60 degrees. They carry considerable grey copper as well as some galena, blende, and pyrite. They appeared to be faulted at intervals and their continuity and correlation are difficult to determine. A third quartz vein follows the bedding of the sediments and dips 30 degrees southwest. It carries much the same type of mineralization but holds more galena (both cube and steel) and blende. Antimony, probably in the form of stibnite, has been reported from this slope of the hill, but was not seen.

The ore from the main lode consists of cube and steel galena, zinc blende, pyrite, grey copper, ruby and native silver, and a little copper pyrites in a gangue composed principally of quartz. The early shipments, 1896 and prior, yielded 31 to 64 per cent lead and from 79·6 to 273·3 ounces of silver to the ton, the oxidized ore running 22½ per cent lead and from 166 to 178·5 ounces in silver to the ton. A general average of the south shoot on No. 9 level gave 174 ounces in silver to the ton and 65 per cent lead. The silver content, in carload lots, of the main shoot between levels Nos. 5 and 3 ranged from 264 to 366 ounces a ton, and on No. 10 level and between levels 10 and 9 assayed 200 ounces of silver to the ton. On No. 9 level, one shoot 70 feet long and averaging from 2 to 6½ feet of clean ore sampled 246 ounces in silver to the ton and 74 per cent lead. On the twelfth level a sample gave silver 169 ounces, lead 76 per cent. Pyrite, in places, contains much silver and is, no doubt, impregnated with grey copper.

At present (1928) the property lies idle. Its larger ore-bodies have apparently been worked to the economic limit. Such mineralization as is still in evidence is of doubtful value. Much of the underground workings are inaccessible or in poor repair, but certain encouraging features were noted. The underground workings show remarkably few crosscuts and there are long stretches along low-grade lode matter from which carefully planned crosscuts might lead to something more important. The significance

of what appear to be " cross-fractures," such as those recently encountered on levels 9 and 10 southwest of the main raise, should be investigated. Elsewhere in the mine where the main lode has, apparently, swung rather sharply towards the east or west there is the chance that a cross-fracture may have been followed and the continuation of the main lode overlooked. The location of the main lode both to the north and south of No. 14 crosscut should be determined and the downward continuation of the main ore-bodies investigated by crosscutting. The possibilities of finding further ore in the large block of ground above No. 3 level are somewhat encouraging in view of the mineralization apparent both along No. 3 level north of the shaft and on the ridge top 1,000 feet above. The discovery on level 14 of lead ore of essentially similar character to some noted in the vicinity of stopes above No. 1 level, 1,300 feet above, indicates the possibility of ore occurring at even greater depths. Further work in the vicinity of level 14 south might be undertaken to prove whether commercial ore exists, whether the mineralization there represents the top or bottom of an ore shoot, and whether the lode being followed is the main lode developed in the upper levels. Investigation of apparent offsets of the lode such as that observed on level 3 south of the main shaft should be made to determine the direction of faulting, which probably is the direction of other offsets or apparent offsets in the lode.

RECO GROUP

References: Geol. Surv., Canada, Ann. Rept. 1894, pt. A, p. 34.
Ann. Repts., Minister of Mines, B.C., 1896, p. 58; 1897, p. 534; 1904, p. 191; 1908, p. 98; and other years.

The Reco group comprises the following eighteen Crown-granted claims and fractions: Clifton, New Denver, Grand View, Ruecau, Gopher, Texas, Twilight, Omega, Mollie, Eldorado, Pirate, Polo, Number One, Number Two, Number Three, and Number Four claims and Ephraim and Number Five fractions (See Figure 1). The group is owned by Reco Mining and Milling Company, Limited, % J. M. Harris, Sandon, B.C. The property on the west side adjoins the Noble Five group. It occupies a large area on the south slope of Reco mountain. Trails lead northeast from Sandon to the principal workings which range to over 6,000 feet above sea-level and are mostly between 1,500 and 2,500 feet above Sandon.

The history of the group dates from the location of the Texas claim, June 14, 1892. In July of the same year the claim was purchased by the Reco Company. Subsequently the other claims of the group were located. Later in 1892 capitalists bonded the property, but in 1894 the property reverted to its original owners. In 1895 the No. 3 or Reco-Goodenough lode was discovered and soon after developed into an important mine. In September, 1896, the Reco Mining and Milling Company was incorporated.

Records kindly furnished by Mr. J. M. Harris indicate production from four lodes referred to as Nos. 1, 2, 3, and 4 lodes. Shipments began from No. 2 lode in 1894, from No. 3 lode in 1895, from No. 1 lode in 1900, and from No. 4 lode in 1911. From 1894 to 1919, inclusive, a production is recorded each year from one or other of these lodes. Shipments from

1895 to 1903, inclusive, were mostly from No. 3 lode and those from 1904 to 1913 largely from No. 2 lode. Production and values from the four lodes may be summarized as follows:

Lode	Producing years	Weight, pounds	Silver, ounces	Lead, pounds	Net smelter returns
					$ cts.
No. 1	1911; 1912; 1918.....	24,986	2,069·21	13,273	1,438 24
No. 2	1894-96; 1904-13; 1915-18.....	7,856,418	390,256·78	3,591,509	271,575 68
No. 3	1895-1904; 1909; 1913; 1915-19..	7,732,001	875,374·44	3,285,618	556,572 05
No. 4	1911-12; 1916-19; 1922.....	943,968	31,109·53	497,207	40,388 19
		16,557,373	1,298,809·96	7,387,607	869,974 16

The average metal content of ore shipped from workings on these four lodes was: for No. 1 lode 165 ounces in silver and 53 per cent lead; for No. 2 lode 98 ounces in silver and 45 per cent lead; for No. 3 lode 226 ounces in silver and 43 per cent lead; and for No. 4 lode 66 ounces in silver and 53 per cent lead. Much the richest ore was derived from the No. 3 or Reco-Goodenough lode, some shipments carrying as high as 730 ounces in silver to the ton.

Except for a shipment of 27 tons from the No. 4 lode in 1922 there is no record of production since 1919. The workings on No. 3 lode are largely inaccessible; those on the No. 1 and No. 2 lodes partly so; but those on the No. 4 lode are mostly open.

The claims are underlain by sedimentary and intrusive rocks. The sediments belong to the Slocan series and have a general northwesterly strike. The major structure over the greater width of the area of the claims is anticlinal, the strata dipping to the northeast and southwest at angles averaging about 45 degrees. The anticlinal structure is complicated by several minor folds and towards the southwest pitches under a syncline chiefly of black slates. These slates are repeated towards the northeast side of the property in the vicinity of Reco mountain on the Clifton and Grandview claims. Elsewhere some slaty rocks are present, but on the whole the sediments are more massive and include calcareous sandstones, quartzites, argillites, and a few narrow limestone beds. Well-defined banding and bedded structures are common and some strata have that curious conglomeratic appearance noted in the vicinity of the American Boy and Last Chance mine workings. A notable feature is the great abundance of minor intrusives bodies. Across the whole width of the property, and particularly in the central and in the extreme northeasterly parts, the sediments are intruded by numerous light-coloured dykes striking with the general trend of the sediments. The dykes occur for the most part in groups in which the individual dykes are separated by widths of sediments about equalling that of the dykes, or lie still closer together. On the Twilight and Goodenough claims such a belt nearly 1,000 feet in width is composed largely of dyke rock which on its northwesterly course through the Texas and Deadman claims fingers out into a number of dykes and smaller groups of dykes (*See* Figure 1). Another such group extends through the New Denver, Ruecau, and Goodenough claims and

another through the Gopher, Dunedin, and Clifton claims. The light-coloured dykes have the general composition of quartz porphyry, but vary to types in which there is less quartz. In addition to these acidic intrusives there are more basic dykes, mostly dark green, micaceous lamprophyres characterized by an abundance of secondary alteration products of which serpentine and calcite are most common. The basic dykes are rarely exposed at the surface where they are easily eroded. They were noted in workings on Nos. 2 and 3 lodes and are younger than the quartz porphyry dykes as, in places, they were observed to cut them.

The workings are on lodes referred to as Nos. 1, 2, 3, and 4 lodes respectively. Of these No. 2 (Large or Main Reco) and No. 3 (Small, Reco-Goodenough) lodes have provided the bulk of the ore shipments. No. 1 or Texas lode has received comparatively little attention. No. 4 lode at Number One mine produced considerable ore. The workings on No. 4 lode are the only ones in which any considerable showings of ore could be seen.

The No. 2 or main lode cuts across the northwestern end of the Ruecau claim on an average strike of north 50 degrees east and an average dip of about 65 degrees or 70 degrees southeast. It has been worked from four adits over a vertical range of more than 350 feet. The lode has also been traced up the hill by open-cuts over an additional vertical distance of about 300 feet. The main workings are Nos. 1, 2, and 5 adits along which an aggregate of almost 5,000 feet of work has been done, mostly in drifting along the lode. No. 5, the longest adit, is about 1,200 feet long. These levels are connected by raises and stopes. None of the adits is accessible for more than a hundred feet or so from the portal. The lode is a strong, mineralized fissure zone, which, as explored underground, was stated to average 2½ feet in thickness, narrowing where it cuts across porphyry dykes and more massive sediments and widening to a maximum of 40 feet where it encountered a crush zone in broken, soft, slaty rocks. In the upper workings the vein matter formed a paystreak which rarely exceeded 18 inches, but in one place was 8 feet thick. A large proportion of crushed country rock was associated with the vein matter. The principal ore minerals were galena, both steel and cube, blende, and pyrite. The gangue minerals were siderite and quartz. Both the galena and blende carried much silver. A shoot entered by the uppermost or "Discovery" adit extended down to a little above adit No. 3, from which level three raises were put up within an interval of 425 feet. At 700 feet from the portal of No. 3 adit the lode entered the crushed zone mentioned above, widened out to 40 feet, and contained parallel bands of ore, one band following the foot-wall through the break. At a winze sunk from No. 3 adit a streak of galena 1 to 4 inches wide was followed downwards for 20 feet. Beyond the winze streaks of galena up to 4 inches thick and 3 feet long followed joint planes to the face.

To the southwest of the workings on No. 2 lode, three adits, Nos. 9, 11, and 15, on the Texas claim, and No. 19 adit, started on the Omega claim but passing into Texas ground, were driven to explore the downward continuation of No. 2 lode. These adits are 228, 318, 535, and 806 feet, respectively, below No. 5 adit. They are not connected underground and there is consequently but little assurance that the vein matter discovered

in them is on the same lode as that found in the upper workings. No. 9 adit is inaccessible and No. 11 partly so. The lower two adits are open to the face and expose encouraging mineralization. These four adits follow a strong zone of shearing and fissuring, striking about north 70 degrees east and dipping southeast at angles varying from less than 35 degrees to over 70 degrees. It seems likely that this zone is connected with the more heavily mineralized lode in the main workings above, although it strikes about 20 degrees more to the east. Towards the face of No. 15 adit, which is 1,200 feet long, some vein matter was observed, including several inches of galena mixed with spathic iron gangue. In the last 500 feet or so of this adit several cross-fractures were observed, striking about north 45 degrees to 50 degrees east and dipping southeast. These fractures form either the foot- or hanging-wall of the main zone of fissuring over short distances and then pass into the wall-rock. This section of the adit is closely in line with the rake of the main ore-body in No. 2 lode above level 5, and is consequently a section where further exploratory work might advantageously be done. On No. 11 adit a lens of galena 12 inches wide was encountered 440 feet from the portal. The shoot is 50 feet long with from 1 to 18 inches of fine cube and oxidized ore assaying 150 ounces in silver to the ton. A winze was sunk on this ore for 35 feet, a short intermediate drift run from it for 45 feet, and the ore stoped out to the main level above. A considerable block of ground still remains to be explored between levels 9 and 11. On level No. 19 the lode structure is complicated by faulting, mostly pre-mineral, which appears to have had some localizing effect on the mineralization. A lens of galena ore was discovered along a short parallel fracture lying about 75 feet to the northeast of the main fissure.

To the southwest of these workings on Texas and Omega claims No. 2 lode seems to be continuous with the lode developed on the adjoining Slocan Sovereign claim.

The No. 3 or Reco-Goodenough lode, otherwise referred to as the "Little vein," lies about 750 feet southeast of and parallel with the main or Reco No. 2 lode. Though much smaller than No. 2 lode it produced probably the richest silver-bearing lead ore yet found in any quantity in the Slocan. The lode is explored by Nos. A, 2, 4, 6, and 8 adits and by No. 7 intermediate level over a vertical range of 529 feet. Altogether about 5,000 feet of drift and crosscut have been run in developing this lode. All levels are connected by raises and stopes. The workings, except for "A" level, are mostly inaccessible. The width of the main vein in this lode averaged only 6 or 8 inches, including about 3 inches of solid ore. The maximum thickness of the vein matter was about 30 inches. Ore was stoped from the surface to a little below No. 7 level, where it apparently gave out along a flat fissure. This ore-body lay along the Ruecau-Goodenough line. Most of the development work was done on the Ruecau claim, across which the longest or No. 4 adit extends for almost its entire length of 1,000 feet. Towards the faces of Nos. 4 and 6 adits the lode is said to have feathered out in a green, basic dyke about 7 feet wide. No ore has yet been discovered on level 8. The shoot pitched to the southwest or out of the hill at about 30 degrees. Cross-fissures or "breaks" were prominent and in places apparently formed boundaries for the ore. The

lode intersects many porphyry dykes within whose walls vein matter formed equally as well as in the sediments. Blende, galena, and pyrite appear along joint planes of the rocks adjacent to the principal paystreak.

The ore minerals included galena, blende, ruby silver, grey copper, argentite, and native silver. Pyrite was also present. The gangue was of quartz and calcite. The paystreak of solid ore was generally easily separated from the adjoining gangue and wall-rock.

No. 4 lode as worked at the Number One mine is directly in line with and probably is the southwesterly continuation of No. 3 lode. The workings on the two lodes are separated by about 1,600 feet, in which is included a great width of porphyry.

The workings on No. 4 lode include four adits over a vertical range of 400 feet. The uppermost or No. 1 adit is inaccessible. The lowest or No. 4 is 1,200 feet or so below the lowest or No. 8 level on No. 2 lode. Altogether over 2,500 feet of drift and crosscut have been run. Some stoping has been done above levels Nos. 2 and 3, but no connexions were made between the different levels. The lode cuts across a variety of sedimentary rocks and a number of quartz porphyry dykes. One large dyke occurs near the face of No. 2 and another at the portal of No. 3 adit. The former is also encountered at the face of No. 3 level and has a width of 40 feet. The dyke at the portal of No. 3 is well over 100 feet in width. The lode is a mineralized fissure having a general strike of north 45 degrees to 50 degrees east and dipping southeast at an angle varying from 60 degrees or less to 75 degrees. It varies in width from a mere crack to over 4 feet, and includes a paystreak which is generally only a few inches wide. A well-developed vein is exposed on No. 3 level where considerable stoping has been done on it over a length of about 200 feet beginning about 235 feet from the portal. This shoot was picked up on No. 2 level, where the 170-foot crosscut from the portal intersects the lode, and has been stoped above the level over a length of 40 feet. The crosscut follows the eastern boundary of the Slocan Sovereign claim and the southwesterly part of the shoot should continue into this claim. Good lead ore was observed at different points along No. 2 level within the last 230 feet of the drift. Near the face a shaft revealed several inches of mixed galena and blende. These showings have not been developed. They should have been found towards the face of No. 3 level where, however, but little mineralization was noted and where, in consequence, some crosscutting might be done to advantage.

Here and there at different places along its course the lode is offset for distances of 15 or 20 feet along fault planes following the bedding of the sediments which strike north 35 degrees to 40 degrees west and dip northwest at angles varying from 50 degrees to 80 degrees.

The ore minerals include galena, blende, and pyrite. The galena is generally coarse cube and in part distinctly gneissic in appearance. The chief gangue mineral is siderite but quartz is locally abundant.

The No. 1 lode is explored on both sides of the Texas-Deadman line, most of the workings, however, lying within Texas boundaries. The workings include Nos. 1, 2, and 3 adits and an intermediate level above No. 3, over altogether a vertical range of 100 feet. Only a few hundred feet of work has been done on this lode, which lies parallel with and about 600

feet northwest of the No. 2 lode. It contained some ore which is said to have been rich, but bunchy. To the southwest the lode is thought to include the Omega vein on the adjoining Omega claim.

RED FOX GROUP

References: Ann. Repts., Minister of Mines, B.C., 1902, p. 148; 1904, p. 202.

The Red Fox group consists of the Red Fox, Red Fox fraction, and Central Crown-granted mineral claims, the property of Geo. H. Aylard and associates, 211 Belmont House, Victoria, B.C. The group lies east of and adjoins the Antoine claim and contains the east and northeasterly extensions of the Antoine lode.

No work has been done on this group for many years and the underground workings are mostly inaccessible. The property was partly developed by extending the upper workings of the Antoine mine into Red Fox ground. In 1902 the Red Fox workings included 675 feet of drifts and crosscuts, 425 feet of raises and winzes, 300 feet of stoping, and 200 feet of open-cuts.

Development commenced in 1895, but no production is recorded until 1901 when 161 tons of silver-lead ore was shipped. This ore averaged 170 ounces in silver to the ton and 41 per cent lead. Shipments were made in each of the following five years and aggregated 396 tons of ore yielding an average return of 213 ounces in silver to the ton and 47 per cent lead.

The workings extend through the narrow ridge separating the Antoine and Rambler-Cariboo basins. The slope facing northeast into the latter basin is quite precipitous and exhibits a section of contorted slaty and thinly bedded argillites cut by a great number of twisted porphyry dykes which, in a general way, follow the trend of the enclosing sediments and average only a few feet in width. The southwestern slope into the Antoine basin is more gentle and partly conforms with the southwesterly dip of the formations, which include a large proportion of slaty sediments intercalated occasionally with limy beds. These sediments are invaded by bodies of quartz-porphyry or other acid intrusive types and by a few narrow basic dykes.

The vein system and mineralization are similar to those of the adjoining Antoine property (*See* description of this property).

REDRESS CLAIM

The Redress Crown-granted claim, property of G. F. Ransom, J. H. Drewery, and H. T. Twigg, Enderby, B.C., lies northeast of and adjoins the Mercury claim (*See* description of this claim) and includes an extension of the same lode. A total production of 8 tons, in 1920 and 1921, is credited with an average content of 237 ounces in silver to the ton and 60 per cent lead.

R. E. LEE CLAIM

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 31.
Ann. Repts., Minister of Mines, B.C., 1896, p. 60; 1898, p. 1074; 1923, p. 224; and other years.

The R. E. Lee Crown-granted claim is on the crest of the divide between Carpenter and McGuigan creeks and just to the northeast of the

summit of mount Payne. It is owned by H. W. Foster, % Jas. Anderson, Stock Exchange Building, Vancouver, B.C. The property is accessible from Sandon via either the Payne or Last Chance mines.

The property has a long history, development having commenced in 1892. Work was first confined to investigating a well-defined fissure-vein lode outcropping on the northern or McGuigan Creek slope of the ridge, and subsequently (about 1898) a long crosscut tunnel was run from the southern or Carpenter Valley slope to tap this lode at a depth of nearly 400 feet below the lowest workings on the north slope. This long crosscut was inaccessible at the time visited, but is reported to have intersected the lode at 2,000 feet from the portal. The workings on the north slope include three adits, of which only the uppermost was accessible and this had caved at about 685 feet from the portal.

Production returns are incomplete. The first recorded shipments were made in 1895 and amounted to 35 tons of silver-lead ore carrying an average of 130 ounces in silver to the ton and 54 per cent lead. To the end of 1906, some 247 tons are accounted for, this ore having an average content of 122 ounces in silver to the ton and 68 per cent lead. No other shipments are recorded, though it is reported that in 1923 about 10 tons had been extracted by lessees and that this ore was ready for shipment.

The underlying rocks near the summit of the divide are argillaceous and quartzitic sediments of the Slocan series. In the vicinity of the portal of the lower crosscut adit on the south slope black, slaty rocks outcrop. The sediments are intruded by numerous dykes and sill-like masses of quartz and feldspar porphyry.

The workings on the north slope are along a strong fault-fissure lode striking north 72 degrees east and dipping steeply to the southeast. The lode intersects sediments and porphyritic intrusives whose general trend is about north 65 degrees west, the sediments dipping about 50 degrees to the southwest. The lode varies from a few inches to 3 feet in width and is partly filled with crushed wall-rock, and partly with quartz, spathic iron, and ore minerals. In the upper adit the vein matter is strongly oxidized. In places a paystreak from 3 to 18 inches wide follows one or other of the walls of the lode for a few feet, but the best ore appears to have been stoped out. The ore minerals are galena, pyrite, and zinc blende and these form a vein breccia in quartz and siderite. At one place, about 400 feet from the portal of the upper adit, white sulphate of alumina and sodium is forming on the walls of the adit.

RICHMOND-EUREKA GROUP

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1,058; 1908, p. 99; and other years.
Rept. of Zinc Commission, 1906, pp. 189-190.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 201-202.

The Richmond-Eureka group, property of the Consolidated Mining and Smelting Company, consists of seven Crown-granted claims and fractions. It is on the steep eastern slope of the valley of the east fork of Sandon creek. The main working adit (No. 5) is connected with the railway at Sandon by an aerial tramway about 4,000 feet long with a drop of 1,500 feet.

The Richmond-Eureka lode (*See* Figure 12) was staked by Bruce White in 1891. The first recorded shipments, amounting to 70 tons, were in 1896. This ore ran about 100 ounces in silver to the ton and 50 per cent lead. No further shipments are recorded until 1907 when 40 tons of very similar ore were produced. The following five years include the period of greatest production during which the property was most actively operated. During these years 13,678 tons of ore was extracted and yielded an average return of about 47 ounces in silver to the ton and 15 per cent lead. In 1913 and 1914 about 1,200 tons of similar ore was produced. Since 1914 several parties have leased the property and the production has been small. More recently lease holders have been doing development work mainly on No. 4 level. In 1928, records show a further production of 59 tons of silver-lead ore averaging over 82 ounces in silver to the ton and about 46 per cent lead.

The underlying rocks are chiefly sediments of the Slocan series. These (*See* cross-section IJ, Figure 3, of Memoir 173, in pocket) are mostly compact, quartzitic, argillaceous, and calcareous varieties striking north to northwesterly and dipping rather steeply to the northeast. They are dislocated by strong reverse faults conforming closely in attitude with that of the sediments. The faults are of pre-mineral age, though some subsequent movement has taken place along them. The sediments are intersected by quartz-diorite porphyry dykes and a few basic lamprophyre and minette dykes.

The workings comprise a shaft, a series of open-cuts and short adits, and four main adits connected by raises and stopes. The underground work comprises about 6,000 feet of drifts and crosscuts and over 1,000 feet of raises. No. 5 adit is a drift about 1,500 feet long. The workings have explored the main lode over a horizontal distance of about 2,000 feet and a vertical distance of nearly 1,000 feet. In addition, the King adit, started on the Slocan King claim of an adjoining property, picks up the same lode in Richmond-Eureka ground at an additional depth of 263 feet.

The main lode is the eastern extension of the Slocan Star lode from the adjoining Silversmith-Slocan Star property. On Richmond-Eureka ground it has a general strike of north 80 degrees east and an average dip of 45 degrees to the south. In places the lode turns to follow formational planes, especially near the basic dykes. It is a strongly sheared fissure zone varying in thickness from a few inches to 42 feet, the thicker parts being largely filled with crushed rocks and horses of wall-rock. In general the lode widens out and has proved more profitable in the softer rocks and tightens in the more siliceous strata and dyke rocks.

Two important shoots have been found and have been largely stoped out. Of these the "main" shoot was much the larger. It varied from a few inches to 10 feet in thickness, had an average length of 150 feet, and extended 267 feet down the dip. This shoot has been mostly stoped out between the surface and No. 5 level, below which the lode tightens and includes mostly low-grade ledge matter. In this shoot streaks or bands of steel galena from 1 to 2 inches thick occurred close to the foot-wall of the lode, but the main pay-streak followed the hanging-wall, ranged up to 8 feet thick, and was composed largely of clean galena. Beyond the main shoot the lode splits. The workings follow the most southerly split and

disclosed a second but smaller shoot in harder ground. Recent work has been partly devoted to investigating the northern, foot-wall side of the divided lode, but without as yet finding any important mineralization. This recent underground work has been supplemented by surface prospecting which has yielded results that encourage the view that the block of ground extending from No. 3 level to the upper small workings, and which is as yet comparatively undeveloped, may provide substantial returns with a reasonable amount of further exploration.

The metallic minerals are steel and cube galena, zinc blende, pyrite, and a little chalcopyrite. Grey copper is generally present and leaf silver, though rare, has been noted. The gangue minerals include siderite, quartz, and some calcite. Siderite is abundant from the highest workings to the lowest. In the former it is associated with considerable calcite and at the lower levels mainly with quartz. Galena is the abundant and valuable ore mineral in the main workings, but its place is largely taken by sphalerite with depth. As a whole the mineralized area tends to rake westerly but this tendency is overcome by the fault zones which dip into the hill.

Early assays and analyses provide some interesting data. First class ore averaged about 40 per cent lead and 90 ounces in silver to the ton; second class, 8 per cent lead and 40 ounces in silver. An assay of a sample across a 3-foot band of clean galena gave 62·4 per cent lead and 157·3 ounces in silver a ton. One ore analysis gave: gold, trace; silver, 45·2 ounces; lead, 28·2 per cent; zinc, 10 per cent; iron, 11·4 per cent; silica, 18 per cent; lime, 7 per cent; sulphur, 11 per cent. Pyrite (with finely disseminated grey copper?) in quartz held: gold, trace to 0·02 ounce and silver, 581·9 ounces. Clean zinc blende held 9 ounces in silver. Blende and pyrite in a fine mixture held: gold, 0·14 ounce and silver, 50·2 ounces. Pyrite with a little galena in quartz held: gold, 0·08 ounce; silver, 19·06 ounces; and lead, 4·9 ounces.

RIO CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1911, p. 143; 1928, p. 294; and other years.

The Rio Crown-granted claim is in the basin of McGuigan creek above the Rambler-Cariboo vein and is accessible by road and trail from Rambler station. It is owned by J. L. Drumheller, 502 Columbia Building, Spokane, Wash.

Records of production show that this property made an initial shipment, amounting to 8 tons, in 1903. The ore carried about 140 ounces in silver to the ton and, altogether, 282 pounds of copper. Further shipments, comprising a total of 70 tons, were made in the years 1908, 1912, and 1915, this ore yielding an average of 295 ounces in silver to the ton and 40 per cent lead. In 1908, 15 tons netted $3,500.

Development work includes an upper adit, 200 feet long, a shaft, and a lower crosscut adit, 176 feet vertically below, that cuts the lode at 500 feet from the portal and drifts on it for over 400 feet.

These workings are on a fissure-vein lode cutting quartzites and siliceous slaty argillites of the Slocan series and quartz-porphyry dykes. The lode strikes north 65 degrees east and dips 45 degrees southeast. In the upper adit a shoot of dry ore was struck near the portal and, farther

in, a shoot of galena ore, 20 feet long and up to 6 inches thick. The long drift from the lower crosscut adit also encountered two ore shoots corresponding approximately in position to those discovered in the upper level, but on the whole carrying considerable more galena. The amount of work done on these showings is not known. The principal ore minerals are galena and grey copper.

ROCKLAND GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1904, p. 173.

The Rockland group consists of the Rockland, Rustler, and Willa Crown-granted claims, and extends across Aylwin (Eightmile) creek at an elevation of 3,900 feet and about one mile by trail from the Slocan-Silverton highway. The property is owned by Walter J. Nicholls, 202 Standard Stock Exchange Building, Spokane, Wash.

An adit on the north side of the creek is driven for 30 feet on a narrow faulted zone striking north 50 degrees east, dipping 70 degrees southeast, and occurring in a belt of sheared, rusty weathering, dark-coloured quartzites. The rocks contain disseminated pyrite and chalcopyrite, but no other sulphide minerals were observed either in them or along the course of the faulted zone. Two adits on the south side of the creek were caved at the time of examination. It is reported that samples from this property carried appreciable values in gold, principally associated with the chalcopyrite.

RUBY SILVER CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 63.

The Ruby Silver Crown-granted claim, owned by W. P. Russell, 2231 W. 1st Avenue, Spokane, Wash., is at the head of McGuigan creek in the Surprise basin. It lies south of the Antoine and Red Fox properties and north of the Surprise group.

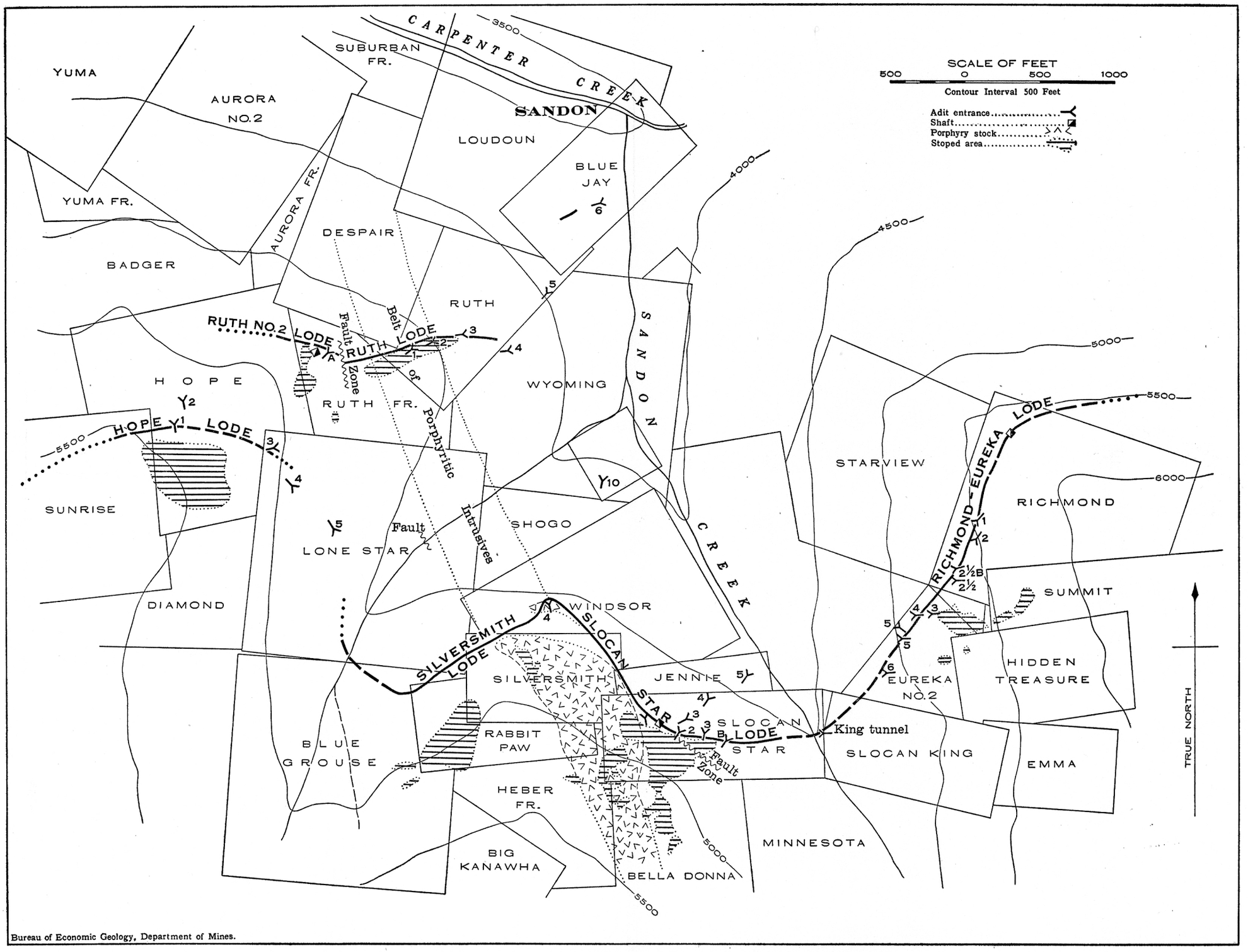
No work has been done on this claim for many years and the workings are mostly inaccessible. They are in slaty and sandy argillaceous sediments of the Slocan series intruded by dykes of quartz porphyry and develop a fissure-vein lode from which a small tonnage of high-grade silver-lead ore was produced.

The recorded production consists of 25 tons in 1896, 11 tons in 1906, and 4 tons in 1908. The ore averaged 211 ounces in silver to the ton and 51 per cent lead.

RUTH-HOPE GROUP

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 29; Sum. Rept. 1925, pt. A, pp. 202-204.
Ann. Repts., Minister of Mines, B.C., 1896, p. 52; 1921, pp. 134-135; 1922, p. 198; 1923, p. 222; 1924, p. 195; 1925, p. 240; 1926, pp. 248-250; 1927, pp. 272-273; 1928, p. 284; and other years.
Rept. of Zinc Commission, 1906, pp. 190-193.

The Ruth-Hope group of fourteen Crown-granted mineral claims is owned by H. W. Foster and Geo. Alexander, % Jas. Anderson, Stock Exchange Building, Vancouver, and has for a number of years been operated by the Ruth-Hope Mining Company, Limited, of Vancouver. The



Bureau of Economic Geology, Department of Mines.

Figure 12. An area near Sandon showing claim boundaries and lode systems.

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property lies south and southwest of Sandon, between elevations of 3,500 and 5,800 feet. It adjoins and lies west of the property of Silversmith Mines, Limited (*See* Figure 12).

The original claims, the Ruth, Hope, Wyoming, and Ruth fractions, were located in 1892. The Ruth lode was worked for silver-lead until 1904 and for zinc blende until 1909 when work was discontinued for a number of years. Development work on the Hope lode commenced about 1906 and shipments were made nearly every year until 1919, since when production has been mainly from the Ruth, Ruth No. 2, and, more recently, the Silversmith lode. Other lodes of some prospective value occur on the property but have not been developed to the point of production.

According to the report of the Zinc Commission the property prior to the autumn of 1905 had produced

> "17,410 tons of silver-lead ore, 15,000 tons of which was handsorted. About 1,000 tons of blende concentrate was produced and stored at the mill during 1905, which is said to assay 36 per cent zinc, 1·5 per cent lead, 14 per cent iron, and 12 ounces of silver per ton. The silver-lead ore averages about 65 per cent lead and 85 ounces of silver. The mine is credited with the payment of $165,000 dividends."

Government records of production during these early years are incomplete but indicate that up to the end of 1905 over 8,000 tons of silver-lead ore had been mined and carried an average of about 92 ounces in silver to the ton and 51 per cent lead. In the period extending from 1906 to and including 1924, exclusive of the years 1908, 1917, and 1918, the production included 6,506 tons of silver-lead ore averaging 115 ounces to the ton in silver and 44 per cent lead. In 1917 and 1918 production included 316 tons of ore which yielded an average of over 42 ounces in silver to the ton, over 9 per cent lead, and about 25 per cent zinc. Production figures for 1908 are indefinite but it appears that several hundred tons at least were mined that year. From 1924 to about the end of 1928 the property is credited with a production of between 16,000 and 17,000 tons. Of this, 1,928 tons of silver-lead-zinc ore produced in 1925 averaged over 33 ounces in silver to the ton, about 13 per cent lead, and over 3 per cent zinc. In 1927 the old mill was remodelled and it was put into use in 1928. The grades of ore being fed to the mill in October of that year are stated in the resident engineer's report to be about as follows, and to represent about an average: silver, 20·5 ounces to the ton; lead, 7 per cent; zinc, 7·4 per cent.

The underlying rocks are chiefly massive argillaceous and quartzitic strata of the Slocan series. These rocks in many places are calcareous and are interbedded with minor belts of more thinly banded, fissile, argillaceous strata. The general strike is northwesterly. About Sandon, on both sides of Carpenter creek, the structure is anticlinal and, in consequence, the dip on the more easterly parts of Ruth-Hope ground is mostly to the southwest at moderate angles. Farther up the valley slopes the structure is less regular. Northeasterly dips were observed in the vicinity of the workings on Ruth No. 2 and Hope lodes, and farther northeast the structure is that of a rather shallow syncline. Locally pronounced movements have taken place along more slaty or otherwise less competent beds, but the amount of displacement is probably not great. Strongly crushed and commonly carbonaceous ground has resulted from these movements, particularly in the vicinity of local rolls in the formations. Where vein

matter lies in these crushed zones it is brecciated and otherwise deformed. Sharply defined faults marked by comparatively narrow fault zones are fairly numerous. The more steeply dipping faults generally cross the strike of the sediments, whereas the others tend to follow the bedding.

The sediments are intersected by many dykes, chiefly of quartz or quartz-feldspar porphyry, but including some darker, mostly small, dykes varying in composition from minettes to basic lamprophyres. The dark dykes are notably irregular, appear to be later than the light-coloured dykes, and to be rather closely related in time to the period of vein deposition. The acid dykes strike northwesterly about in line with the sediments, but on their dip they cut across the bedding structures. Most of them lie within a belt several hundred feet wide striking southeasterly across the main Ruth workings and towards a large porphyry plug outcropping on adjoining Silversmith ground. Ore deposition was later than the acid dykes, but they exerted a structural control over the courses followed by the lodes and the location of the ore deposits.

Mine workings on the Ruth-Hope property extend over a vertical range of 1,400 feet and comprise nearly 5 miles of drifts and crosscuts and, in addition, many hundred feet of raises and other development work exclusive of stoping. An aerial tramway extends from the mill at Sandon to the main working levels on the Ruth and Hope mines. A graded road has also been constructed from Sandon to these workings.

The Ruth-Hope workings develop what may, for convenience, be referred to as the Ruth, Hope, Ruth No. 2, and Silversmith lodes. These lodes though forming parts of one broad zone of shearing, fissuring, and mineralization, and possessing some features in common, nevertheless have pronounced individual characteristics and their mutual relations are not entirely understood.

The Ruth lode is explored by five adits, the lowest 600 feet below the outcrop. The upper three adits are drifts, but the lower two, Nos. 4 and 5, are crosscuts about 350 and 800 feet long respectively. No. 5 is the main working adit for this as well as the Ruth No. 2 and Silversmith lodes. Altogether the workings on these and several short intermediate levels include about 11,000 feet of drifts and crosscuts and over 2,500 feet of raises and winzes. Most work has been done on No. 2 level which has a length of over 2,000 feet and extends more than 1,000 feet beyond (southwest of) the workings on the Ruth lode, to a position below the upper workings on the Hope lode, 700 feet above.

The workings explore the Ruth lode for a length of about 700 feet. As exposed in this distance the lode is a well-defined fault-fissure striking north 70 to 75 degrees east and dipping southeast at about 70 degrees. It is about 4 feet wide and above No. 3 level was composed largely of clean ore and mixtures of ore and gangue minerals, now mostly stoped out. Below No. 3 level the vein matter is more zincy and is associated with a large proportion of siderite gangue. Its continuity to No. 4 level has not been fully demonstrated, though work to September, 1927, appeared to indicate a considerable, possibly a large, tonnage of this class of material. On No. 5 level, 250 feet below No. 4 level, little mineralization has been found. In the main raise to No. 4 level, at a height of 100 feet above No. 5 level, a vein deposit about 2 feet wide carrying blende and siderite

was exposed in 1927 and was said to lie close to an underhand stope on the Ruth lode from No. 4 level. Apparently this lode has not been sufficiently prospected on No. 5 level.

About 700 feet from the portal of No. 3 adit, and exposed also in the other levels, is a well-defined crush zone in the sediments. The zone strikes north to northwesterly; it conforms or nearly conforms with the bedding structures and along it there has been considerable movement in and crushing of a narrow belt of rocks. The Ruth lode extends to this zone but the mineralization encountered beyond it should, perhaps, be considered as lying in the Ruth No. 2 lode. Sufficient evidence fully substantiating this opinion is not available but such as has been noted seems to indicate: (1) that the crush zone was essentially a pre-mineral feature; and (2) that the lodes on the opposite sides of it developed to some degree independently of one another. If the situation has been correctly interpreted, then the lodes and contained mineralization on the opposite sides of the crush zone should not be correlated. This being so it is assumed that the Ruth lode terminates at the crush zone. Its continuity in the opposite direction, down the western slope of the valley of Sandon creek, has not been proved much below the portal of No. 3 adit. Crush zones were encountered in the crosscuts on both No. 4 and No. 5 levels and it seems likely that such features may limit the Ruth lode in this direction. Such mineralization as, for example, was discovered in a short adit on the Blue Jay claim near the level of the Ruth mill, may, consequently, lie either in another lode or may represent a section of the Ruth lode that has been mineralized independently.

The Hope lode is developed by five adits, the lowest, No. 5, lying between 500 and 600 feet vertically below the outcrop. No. 4 level is the main working level and is connected with No. 2 by an incline shaft. No. 2 is in turn connected with the upper workings. The workings on this lode lie west of those on the Ruth and Ruth No. 2 lodes (*See* Figure 12) and are chiefly on the Hope and Sunrise claims. They include altogether about 6,000 feet of drifts and crosscuts and several hundred feet of raises and explore the Hope lode over a maximum length of about 1,200 feet.

The Hope lode differs in structure and mineralization from the Ruth lode. It is a productive zone rather than a well-marked fissure. This zone has a general east strike, dips to the south at angles varying from 25 to 40 degrees, and in its productive parts varies in width from less than a foot to about 40 feet. It has been formed by a combination of fracturing and shearing, factors which vary in relative importance according to the nature of the rocks traversed and the angle at which the zone encounters them. In general the steeper dipping parts of the lode are the more regular and better defined and are coincident with the intersection of the more competent rock members, particularly where the lode cuts most abruptly across them. Where the lode dips at a low angle and tends to follow the bedding of the sediments, the rocks are much broken, the channels followed by the mineralizing solutions are irregular, and the walls of the lode are ill-defined and require much crosscutting to fully explore them. Much of the old workings have, by reason of the broken nature of the ground, caved and are accessible with difficulty if at all. The principal productive area was in the eastern section of the mine workings and extended from the

surface to a little below No. 4 level. It had a maximum length on No. 2 level of about 550 feet and pitched to the east, out of the hill. The lode filling consisted of crushed rock, calcite, siderite, quartz, and ore. A feature of the lode was the large bands or lenses, up to 3½ feet thick, of coarsely crystalline calcite that lay chiefly next or near the hanging-wall and were underlain by ore partly cemented by calcite. The ore shoots were irregular in form, pinching, swelling, and in places abruptly terminating at their greatest thickness against a cross-fissure. They consisted of galena or blende or mixtures of the two. These lenses were strung out in line, or overlapped, or were arranged *en échelon*. In general they favoured the hanging-wall but also occurred on or near the foot-wall or well within the body of the lode. They varied in thickness from a fraction of an inch to 2½ feet and averaged, probably, about 100 feet in length. Cross-fissures were encountered in places and in part proved productive but were small, the largest being a fissure following the bedding on No. 1 level and running into the foot-wall.

The ore as mined was clean galena and blende with comparatively little concentrating material. Grey copper, chalcopyrite, and pyrite were present and a little crystalline anglesite was found. The gangue minerals were quartz, in part vuggy, calcite, both massive and in crystals, and siderite. Limonite and anglesite occur in the oxidized parts of the ore-bodies. The ore was cut by veinlets of quartz holding copper pyrites. The steel and fine cube galena ore carried from 155 to 170 ounces of silver to the ton and 60 per cent lead. Some of the zinc blende carried high values in silver, an assay by H. A. Leverin of the Mines Branch of a picked specimen giving 318·38 ounces of silver and 0·07 per cent copper.

The Ruth No. 2 lode lies between the Ruth and Hope lodes. Vein matter picked up towards the face of Nos. 3 and 4 levels of the Ruth mine and explored years ago by these and a couple of short intermediate levels was probably on the Ruth No. 2 lode. These lower workings were abandoned because of the zincy character of the vein matter. They lie west of the crush zone previously referred to as marking the western limit of the Ruth lode. More recently considerable work has been done on the Ruth No. 2 lode between No. 2 level of Ruth mine and the surface over 300 feet above. This work was done on five levels and comprised, in 1927, about 2,400 feet chiefly of drifts and several hundred feet of raises. An inclined shaft from the surface connects with the three upper levels, which in turn communicate by a series of raises and shafts with the lower levels and with No. 2 Ruth adit. These workings explore the Ruth No. 2 lode over a maximum length of about 500 feet. The lode is irregular in strike but is, in general, about parallel with the Hope lode and dips at an average angle of about 45 degrees to the south. It varies greatly in width, spreading out in the lower levels to 30 feet or more and holding pay ore on both foot- and hanging-wall sections with waste between. As in the case of the Hope lode the strike and dip of the Ruth No. 2 lode changes where the lode enters the less competent, flatter lying strata and in them the lode widens irregularly and has proved difficult to follow. Owing partly to the shattered character of the lode filling and wall-rocks the contained vein matter is strongly oxidized down to the lower levels. Crystalline cerussite is rather common in this oxidized ore. The ore forms a series of irregular

shoots carrying clean galena or galena mixed with blende. Galena is the most abundant sulphide and zinc blende, where found, generally carries much silver. The shoots vary in length from a few feet to over 100 feet and in thickness from an inch or so to a couple of feet. Up to 1925 ore to the value of about $75,000 had been extracted. The lode may be regarded as only in the initial stages of exploration and development.

In recent years the extension of the Silversmith lode from the adjoining Silversmith claim has been explored. This lode was tapped from No. 5 level of the Ruth mine by a crosscut 2,700 feet long started from a point 1,000 feet from the portal of the adit. The crosscut closely parallels the western boundary of the Silversmith claim and reaches the Silversmith lode at a point 40 or 50 feet below No. 10 level of the Silversmith mine and a few feet from the boundary of this property.

The Silversmith lode is more fully discussed in the account of the Silversmith mine. Where entered on the Ruth property, about 800 feet below the surface, the lode is composed of two members known as the hanging- and foot-wall splits. Each is a wide zone of shearing and slipping separated from the other by 80 feet of comparatively massive rocks. The two splits diverge as depth is attained, and are 120 feet apart on No. 6 level (100 feet below No. 5) in the Ruth workings. The hanging-wall split lies against or close to the sheared flanks of a plug of feldspar porphyry. The foot-wall split lies in argillaceous and quartzitic sediments of the Slocan series, but along its hanging-wall are sections of porphyry dykes that appear to be dyke-like apophyses from the main porphyry plug from which they are separated by intervals of sheared and faulted ground. Where the lode was intersected in No. 5 adit the course of the two splits is a few degrees south of west and the dip is to the south at an angle of about 45 degrees in the case of the foot-wall split and at a little lower angle in the case of the hanging-wall split. To the east of the crosscut intersection, and beyond the limits of the Ruth property, the two splits join and the lode swings to the southeast to follow the northeast flank of the porphyry plug. In the opposite direction the hanging-wall split in September, 1927, had not been followed for more than 100 feet on either No. 5 or No. 6 level. In this distance it is interrupted by a series of cross-slips which appear to have had more effect on localizing mineralization than on displacing the lode. The foot-wall split had been followed for 700 feet on No. 5 level and 450 feet on No. 6 level. It swings to the northwest, the change commencing 100 to 150 feet west of the crosscut. The northwesterly course is produced by a series of northerly and westerly jogs. Ore mineralization formed a succession of lens-like masses for about 350 feet from the crosscut, at which distance a winze 140 feet deep was sunk on ore to No. 6 level. The ore averaged 3 feet wide in this winze. Some encouraging mineralization was also found in the smaller operations on the hanging-wall split on No. 5 level.

Both splits consist of several to more than 50 feet of crushed, slickensided ground produced by slipping of the constituent materials against each other but not, so far as could be determined, representing any considerable displacement from point to point along the lode. The ore forms lens-like bodies conforming somewhat in shape to minor undulations in the wall-rocks and includes clean galena, clean zinc blende, and mixtures

of the two with varying proportions of spathic iron and quartz. The lenses may terminate abruptly against cross-slips or may overlap. The outer parts of the lenses consist of quartz grading inwardly into spathic iron and zinc blende and this grades to galena in the centre. The galena is mostly gneissic, as might be expected in view of the associated, highly sheared lode filling.

Mining is somewhat handicapped by the great width of the lodes of which the vein matter forms a relatively small part and is not confined to any particular section though, in general, favouring one or other of the walls. The ore discovered occurs mainly at points of flexure in the lode. Towards the northwest face of the drift on the foot-wall split on No. 5 level the lode is striking towards the old Hope mine workings, suggesting that a relationship between the Silversmith and Hope lodes may yet be established.

SAPPHIRE AND GEM CLAIMS

The Sapphire and Gem Crown-granted claims cross Payne ridge northwest of mount Payne, at an elevation of 6,750 feet. The claims belong to Henry P. Jackson, Paulson, B.C., and may be reached from Sandon by road and trail via the Payne mine. The Sapphire claim is credited with a production, in 1899 and preceding years, of 128 tons yielding an average of about 104 ounces in silver to the ton and 58 per cent lead.

The workings on the Sapphire claim lie mostly on the southwest and those of the Gem claim on the northeast slope of the ridge and are partly inaccessible. They comprise a series of short adits, shafts, raises, and open-cuts and extend down the slopes of the ridge to about 350 feet below the summit on the Carpenter Creek (southwest) slope and 120 feet or so on the McGuigan Creek slope. The workings explore a fissure-vein zone, several feet wide, striking north 50 degrees east and dipping 60 to 70 degrees southeast. It intersects mostly massive sediments of the Slocan series, including a number of narrow limestone beds and limy quartzitic strata, striking north 50 degrees west and dipping 55 degrees southwest. The zone contains a number of closely spaced, narrow fissures representing joint fractures in the sediments, along some of which movement has occurred. The fissures vary from an inch or less to several inches in width and carry veins of argentiferous galena which, so far as could be seen, have been mostly stoped out near the surface. The gangue mineral is quartz.

SILVER BAND CLAIM

The Silver Band Crown-granted claim is near the head of Aylwin (Eightmile) creek at an elevation of about 6,600 feet. It is owned by P. J. Keogan, Kaslo, B.C., and is accessible by a trail, 3½ miles long, up Aylwin creek from the Silverton-Slocan highway.

The workings comprise several open-cuts and a caved adit and prospect a shear zone about 5 feet wide cutting coarse-grained porphyritic granite of the Nelson batholith and striking nearly east. Little mineralization could be seen, but material on the dump from the caved adit indicated that some had been discovered, including galena and blende in a gangue of quartz with a little calcite and spathic iron.

A little high-grade silver ore is reported to have been shipped from the property although there are no official records of production.

SILVER BELL CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 55; and other years.

The Silver Bell Crown-granted claim is in Idaho basin (Howson creek) to the southwest of and adjoining the Idaho claim of the Idaho-Alamo group. It is owned by the Silver Hustler Mining Company, % Swinnerton and Musgrave, Box 1146, Victoria, B.C.

Production from this and (?) the adjoining Hustler claim is recorded for several years in the period from 1901 to 1909 and amounts to 209 tons of silver-lead ore carrying an average of about 84 ounces in silver to the ton and 56 per cent lead.

The property is underlain by sediments of the Slocan series intersected by a number of acid porphyry dykes.

Development work consists of one main adit and some smaller workings. The adit is about 200 feet above No. 1 adit of Idaho mine (Figure 8), and the other workings are at intervals higher up the slope of the ridge leading to Idaho peak.

The Silver Bell claim contains the southwesterly extension of the Idaho-Alamo lode systems. The main adit is along a wide, well-defined lode cutting grey quartzites and argillites that strike from north 5 degrees west to south 66 degrees west and dip east and southeast at angles of from 55 degrees to 70 degrees. The lode varies in thickness up to over 4 feet and consists of crushed and brecciated rock cemented with calcite, quartz, and a pale yellowish brown carbonate (probably ankerite). The vein matter carries streaks, bunches, and fragments of galena and blende, and near the face of the adit has been stoped to a height of about 135 feet. The ore removed was galena with a little blende and was hand sorted and roughly jigged to produce a fairly clean shipping product.

The upper workings are mostly inaccessible but material from the dumps indicates that some mineralization had been encountered.

SILVER BELL No. 2 CLAIM

The Silver Bell No. 2, formerly Native Silver Belle, Crown-granted claim is in the Rambler basin (McGuigan creek) to the south of the Rambler-Cariboo mine. It is owned by Emeline Sweeney and F. J. Finnucane, % Sweeney Investment Company, Rookery Building, Spokane, Wash.

The property occupies part of the steep northern slope of Reco mountain and is underlain by slates and thinly interbedded argillaceous and calcareous sediments of the Slocan series cut by many, narrow, acid porphyry dykes.

Prior to 1929, when some attempt was made to reopen the property, no work, so far as is known, was done on this claim for nearly thirty years. The old workings consist of two adits, of which the lower is a crosscut that did not reach the lode explored in the upper adit. This lode is thought to be an easterly extension of the lode on the adjoining Red Fox and the Antoine claims.

In 1898 and 1899 an aggregate production of 106 tons of silver-lead ore is recorded. This ore carried an average of 197 ounces in silver to the ton and 66 per cent lead.

SILVER NUGGET CLAIM

The Silver Nugget claim is near the head of Aylwin (Eightmile) creek at an elevation of about 6,500 feet. It is reached by a trail up Aylwin creek and is 2½ miles southeast of the Slocan-Silverton highway.

The country rocks are chiefly massive, dark-coloured, pyritic quartzites.

Some work has been done on a lode striking south 63 degrees west and dipping 55 degrees southeast. The lode is a fissure carrying small lenses of quartz sparingly mineralized by pyrite and one or more silver-bearing sulphides. It is explored by two adits, one of which is caved. The other is a crosscut for about 80 feet and from there drifts on the lode for a few feet.

One ton of ore in 1907 and another in 1908 are recorded as having been shipped from this property. This ore averaged 227 ounces in silver to the ton.

SILVERSMITH-SLOCAN STAR GROUP

References: Geol. Surv., Canada, Ann. Rept. 1894, pt. A, p. 33; Sum. Rept. 1925, pt. A, pp. 205-206.
Ann. Repts., Minister of Mines, B.C., 1896, pp. 49-50; 1904, pp. 183-184; 1918, p. 166; 1919, p. 125; 1922, p. 194; 1923, p. 221; 1924, p. 195; 1925, p. 239; 1926, p. 247; 1927, pp. 270-271; 1928, p. 286; and other years.
Rept. of Zinc Commission, 1906, pp. 184-189.

The Silversmith-Slocan Star group, comprising the Silversmith and Slocan Star mines, consists of the Slocan Star, Rabbit Paw, Jennie, Silversmith, Windsor, Shogo, Minnesota, Bella Donna, Millie, Whistler fraction, Heber fraction, Pembroke, and Millsite Crown-granted claims, covering an area of 298 acres. The property is half a mile south of Sandon and lies mostly between the two forks of Sandon creek. The workings (Figure 12) range from an elevation of about 3,800 to over 4,800 feet. The main working level, No. 10 adit, stands at 4,000 feet or about 500 feet above Sandon. This adit communicates with the company's mill on the railway by an aerial tramway 4,600 feet long. The property is owned by Silversmith Mines, Limited, Spokane, Wash.

The Slocan Star lode was located in October, 1891, and the first production, 500 tons, was recorded in 1893. This ore carried an average of about 50 per cent lead, 100 ounces of silver, and gold to the amount of $6 to $7 a ton. Total shipments to the close of 1899 amounted to 20,384 tons of crude ore and concentrates, the former carrying 77·4 ounces in silver and 68·4 per cent lead and the latter 93·2 ounces in silver to the ton and 69 per cent lead.

The provincial mineralogist, W. A. Carlyle, in his report for 1896, refers to this property as having paid more dividends ($300,000) than any other mine in British Columbia, apart from the coal and placer mines, and as being the largest silver-lead mine in the province.

Shipments to July 1, 1904, amounted to 32,453 tons of crude ore (⅓) and concentrates (⅔) and yielded 2,673,248 ounces of silver and 18,549 tons of lead. The Zinc Commission reports that up to about the end of 1905, the property had produced 34,000 tons of silver-lead and 4,183 tons of zinc ore.

Production, 1894 to 1905, has been valued as follows:

17,870	tons silver-lead (crude)	$1,291,728
15,594	tons silver-lead (concentrates)	1,229,641
3,455	tons zinc (concentrates)	154,061
Total 36,919	tons	$2,675,430

During 1906 and following years, mining nearly ceased as the result of litigation over the extralateral rights of the Rabbit Paw claim owned by the Star Milling and Mining Company. The two companies amalgamated in 1911 to form Slocan Star Mines, Limited. In 1914 the property again became an outstanding producer.

Production during 1914 to 1917, inclusive, was 54,235 tons, chiefly concentrating ore, and included an average content of 6·3 ounces silver to the ton, 4·4 per cent lead, and 2·5 per cent zinc. Towards the end of 1917, financial difficulties interposed and the property was shut down for about a year, after which the company was reorganized as Silversmith Mines, Limited, and operations were again resumed. This period is noted for the discovery and development of the Silversmith shoot which ranks next to the main shoot of the Standard mine as the largest and most valuable ore-body found in the Slocan. Since 1918 the output has been largely from this shoot. A prospectus issued in 1922 by Clyde White, mining engineer for the company, indicated that the total production from this shoot to the end of August of that year amounted to 57,123 tons of mill feed and 1,006 tons of shipping ore. The average assay of the feed was stated to be 20·5 ounces silver to the ton, 9·3 per cent lead, and 9·1 per cent zinc; the clean ore carried 115 ounces silver to the ton and 60 per cent lead.

To the end of 1926 the Silversmith shoot produced nearly 300,000 tons averaging 10·7 ounces silver to the ton, 4 per cent lead, and 2 per cent zinc and an aggregate of 878 ounces gold. To about the end of 1926 this property produced ore worth between $6,000,000 and $6,500,000 dollars.

In 1921 the company acquired the Ivanhoe mill at Sandon and remodelled it. Prior to that year milling had been done at the Slocan Star concentrator.

The geological formations are sediments of the Slocan series cut by dykes and one small stock. The sediments are mainly massive and somewhat carbonaceous argillites, but include both quartzitic and limy beds. The structure is complicated by folding and faulting and by much slipping and crushing. In general the beds appear to strike south to southwest near the main Slocan Star workings, but swing more to the west on Silversmith ground and turn to the northwest towards and beyond the western side of the property. The dips are southerly at angles varying from 30 to 75 degrees. Minor folds, faults, slips, and shears are common.

The sediments are intruded by acid and basic dykes and by one small stock of biotite-feldspar porphyry. The acid dykes are light-coloured, medium to fine, quartz porphyries and feldspar porphyries in part showing advanced alteration, particularly where involved in the shearing or other movements to which the associated sedimentary rocks have been subjected. Most of these dykes are regular in their attitude and dimensions, and on their strike they tend to conform with the bedded rocks. They vary from

2 or 3 feet to 30 feet thick. The basic dykes are dark green types of variable composition and many are rather greatly altered. They vary in composition from minettes in which biotite and orthoclase are the predominant minerals to more basic lamprophyres in which olivine, and (or) pyroxene and biotite are conspicuous. In contrast with the acid intrusives these basic dykes are notably irregular in their individual structures and dimensions. They appear to be younger than the acid intrusives and, on the whole, are considerably smaller, averaging probably less than a foot in thickness. They are, as on other properties, intimately associated in places with the lode structures, an association that suggests that their period of intrusion was separated by no great interval from the period of mineralization.

The workings of the Silversmith and Slocan Star mines include six adits, Nos. 1, 2, 3, 4, 5, and 10, connected by shafts and raises from which six principal blind levels, Nos. 6, 7, 8, 9, 11, and 12, have been run (*See* Figure 12). Main access to both mines is now provided by the lowest or No. 10 adit, which is driven southerly as a crosscut for 2,100 feet to where it reaches the main lode. Prior to driving this crosscut the main entrance to the Slocan Star mine was via No. 5 adit which crosscuts the lode at 365 feet above and 1,600 feet southeast of the portal of No. 10. No. 10 level is connected with No. 5 by several raises, from which levels 6 to 9 have been run. The lowest levels, Nos. 11 and 12 at 100 and 200 feet respectively below No. 10, are situated at the western end of the property and are connected with No. 10 level by a two-compartment shaft. Underground work up to September, 1927, included about 20,000 feet of drifts, 8,700 feet of crosscuts, and 6,000 feet of raises. The main adit, No. 10, is the longest. From its intersection with the main lode it extends for about 3,500 feet to the east and over 900 feet to the west of the crosscut. In the former direction it picks up the downward continuation of Slocan Star ore-bodies and towards the face explores some vein matter occurring in an area underlying the westerly workings on the Slocan King. In the opposite direction No. 10 level was the first to encounter the great Silversmith shoot.

The lode in which these ore-bodies occur has been traced across this property in which it has a length of 2,700 feet. Farther east it occurs on the Slocan King and the Richmond-Eureka groups and in the opposite direction it extends into adjoining Ruth-Hope ground. The lode has a curving strike (Figure 12) swinging from southwest, in the eastern half of Slocan Star claim, to west and northwest, and then back to southwest and nearly west at the extreme west end of Rabbit Paw claim. The average dip is about 47 degrees and is southerly. In the lower levels of the Silversmith mine the lode steepens to from 70 to 75 degrees. Its irregular course in part reflects the changing trend of the enclosing rocks and in part is due to the large feldspar porphyry plug located at about the centre of the property. This plug has a general northwesterly strike, is from 400 to 500 feet wide at the surface, and has an exposed length of about 1,400 feet. The lode swings from the southeast around the northern end of this intrusive, curving back to a southwesterly course after passing it.

The lode is widest where its attitude conforms more or less closely with that of the strata and is most sharply defined and narrower where

it cuts across the strata. It widens at the marked bends in its course and these wider parts have formed channels for abundant mineralization and ore deposition.

The Slocan Star-Silversmith lode, though continuous across the property and beyond it, is a series of component fissures, mineralized in part and alternately striking northeasterly and northwesterly. The northeasterly striking components correspond in their structure and attitude to the more normal fissure-vein type of the district, whereas those striking northwesterly resemble the shear zones that follow the trend of rock structures and are the less commonly mineralized. In this case the two sets have provided a continuous channel, but, as might be expected, ore deposition has tended to favour the northeast-southwest components.

The lode varies in width from a few inches to over 80 feet, the narrower parts, in general, occurring where the strike is northeasterly. The lode filling is largely crushed and sheared fragments of the wall-rocks and in the wider parts includes large and small horses of comparatively massive rock surrounded by wide zones of intensely sheared ground. Much of the sheared material consists of large and small lenses, nodules, and fragments of beautifully polished argillite coated with thin films of carbonaceous matter and requires substantial and immediate timbering. The aggregate movement since ore deposition has probably been considerable and is responsible for the nodules of "drag ore" which may have been carried an appreciable distance from their original point of deposition. Large and small fragments and blocks of porphyry have been incorporated in the vein filling by these shearing processes and are particularly notable in the workings around the northern end of the porphyry plug.

The Slocan Star ore-body (or bodies) formed where the lode swings from a southwest to a west and then a northwest course. The swing forms, roughly, an arc of a circle having a radius of about 700 feet. Ore deposition was best towards the centre of this arc, where the lode had a maximum width of about 50 feet and was composed partly of sheared, slickensided rock and partly of vein matter. The walls of this part of the lode are not well defined and required numerous crosscuts and subsidiary drifts, particularly in the lower levels, to explore it. This work revealed the tangential crush zones striking both southwest and southeast and into the hanging-wall. Their presence supports the view that the curving part of the lode marks the intersection of northwest-southeast and northeast-southwest zones of shearing and fissuring. To what extent mineralization may extend outward along the tangential shears seems a matter worthy of further investigation.

Much the same structural phenomena occur at the north end of the porphyry plug, though the curve there from northwest to southwest is more abrupt. The northwest-trending shear is very strong, and follows along, or close to, the northeast flank of the porphyry plug. Near the north end of this plug this shear zone encounters a strong fissured zone coming from the southwest and cutting rather sharply across the rock structures. These zones link up along the arc of a comparatively small circle swinging around the north end of the porphyry plug. In part, however, each zone continues towards the east and west, respectively, beyond the circumference of the arc. The easterly prolongation of the north-

easterly zone has been explored for only a short distance on levels Nos. 10 and 11 of the Silversmith mine, but the westerly extension of the other zone has been investigated to beyond the west limit of the property and forms what is known as the north or foot-wall split of the Silversmith lode, the main lode along its southwesterly course being termed the south or hanging-wall split. Above No. 8 level, Silversmith mine, the two appear to form one lode to at least No. 4 level. Below No. 8 level the two splits gradually diverge. The heart of the great Silversmith ore shoot lies at the juncture of the two splits within a broad flexure of the composite lode from a southwest to a more westerly direction.

The main Slocan Star ore-body has been stoped almost continuously from the surface to No. 10 level, a vertical distance of 850 feet or about 1,200 feet on the dip of the lode. The stopes had a maximum length, between levels Nos. 2 and 4, of about 500 feet and shortened rapidly below to a minimum of less than 30 feet in No. 5 adit. At greater depth the length again increased and the stope between levels Nos. 6 and 8 has a maximum length of 150 feet. Below No. 8 level the ore-body shortened again and had a stoping length on No. 10 level of less than 50 feet. Below No. 3 level the main ore shoot was separated by an interval comparatively barren of vein matter, and varying from less than 50 feet to over 300 feet in length, from a second ore-body or succession of bodies which afforded almost continuous stoping ground over a vertical range of 500 feet and a maximum length between levels Nos. 4 and 5 of nearly 200 feet; elsewhere it averaged about 50 feet in length.

The vein matter in these ore-bodies varied from a few inches to 50 feet in width and was associated with much crushed and brecciated rock. The ore-bodies pitched nearly with the dip of the lode and varied in thickness from a few inches to about 20 feet. They were composed of lenses, bands, and streaks of both clean and concentrating ore. Lenses of clean galena varied up to 10 feet in thickness. Others were mixtures of galena, blende, siderite, and quartz, many striking diagonally across the lode. The galena, and to a less extent the blende, carried grey copper. Other sulphide minerals included chalcopyrite and pyrite. The common gangue mineral was siderite which persists to the lowest levels. Quartz is an important constituent in the upper levels, is less plentiful at intermediate depths, but increases in proportion to siderite in the lower workings. Bands of clean ore commonly followed one or other wall of the lode but favoured the hanging-wall side.

The main Silversmith shoot had a maximum length of about 500 feet and extended from the vicinity of No. 4 to No. 11 levels, a vertical distance of over 600 feet. The greatest stoping width was probably at or above No. 8 level where the two splits come together and where the vein matter in places was between 20 and 30 feet thick. One occurred along both splits down to at least about No. 11 level, below which comparatively little exploration had been done. In general the most continuous and better mineralization favoured the foot-wall split.

The Silversmith ore included much the same suite of ore and gangue minerals as the Slocan Star ore, but as a rule carried more silver. Galena was the dominating sulphide, forming masses of cubes of uniform, medium size. It carried abundant grey copper in both microscopic and megascopic particles, $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter being quite common. Zinc blende was

the common associated sulphide and spathic iron the abundant gangue mineral. In places there were large, lens-like masses several feet wide, of banded zinc blende and spathic iron with less to almost no galena. Pyrite and chalcopyrite were also present. Quartz was locally abundant and mainly was associated with the more zincy parts of the ore-body. The ore minerals occurred both in solid masses and mixed with gangue minerals and crushed fragments of the wall-rocks.

Aside from the main Slocan Star and Silversmith shoots some ore has been discovered at a number of other places on this property. A comparatively small ore-body, the "Old Silversmith" shoot was found on levels Nos. 4 and 5 on the Silversmith claim, several hundred feet northeast of the main Silversmith shoot. This shoot raked to the east at about 50 degrees, had a maximum length on the pitch of 280 feet, and an average stoping length of about 40 feet. It did not continue as pay ore below No. 5 level.

More recent work has been partly devoted to exploring the lode, first, at greater depths, below the Slocan Star and Silversmith ore-bodies; second, northwest of the Slocan Star ore-bodies; and third, east of the Slocan Star ore-bodies. The investigations at greater depth were conducted partly by sinking and drifting along the lode at the twelfth level, and partly by drilling below this level. Some mineralization was encountered and it was the intention of the company to continue the shaft, commencing at No. 10 level, to the fifteenth level and then to explore the lode below the Slocan Star ore-bodies by drifts and crosscuts. Operations northwest of the Slocan Star ore-bodies encountered some good ore over a length, in one stope above No. 10 level, of 200 feet and an average width of 2 feet. The ore includes widths of as much as a foot or so of nearly solid galena. The ore occurs partly in nodular and lens-like masses, and is mostly quite gneissic in structure. Nodules of "drag" ore are common. Explorations east of the Slocan Star ore-bodies were, up to September, 1927, confined to work on Nos. 5, 8, and 10 levels and extended into the adjoining Slocan King property. These operations encountered some encouraging mineralization on No. 5 and No. 10 levels. On No. 5 level, over a length of about 700 feet from the face, quartz and spathic iron with, locally, zinc blende and disseminated galena, widens in several places to a foot or more, and has been explored by small stopes and short raises. The course of the lode over this distance is about north 60 degrees east. The work towards the face of No. 10 level has been largely along a shear zone, striking about north 60 degrees west, and which had been drifted on for over 700 feet. Mineralization was discovered at different places and consisted of considerable galena, with some blende and pyrite and a gangue of both spathic iron and quartz gangue. Along this stretch of No. 10 level a basic lamprophyre dyke, or dykes, follows somewhat closely the shear zone. This dyke, or dykes, much resembles the large dyke encountered 230 feet from the portal of the Slocan King adit about 450 feet above. The relation between the mineralization on levels Nos. 5 and 10 in this section of the mine is not clear. The courses of the lodes on the two levels are quite different and the mineralization on No. 10 level is not of the type that might be expected in a downward prolongation of the mineralization on No. 5 level. It may be that two lodes are present, joining or intersecting one another above No. 10 level.

SLOCAN KING GROUP

References: Ann. Repts., Minister of Mines, B.C., 1926, p. 247; 1927, pp. 271-272; 1928, p. 286.

The Slocan King group includes the Slocan King, Hidden Treasure, and Emma Crown-granted claims (*See* Figure 12). They lie east of and adjoin the Slocan Star-Silversmith group. The group is owned and operated by Slocan King Mines, Limited, Sandon, B.C. It is reported that in 1928 this company acquired the adjoining Richmond-Eureka property.

Operations on this property have investigated the easterly extension of the Slocan Star-Silversmith lode as found on the Slocan Star-Silversmith property and the extension of the same lode down the dip from the workings of the Richmond-Eureka mine.

Work has been done on four different levels, namely No. 6 of the Richmond-Eureka mine, the Slocan King adit level, and Nos. 5 and 10 levels of the Slocan Star-Silversmith mine workings. These workings explore the lode over a vertical depth of about 800 feet. No. 5 level is connected near the face with a raise to the Slocan King adit 80 feet above, the raise reaching the adit about 40 feet from the portal. The portal of the adit is on the east side of the east fork of Sandon creek at an elevation of about 4,600 feet. No. 6 level of the Richmond-Eureka mine is 260 feet above the Slocan King adit and is not connected with it underground.

The underlying rocks and rock structures are briefly discussed in the accounts of the Richmond-Eureka and Slocan Star-Silversmith groups. A dark green, basic dyke was intersected by the Slocan King adit about 230 feet from the portal. The dyke is several feet wide, of dark green colour and crystalline appearance. It carries large phenocrysts of altered olivine, abundant pyroxene (probably augite), and considerable biotite which under the microscope is brownish to reddish brown. Other minerals are iron sulphide, magnetite, and many secondary alteration products including serpentine, talc, and calcite. Some spathic iron and abundant pyrite occur at this point. The course of the dyke apparently coincides with that of a strong shear zone striking northwesterly and dipping 30 to 35 degrees northeast.

Much of the work on the Richmond-Eureka No. 6 level and on the Slocan King adit level was done many years ago when connexions had been established by raises and small stopes with No. 5 level Richmond-Eureka (120 feet above No. 6 level) and No. 5 level of the Slocan-Star mine. More recent work has (1) advanced the Slocan King adit level and (2) explored the block of ground underlying the westerly part of Slocan King adit at No. 10 level of the Silversmith mine, which gives an additional depth of about 450 feet.

On No. 6 level, Richmond-Eureka mine, and in the Slocan King adit heavy vein mineralization was encountered at different places and over distances varying from a few feet to more than 100 feet. Along the Slocan King adit this mineralization is interrupted by a series of strong faults striking at various angles from northwest to northeast and dipping, in some cases easterly, in others westerly, at angles ranging from about 30 degrees to nearly vertical. These faults displace the lode either to the left or right, depending upon their direction of dip. The vein mineralization consists

largely of siderite or quartz or mixtures of the two, and varies in width from an inch or so to over 2 feet. Considerable zinc blende and, less commonly, an appreciable amount of galena, is present in places. Pyrite is also conspicuous. Probably the best showings of zinc ore occur within 300 feet of the face of No. 6 level of the Richmond-Eureka mine, a section that appears worthy of further exploration. The most interesting discovery of galena was made in the Slocan King adit at the face, about 1,900 feet from the portal. This discovery, as visible in 1927, was a narrow lens of gneissic galena about 6 inches in maximum width. It lay in a shear zone striking nearly north and dipping steeply to the east. Other narrow stringers carrying galena, spathic iron, and quartz were observed at the north face of the drift on this shear zone and dipped about 30 degrees to the east. Though not large enough to be of value these masses of galena are interesting because they lie at a great depth and in a shear zone striking at a strong angle to the normal course of the main lode. These small bodies of galena may lie along a zone tributary to some more important, perhaps not far distant, occurrence in the main lode and efforts were being directed to pick up the lode whose position in this section of the workings was uncertain, but from work done at the higher levels seemed to lie some distance farther north. Other discoveries of vein matter carrying an important content of galena were made about midway along both No. 6 and Slocan King adits, beneath and presumably about on the downward continuation of the main Richmond-Eureka ore-bodies. In general, however, the vein mineralization is distinctly leaner than that developed higher up in Richmond-Eureka mine.

SLOCAN-SOVEREIGN CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1907, p. 99; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 204-205.

The Slocan-Sovereign Crown-granted claim has been acquired (1926) by the American Boy Mining and Milling Company, 642 Peyton Building, Spokane, Wash. The property is on the lower northern slopes of Carpenter Creek valley, northeast of Sandon and north of Cody (Figure 1). Good trails lead to the mine from both Sandon and Cody. The Sovereign aerial tram 7,200 feet long leads from the portal of the lowest or No. 4 adit at about 5,000 feet elevation to Sandon, 1,500 feet below. Connexions may also be made near No. 3 portal with the Noble Five aerial tramway to the Noble Five concentrator at Cody. The Slocan-Sovereign claim is surrounded by claims of the Reco group and is crossed by the southwesterly extension of the Reco No. 2 lode.

The first shipment of ore, amounting to 160 tons, was made in 1898. This ore averaged 50 ounces in silver to the ton and 40 per cent lead. No shipment was made in 1899, 1900, 1902, 1903, 1905, 1921, or 1925. For all other years some production is recorded, amounting in the aggregate to 4,472 tons and averaging 18 ounces in silver to the ton and 14 per cent lead. A production of 25 tons in 1926 assayed 21 ounces in silver and 16 per cent lead. The years of greatest production were 1918 and 1919.

The rocks encountered in the underground workings are sediments of the Slocan series and minor intrusives. The sediments are chiefly argillites with some quartzitic beds. Their general strike is north 50 degrees west and they dip mostly southwest at steep angles averaging 70 degrees. Towards the western and southwestern boundaries of the claim the workings encounter a belt of black slates, which is apparently continuous with a broad syncline of these rocks extending across adjoining claims of the Reco group. Intersecting the sediments are a number of light-coloured, quartz porphyry, and a few, dark green, lamprophyre, dykes. The more acid dykes appear to conform in attitude with the sedimentary structures. They are prominent in the central part of the mine workings across a width of about 150 feet. Other narrow dykes of this type occur towards the face of the four main levels. The basic dykes, on the other hand, follow rather closely the course of the lode. They vary from a foot or so to 50 feet or more in width, the widest exposures occurring in the lower levels, particularly towards the face of No. 3 adit and the intermediate adit above. At different points the basic dykes were observed to cut the quartz porphyries.

The workings of the Slocan Sovereign mine include three main adits connected by raises and stopes to a number of intermediate drifts. Altogether, over 4,000 feet of development work has been done and the lode explored to a vertical depth of about 450 feet. The workings mostly follow the lode which strikes north 40 to 45 degrees east and dips southeast at, in most places, an angle of 50 to 55 degrees. Adits Nos. 1 and 2 and the principal intermediate level between adits Nos. 2 and 3 have been driven to within 100 feet or so of the claim boundary. No. 3 level is 300 feet from this line. On its dip before the lode passes into adjoining property there remains a depth to be explored about equal to that already developed. The lode is a mineralized fissure zone along which considerable shearing and crushing accompanied by more or less cross-fracturing and faulting have occurred. In width it varies from a crack to several feet, the wider parts commonly including distinct hanging- and foot-wall fissures separated mostly by sparsely mineralized or barren country rock. Paystreaks follow one or both walls and include several inches of solid ore. Most of the production has come from stopes extending from No. 2 level to above No. 1. Below No. 2 very little encouraging ore has been discovered and there the wall-rock is largely the green dyke rock mentioned above. Dykes of this character elsewhere in the district are frequently associated with ore mineralizations, follow closely the productive lodes, and not uncommonly form much of the brecciated lode matter. Nowhere in the district are these dykes, so far as the writer is aware, as large as in the Slocan-Sovereign mine. They have followed a line of fissuring corresponding closely in position to the lode that has broken irregularly across them. The dyke rocks seem to have been but slightly if at all susceptible to replacement by the mineralizing solutions. In the Slocan-Sovereign ground they seem to have tended to block the process of mineralization by having occupied the line along which the pre-mineral shearing and fissuring occurred, thus causing a dissipation of the later movements and allowing but little opportunity for extensive mineralization across their width. Where fissuring is developed to one side of these dykes, particularly the

hanging-wall side, and the rocks are much fractured but not too crushed to permit access of mineralizing solutions, opportunities for the development of ore-bodies are better. Such sections in the lower levels are worthy of investigation and a few crosscuts might lead to important discoveries.

Most of the ore shoots followed the dip of the lode, but in places they rake to the northeast at an angle of 45 to 50 degrees. Cross-fractures cutting the lode, in most cases forming large angles with it, seem to have had some influence in localizing ore deposition. A number of post-mineral faults have caused small displacements of the lode.

The chief ore minerals are galena, zinc blende, and pyrite. The gangue minerals are siderite, quartz, and a little calcite. The relatively large amount of pyrite and the comparatively low silver content indicate that the ore formed at somewhat greater depth than the ore found in the Reco, American Boy, Last Chance, and Noble Five.

The No. 4 lode of the Reco group cuts across the southeastern corner of the claim for about 500 feet. In this lode, on No. 2 level of the adjoining Number One mine, some lead ore was discovered and partly stoped near the Slocan-Sovereign line. At the claim boundary the lode has a width of about 4 feet and is composed largely of narrow veins of spathic iron separated by bands of rock.

SOHO GROUP

References: Ann. Repts., Minister of Mines, B.C., 1923, pp. 225-226; and other years. Dept. of Mines, B.C., Bull. No. 1, 1929, p. 48; Bull. No. 2, 1929, p. 64.

The Soho group consists of the Old Tom Moore, Liberator No. 2, Northern Pacific, Red Cross, Laughing Waters, Soho, and Boxer II claims, and Faraway No. 2 and Abey Dones fractions, and is the property of Mary Ryan Mines, Limited, Seattle, Washington, a company lately organized to take over the holdings of Soho Mines, Limited.

The property is most readily accessible from Rambler station via the Rambler-Cariboo wagon road for 4½ miles up McGuigan creek, from where a good trail leads to the Soho camp at an elevation of 6,560 feet. The camp may also be reached from Sandon via the Payne wagon road and trail, a distance in all of about 5 miles. The property lies between the Rambler-Cariboo on the east and the Washington group on the west.

Work on the property began about 1895 and has been continued intermittently up to the present. The important years of production were the early years of this century. There apparently followed a long interval of idleness until 1923, when a further shipment was made. It was reported by the late J. C. Ryan, former manager, that altogether $200,000 had been spent in development work and over $100,000 worth of ore shipped. Government statistics record production in 1901, 1902, and 1923, aggregating 163 tons. Ore from the Tom Moore lode is stated to have averaged 150 ounces in silver to the ton and 51 per cent lead, and to have included shipments running as high as 386 ounces in silver and as much as 56 per cent lead. Shipments of about 100 tons in 1901 yielded an average of 103 ounces in silver to the ton, 38 per cent lead, and 12 per cent zinc. Thirty-three tons shipped in 1923 from the "Ryan vein" carried 54 ounces in silver to the ton, 22 per cent lead, and about 14 per cent zinc.

A belt of thinly bedded argillaceous rocks of the Slocan series extends northwesterly through the property from the adjoining Red Fox group

and is flanked on both sides by more massive, blocky, and banded argillites, quartzites, and narrow limestone beds. The sediments are cut by a great number of dykes and sills that, in general, trend northwesterly with the sedimentary formations, and are mostly quartz porphyry or other acid types but some are more basic.

Mining work has been mostly confined to three roughly parallel lodes. Of these the Tom Moore is the best defined, has received most attention, and has produced the bulk of the ore obtained from the property. It has been explored by five adits over a vertical range of 365 feet below the highest outcrop of the lode, where it crosses the narrow divide between the Antoine and Rambler-Cariboo basins. The main or No. 4 level was driven from the northeast slope of the divide 300 feet below the highest outcrop. It has caved near the portal and access to it and to the lower workings is furnished by No. 5 (crosscut) level, driven from the northwest slope of the ridge near the present camp site. Adits Nos. 2 and 3, 110 and 150 feet, respectively, below the highest outcrop, are also driven from the northwest side. No. 1 level, 40 feet below the highest outcrop of the lode, was driven through the hill, but is now quite inaccessible. No. 2 level is caved about 180 feet from the portal. Levels Nos. 1, 2, and 3 are drifts, whereas Nos. 4 and 5 include 340 and 245 feet, respectively, of crosscutting before reaching the lode. Altogether work on this lode includes about 3,500 feet of drifts, crosscuts, raises, and winzes. The lode strikes north 50 degrees to 55 degrees east and dips southeast at angles of about 60 degrees or 70 degrees, but in places is nearly vertical. The maximum lode length developed by the workings is about 650 feet. The productive part occupies a central position beneath the summit of the ridge. Most of the ore has been obtained above No. 4 level from a number of stopes ranging up to 60 feet in length and 40 feet maximum depth. Previously to running No. 5 adit, two 40-foot winzes had been sunk on the lode from No. 4 level. From one of these a small stope produced some $3,000 worth of ore. Drifts from the end of No. 5 crosscut adit follow along or close to the lode for some 360 feet to the northeast and 100 feet to the southwest of the end of the crosscut. Towards the end of the northeast drift a raise extends to No. 4 level. The northeast drift has not yet reached a point beneath the ore zone found on the higher levels beneath the centre of the ridge, and has still some 250 feet to go to get under the winze sunk from No. 4 level. As at present opened up on No. 5 level, the lode nowhere shows more than 3 or 4 inches of mineralization. It is mostly a very tight fracture, showing but little evidence of movement along the walls, and follows a line of master jointing. In the upper levels, and particularly towards the centre of the ridge near the more productive parts, the lode widens and in places shows some gouge and sheared country rock. It was noticeable that evidence of movements was more pronounced in the more slaty, softer ground than in the more massive sediments and the numerous porphyry dykes and that the lode, in consequence, was narrower where it traversed these more massive rocks. The latter have supported the less competent members and thereby tended to preserve the line of fissuring and thus to maintain the channels for ore deposition.

The chief ore minerals are galena and blende. These are commonly associated with pyrite in a gangue of quartz, siderite, and broken country rock.

The future of this mine depends largely on results obtained by drifting farther to the northeast on No. 5 level. Most of the profitable ore above No. 4 has been extracted, that which remains being essentially of concentrating character carrying chiefly zinc. Along the floor of No. 4 level, however, there is reported to be a vein carrying up to 300 ounces in silver. The presence of this vein and the proven continuity of ore to at least 40 feet below the level make it desirable that the character of the downward continuation of this part of the lode at No. 5 level be determined.

The second or Ryan lode crosses the same ridge about 450 feet northwest of the Tom Moore lode and has been explored by two short adits, 45 feet apart vertically, and by a winze sunk 60 feet below the lower level. The upper adit is caved, but at the portal there is a pile of yellowish stained quartz said to carry good silver values. The lower adit driven for about 200 feet from the northeast side of the hill intersects badly broken, slaty ground and a couple of porphyry dykes. The lode is not well defined except in the vicinity of the winze, where it has a strike of about north 45 degrees east and, as indicated by the slope of the winze, which was filled with water, dips about 37 degrees northeast. The mine manager reports that the lode steepens to 55 degrees in the lower 20 feet of the winze. It is claimed that the winze encountered good ore to the bottom. A crosscut has been driven from the northwest side of the hill at a depth of 200 feet below the lower adit, to reach the lode below the winze. This crosscut is in 390 feet and at the face is about vertically beneath the adit at a point 80 feet or so southwest of the winze. Assuming the dip of the lode to be 37 degrees, this crosscut still has 265 feet to go before reaching its objective. If the dip of the lode averages 55 degrees, this distance would be reduced to about 150 feet. The ore from the winze was a mixture of galena, zinc blende, and pyrite with some grey copper and ruby silver in a quartz gangue. Two carloads carrying over 100 ounces in silver a ton are stated to have been obtained from the winze.

The third or Soho lode is exposed about 3,100 feet northwest of, and more than 1,000 feet vertically below, the highest outcrop of the Tom Moore lode. It is explored by two shafts 60 feet apart. One of these is 32 feet deep and the other follows the lode for 100 feet. From the bottom of the deeper shaft drifts have been run for an aggregate distance of 120 feet. Neither shaft was accessible in 1927, the shallower one having caved and the deeper being filled with water. It was stated that in sinking the deeper shaft 25 tons of 90-ounce silver ore was obtained and that the drifts provided two carloads of ore averaging 95 ounces in silver, 47 per cent lead, and 12 per cent zinc. Specimens of ore at the shaft head showed brecciated vein matter carrying galena, and blende in a gangue of spathic iron, quartz and fragments of country rock. The Soho lode is said to strike about north 55 degrees east and to dip steeply southeast. The shafts are about 750 feet south and 1,050 feet vertically above the long crosscut of the Rambler-Cariboo mine (No. 14 level). This crosscut should intersect the Soho lode if it continues northeasterly along its strike. In driving the crosscut a number of quartz veins were encountered. A couple of drifts run on them discovered some mineralization, but nothing of commercial value.

Exposures of vein matter have been observed elsewhere on the Soho group.

STANDARD, EMILY EDITH, AND ALPHA GROUPS

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 28; Sum. Rept. 1925, pt. A, pp. 207-208.
Ann. Repts., Minister of Mines, B.C., 1896, p. 67; 1904, pp. 176, 178; 1911, pp. 145-148; 1915, pp. 124-125; and elsewhere, 1896-1928.
Rept. of Zinc Commission, 1906, pp. 213-215 and 269-271.
Vallance, John: Jour. Can. Min. Inst., vol. XIV, 1911. "The Standard Mine, Silverton, B.C.," pp. 55-58.

The groups consist of the Gordon, Page, Standard, Standard fraction, Ironclad, Eagle, Eagle fraction, J.I.C., Arena fraction, Jennie Jones, Emily Edith, Shunieau, Alpha, Anacortes fraction, and Surprise Crown-granted claims and is owned and operated by the Western Exploration Company, Limited, Silverton, B.C. The property occupies a large area extending from Silverton up the north slopes of Silverton Creek valley to an elevation of over 3,000 feet above Slocan lake. It is accessible by wagon road from Silverton. The workings are largely concentrated on three claims and are referred to as the Alpha, Standard, and Emily Edith mines, respectively (*See* Figure 5). The Standard claim lies south of and is separated from the Alpha claim by the narrow width of the Surprise claim. The Emily Edith claim lies west of and is separated from the Standard by Shunieau claim. The three claims were located in 1892.

A large outcrop of partly oxidized silver-lead ore on Alpha claim was the original discovery and was worked energetically to about the end of 1895, following which year but little work is recorded. The Emily Edith group of six claims in the early years was operated independently of the Alpha and Standard mines. Production from this group commenced in 1899. About 1907 or 1908, the Standard and Emily Edith groups were amalgamated. During 1909 and 1910 the main Standard ore-body was intersected by the lower levels, resulting in a long period of heavy production unequalled by any other property in the district. About 1913 the Standard Silver-Lead Mining Company of Spokane was organized to operate the property. This company continued operations until 1921, since which time production has been maintained by lessees. In 1928 the present owners acquired all groups from the Standard Silver-Lead Mining Company.

First production from this property came from the Alpha mine, which is recorded as having shipped about 2,200 tons of clean galena and oxidized ore in 1894 and 1895. This ore yielded 107 ounces in silver to the ton and 60 per cent lead. Some ore was obtained from the Alpha claim during the period of development of the Echo mine, but the amount is not separately recorded and all subsequent recorded production of the group has been from the Emily Edith and Standard mines. Shipments from the Emily Edith began in 1899 with the production of 60 tons of silver-lead ore averaging 60 ounces in silver to the ton and 50 per cent lead. During the years 1899 to 1907, inclusive, this mine is credited with 186 tons of ore carrying 55 ounces in silver a ton and about 50 per cent lead. Production from the Standard commenced in 1905 and was maintained each year up to and including 1924. During this period, except for the years 1906 and 1907, the production figures for this mine also include those of the Emily Edith whose aggregate production, however, was small as compared with

that of the Standard. Up to and including 1911, and except for 1906 and 1907, the aggregate production from these two mines amounted to 5,443 tons of silver-lead ore yielding, on the average, about 80 ounces in silver to the ton and 63 per cent lead. Beginning in 1912 and continuing to the present, the recorded production included an increasing content of zinc. In the years 1912 to 1924, inclusive, the production of Standard and Emily Edith mines amounted to over 368,000 tons of crude ore and mill feed, which as a whole averaged over 15 ounces in silver to the ton, over 8 per cent lead, and about 7 per cent zinc. No output is recorded in 1925 but in 1926, 1927, and 1928 an aggregate of over 1,500 tons of silver-lead-zinc ore was produced.

The property is underlain by Slocan sediments cut by dykes and by a small stock of granodiorite. The sediments represent a large part of the Slocan series as developed in the vicinity of Slocan lake (*See* structure section EF, Figure 3, of Memoir 173, in pocket). The rocks are dark grey to black, siliceous, calcareous, and carbonaceous argillites, both massive and platy; grey quartzitic rocks; and some limestone. Pyrite is a conspicuous constituent in some beds. The structure is complex and irregular, strikes and dips varying through all angles. Abrupt changes in attitude are the result of local folds or faults. In the main, however, the strike is north to northwesterly and the structure dominantly synclinal on the Standard and Emily Edith claims and anticlinal on the Alpha claim. The average dips are moderate. The flatter dipping strata exhibit, as a general rule, much shearing and also movement between the more competent and less competent beds. The underground workings are notable for the great widths of greatly sheared ground encountered.

The one small stock of granodiorite lies at an elevation of 4,000 feet in Standard gulch (Emily creek) crossing the southeast corner of the Standard claim. Large, granitic bodies also outcrop along the valley of Silverton creek, but have not been encountered underground. These granitic rocks, and probably also the small stock outcropping in Standard gulch, are part of the Nelson granite whose main area lies a short distance south of Silverton creek. The dykes vary in composition from quartz porphyry to biotite and hornblende granodiorite porphyry and porphyrites, and to more basic types. In the underground workings, particularly in the vicinity of the lode or in other broad zones of sheared ground, the dykes are mostly so altered as to render their identification difficult or impossible. A common type is a grey, fine-grained rock carrying granules of quartz and (or) altered feldspar with some pyrite, in a decomposed groundmass. Under the microscope the groundmass is seen to include an abundance of sericite with some calcite and outlines of altered feldspar grains. Such a dyke, or dykes, occurs rather persistently along or near the foot-wall of the main lode in the Standard mine, particularly on levels Nos. 3 and 4 in the vicinity of the ore-bodies. Less altered portions of the dyke indicate its composition to be that of quartz diorite porphyry. Its maximum thickness is about 5½ feet. Wider, dyke-like intrusions were observed along the course of the lode at greater depths, as on No. 7 level.

The Alpha mine workings include five adits driven on the Alpha lode over a vertical range of about 300 feet, the uppermost being about 4,325 feet above sea-level, or about 2,600 feet above Slocan lake. These work-

ings are now largely inaccessible either because of caving or the accumulation of water. The lode explored by these workings is a greatly sheared and fissured zone cutting across the sediments of the Slocan series on a general northeasterly strike and dipping southeast at angles of from 30 to 40 degrees. The lode is somewhat irregular in the upper levels, but is more readily followed on its course down the hill and in the lower workings. The main ore shoot outcropped in the vicinity of the portals of the upper two levels and pitched into the hill. It consisted chiefly of clean galena and oxidized lead ore. Shipments were won mostly from those near surface workings. It is reported that no ore was encountered in the lower two levels, but that it appeared doubtful as to whether they had been extended far enough to pick up the main ore-body provided it persisted to these lower levels.

The Standard mine workings include eight adits numbered from the uppermost down, Y-level and Nos. 1, 2, 3, 4, 5, 6, and 7.[1] They occur over a vertical range of about 900 feet. The upper three levels are short, but the others range from 1,000 feet (No. 3) to about 4,600 feet long (No. 7). The latter is driven from Emily Edith ground and reaches the main lode by a crosscut 200 feet long. This level crosses the Shunieau and Standard claims. In addition to the adits a number of comparatively short, intermediate levels have been driven, No. 6 is the main working level. No. 1 adit is about 300 feet below the lowest Alpha adit and No. 6 level is about 1,500 feet above Slocan lake. Altogether, these workings comprise about 17,000 feet of drift and crosscutting as well as many hundred feet of raises.

The workings, except for comparatively short crosscuts to the lode in the case of Nos. 3, 4, 5, and 7 adits, follow a greatly sheared and fissured zone. The average strike of this zone in the mine workings is between north 70 degrees east and 75 degrees east and the dip is southeast at an average angle of 45 degrees. On the Shunieau claim, lying west of and adjoining the Standard, the lode on No. 7 level has a general strike of south 75 degrees east, swinging to about north 65 degrees east in the vicinity of the boundary between the two claims. Towards the eastern side of the Standard claim and where the adits first enter the main ore-body, the lode splits. The hanging-wall split continues along the general direction of the lode in the more westerly parts of the drifts, but the foot-wall or main split swings to the northeast and on levels 4 and 5 crosses the southeastern corner of the Surprise claim and continues into the adjoining Page claim. The hanging-wall split (the "I-vein") on No. 5 level has a strike of north 83 degrees east for its explored length of 500 feet. The foot-wall split is apparently present higher up the hill on Alpha ground and still farther up, on the adjoining Echo property. Still farther north the same lode has been picked up at several points and is believed to be continuous to and across the summit of the divide half a mile west of Idaho peak. On the opposite or Howson Creek slope it probably links up with the lode system on the Silver Bell and Alamo-Idaho properties. There is considerable doubt as to whether the hanging-wall split continues east as a separate lode or

[1] No. 7 level is also referred to as No. 02 of the Emily Edith mine, and No. 5 level of Emily Edith mine is commonly referred to as No. 8 level of the Standard but it does not extend into the Standard claim.

swings to the north to join the main lode. The more probable assumption is that it continues to the east and if it does it may be correlated with a lode on the Robin claim of an adjoining property between elevations of 5,300 and 5,500 feet. The lode on the Robin claim also outcrops on the adjoining Goodwin claim and is tentatively correlated with the Mammoth lode of the Mammoth property.

The main Standard ore-body was found along the junction of the two splits. This ore-body was the most productive of any yet encountered in the Slocan and was, probably, the largest shoot of high-grade galena ore ever found in British Columbia. It extended from a little below No. 3 to well below No. 6 level and had a maximum length of 400 feet. At one place on No. 5 level there was 12 feet of clean ore on the foot-wall and 4 feet on the hanging-wall with a 6·5-foot horse of argillite and 8 or 9 feet of milling ore. The clean galena was commonly banded or gneissic and, in general, quite coarse textured. It carried grey copper and in places ruby silver. A selected specimen of grey copper and galena (half and half) from below No. 4 level assayed 2,000 ounces a ton in silver. Above No. 4 a specimen of grey copper gave only 70 ounces of silver to the ton. The milling ore carried galena and blende and considerable pyrite and chalcopyrite in a gangue of quartz, siderite, and calcite, associated with much crushed material from the wall-rocks. The ore shoot was of composite character, forming in both foot- and hanging-wall sections of the vein and composed, principally, of a series of bands or lenses angling obliquely across these sections from wall to wall, with crushed carbonaceous rock between. This structure appears to have developed, partly at least, as a result of deformation subsequent to mineralization. Where the main ore-body was first struck on No. 6 level the adit was being driven along the hanging-wall of the lode and struck a cross-fissure leading towards the foot-wall. This fissure contained a few inches of galena which widened to over 10 feet at the foot-wall side and was composed of bands, 6 to 10 inches wide, and alternatingly galena and zinc blende. The form of the ore-bearing fissure from where first struck to where it takes its course along the foot-wall is "S" shaped.

Below No. 5 level a large tonnage has been won from other shoots lying mostly northeast of the main shoot, nearer the faces of Nos. 5, 6, and 7, and intermediate levels. Much of the development work since 1915 has been done in this section of the mine, the workings reaching to within 250 feet of Standard gulch. The ore found in these eastern workings carried an increasing proportion of zinc blende as depth was attained. In the intermediate levels between adits Nos. 5 and 6 the ore along the upper intermediate carried both blende and galena, whereas in the lower the ore was mainly blende. Much zinc ore was also obtained from the vicinity of levels 6 and 7 not far northeast of the main ore shoot and doubtfully connected with it.

Elsewhere in the Standard mine considerable ore has been discovered, mostly about No. 5 level. One important shoot extended from above No. 2 to and below No. 4 to the west of the main ore-body. This shoot raked into the hill and in the vicinity of No. 4 level joined (?) the main ore-body, which raked in the opposite direction. On No. 6 mineralization occurs at several points, commencing 100 feet from the portal and con-

tinuing for about 400 feet. It consists of quartz and zinc blende with some galena, but has not provided a commercial shoot.

Workings of the Emily Edith mine include six main adits. The lowest is more than 400 feet below the uppermost. Four of the adits are crosscuts from the steep northern slope of Silverton creek. Altogether over 9,000 feet of lineal work, chiefly drifts, has been done on this mine, exclusive of the highest level, which is about 2,200 feet long on Emily Edith ground. Much of this work has fallen into disrepair owing to the "heavy" character of the ground. Since 1908 the property has been operated chiefly by lessees, except in the case of the highest level started on Emily Edith ground which has been projected to get under the Big Standard ore-body.

The Emily Edith workings explore the western continuation of the lode worked in the Standard and Alpha mines. On the Emily Edith claim it is a greatly sheared and fissured zone 50 feet or more wide, striking nearly east and dipping south at from 50 degrees to 60 degrees. Its course on the Shunieau claim, as followed by levels Nos. 7 and 8, varies from about north 78 degrees east to southeast and apparently swings from the latter direction to about north 65 degrees east near the western boundary of the Standard claim.

The ore-bodies developed on the Emily Edith claim lie about 3,000 feet west of the main ore-body of the Standard and mostly occur towards the western end of the workings. In 1905 the ore shoot showing in the four upper adits extended for about 250 feet on the dip. On the highest level it was 60 feet long and averaged 2 feet in thickness. On the next lower level it averaged 4 feet for a length of 30 feet and assayed 34·2 per cent zinc, 7·77 per cent lead, and 7·2 ounces in silver. In the third level the shoot was exposed intermittently for 250 feet and averaged 2 to 3 feet in thickness. Two assays gave: zinc, 29·2 per cent and 26·2 per cent; lead, 12·4 per cent and 8·7 per cent; and silver, 13·2 ounces and 10·4 ounces a ton. In the fourth level, the shoot was 75 feet long, with a maximum thickness of 10 feet. More recent work by lessees on or from the highest and the fifth and sixth levels has opened up good showings of mixed ore from one to several feet wide in both the foot- and hanging-wall sections of the lode, and the impression gathered from a brief survey of these workings was that much ore of this character yet remains in this section of the property.

The principal ore minerals are zinc blende and galena with the blende preponderating. Quartz is the principal gangue mineral. Calcite and siderite are present, but not in such conspicuous amounts as in the Standard mine workings.

The lode opened on the Alpha, Standard, and Emily Edith properties has been explored over a vertical range, between the uppermost Alpha and the lowest Emily Edith adits, of about 1,750 feet. To this might be added the work at the Echo mine above the Alpha, giving an additional range of over 400 feet. The greatest depth below the surface at which ore has been discovered, towards the face of No. 7 (Standard) adit, is about 1,000 feet. At this depth the ore carries relatively little galena as compared with the ore-bodies discovered higher up in the Standard and Alpha mines or even in the lower workings on Emily Edith

ground. Though some ore shoots pitch into the hill, the ore-bearing zone as a whole pitches with the slope of the hill though at a somewhat steeper angle. It seems likely that much galena ore has been eroded from above Emily Edith and Standard ground, particularly from above the Shunieau claim.

Throughout this group of properties the main lode is unusually wide and much movement has occurred along it in both pre-mineral and post-mineral time. At its widest point, namely, in the vicinity of the main Standard ore-body, the lode has a width of about 150 feet, in which, as along many other sections of the underground workings on Standard and Emily Edith mines, two ore-bearing channels developed, one near the hanging- and the other near the foot-wall. Cross fissures occur between these walls and have facilitated ore deposition in the vicinity of the larger ore-bodies.

The lode by reason of its size and composite character has required exploration by numerous crosscuts into foot- and hanging-walls in order that important ore deposition might not be overlooked. This procedure has not everywhere been followed to the extent desirable and further discoveries would probably be made if the better mineralized sections were more thoroughly explored. The future of the property seems dependent, however, not so much on this type of exploratory work as on the investigation of new ground. Outcrops of vein matter at a number of places on this and adjoining properties appear to indicate that there are other lodes running, apparently, about parallel with the lode already investigated underground.

The junction of the Emily Edith lode striking east, and the Standard-Alpha-Echo lode striking northeast, was the site of the big Standard ore-body. Any information indicating that other lodes join or intersect these explored lodes should be carefully considered in any future program of exploratory work.

ST. KEVERNE CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1902, p. 147.

The St. Keverne Crown-granted claim is on the upper, northeastern slope of the high ridge between McGuigan and Carpenter creeks, which extends northwesterly from mount Payne. The claim adjoins and lies northeast of the Payne group and is owned by St. Keverne Mining Company, % C. M. White, New Denver, B.C.

The property is credited with small shipments, in 1902 and 1905, aggregating 16 tons of silver-lead ore averaging 144 ounces in silver to the ton and 78 per cent lead.

SUNSET-TRADE DOLLAR AND BELL GROUP

References: Rept. of Zinc Commission, 1906, pp. 181-182.
Ann. Repts., Minister of Mines, B.C., 1916, p. 186; and other years.

The Sunset-Trade Dollar and Bell group of six Crown-granted claims is owned by W. J. C. Wakefield of Spokane, Washington. The property extends across the divide at the head of Jackson creek between elevations of approximately 6,000 and 7,000 feet (Figure 13). It is accessible either

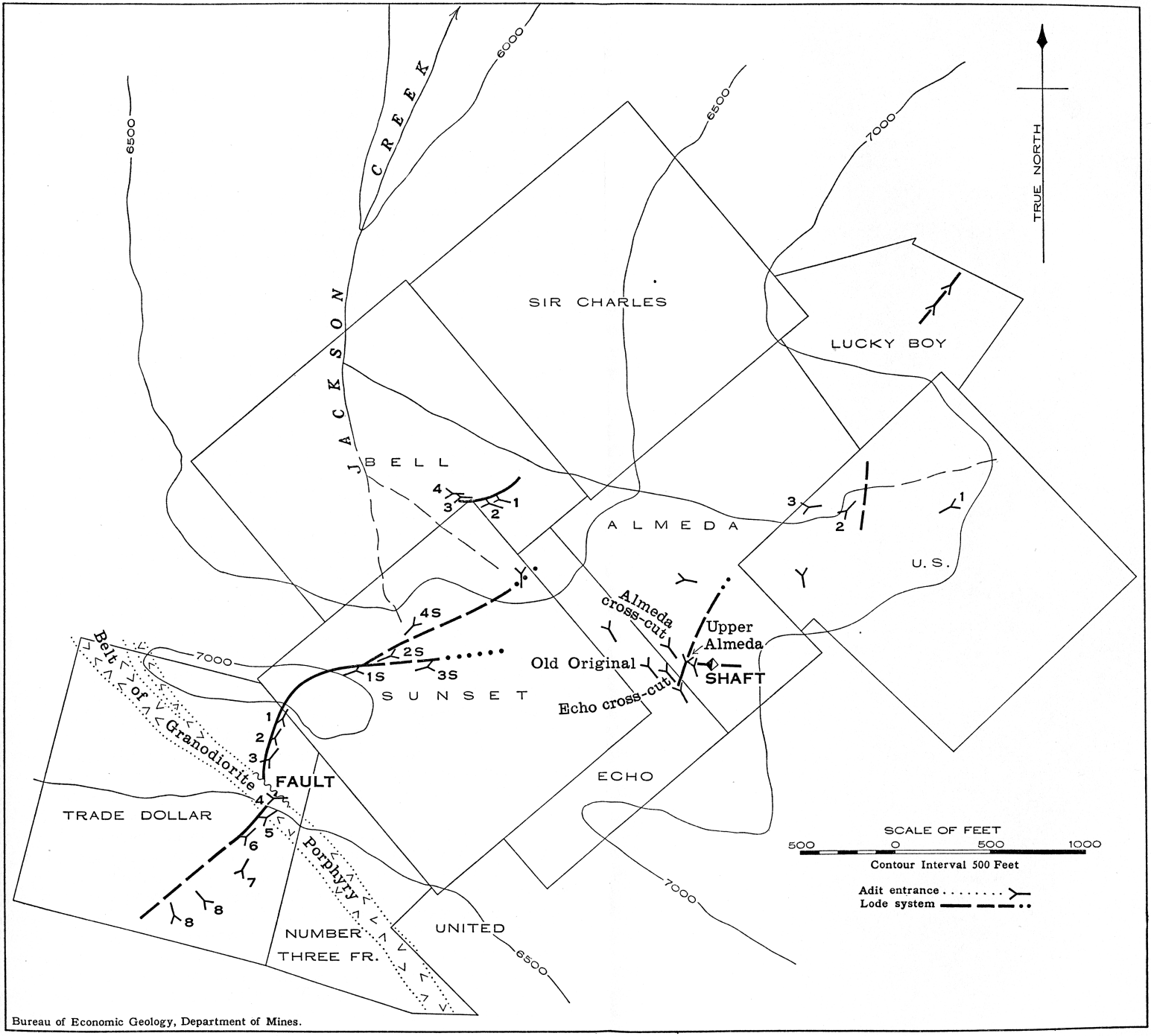


Figure 13. An area at the head of Jackson creek showing claim boundaries and lode systems.

by trail from Sandon or by wagon road up Jackson creek from Retallack station, a distance of 7 miles.

The group includes the Bell claim and the original Sunset-Trade Dollar group comprising the Sunset, Trade Dollar, No. 3 Fraction, Nabob, and Cashier claims. Mining commenced in the late nineties and a considerable production, chiefly from the Sunset and Trade Dollar claims, was obtained in early years of the new century. In the case of the Bell claim the principal producing years were 1916-17-18. After 1918 little work was done on any of the claims until the autumn and winter of 1926-27 when lessees shipped over 100 tons from old workings on the Trade Dollar claim.

The principal workings on the Sunset and Trade Dollar claims are twelve adits, four of which have been driven from the northern slope of the ridge, on the Sunset claim, and the remainder from the southern slope, on the Trade Dollar claim. The respective elevations of Nos. 1, 2, 3, and 4 Sunset adits are approximately 6,870, 6,790, 6,715, and 6,595 feet and those of Nos. 1, 2, 3, 4, 5, 6, 7, and 8, Trade Dollar adits, 6,830, 6,730, 6,630, 6,520, 6,440, 6,300, 6,230, and 6,005 feet. The elevation of the main lode at the summit of the divide is 6,980 feet, nearly 1,000 feet above the level of the lowest, or No. 8, Trade Dollar adit. A short adit known as No. 5 Sunset and located 165 feet vertically below No. 4 adit on the north slope has been opened on what may be a continuation of one or other of the branch lodes developed in the upper Sunset workings. Altogether, at least 7,700 feet of underground work, including drifts, crosscuts, raises, etc., has been done on these claims. The workings are now partly inaccessible, particularly in the vicinity of what have hitherto proved the more productive sections.

The country rocks are mainly sediments of the Slocan series and form a syncline whose axis crosses the divide to the northeast of the main lode outcrop. The strike of the rocks is, on the whole, fairly constant and averages about 33 degrees west of north. The dip varies from 43 degrees northeast on one side of the axis to 58 degrees southwest on the other. The uppermost beds of the syncline are encountered in the upper mine workings within 350 feet of the summit of the divide. They are mostly massive, quartzitic types with varying proportions of argillaceous and calcareous material. In these rocks a large part of the ore on this property has been found. The general synclinal structure is interrupted to some extent by faulting which as encountered underground has effected some apparent displacement of the lode (Figure 13). Beneath this syncline of massive rocks are more slaty sediments interbedded with thinly banded, fragile argillites and occasional narrow limestone beds. Cutting across the dip of these rocks, but in general conforming closely with their strike, are a number of acid porphyritic intrusives. The largest, a granodiorite porphyry, has a maximum width of nearly 400 feet. Its northeastern contact crosses the divide about 950 feet west of the lode. On its southeasterly extension across the Trade Dollar claim between the portals of adits No. 4 and 5 this porphyry body splits into a number of dykes separated by comparatively narrow bands of sediments.

The ore on these claims is a mixed one, whereas that on the Bell claim is almost entirely sphalerite. Early shipments contained a large proportion

of galena, but recent work has been on ore carrying mostly zinc. In the upper levels the vein matter was considerably oxidized, and apparently carried much more galena in proportion to blende than in the lower levels. Early records show an aggregate production of 2,663 tons from the Sunset-Trade Dollar lode. This ore is stated to have averaged 132·23 ounces silver to the ton and 72·8 per cent lead. As mined, the ore was nearly all shipping grade. Shipments in 1916-17-18 were apparently incorporated with those from the Bell claim and are subordinate to those of the Bell.

The main lode as developed by these workings is nearly straight, the strike varying not more than a few degrees from north 73 degrees east and the dip averaging about 60 degrees southeast. Its continuity seems well established above No. 4 level, in part by connecting raises and in part by general conformity in strike and dip from one level to the other. Below No. 4 level on the Trade Dollar slope there is also evidence of the persistence of the same lode to the eighth level. No. 4 level is connected with No. 5 by a raise on the lode reaching No. 4 near the portal. Levels 6 and 7 are also said to be connected. No connexions were observed between 7 and 8, but there seems little doubt that the same lode was encountered towards the face of both levels.

In addition to the main lode branch lodes were encountered in the underground workings and some work done on these. On levels 3 and 4 on the Sunset claim, the main lode is joined by a well-defined fissure striking about north 42 degrees east and dipping from 65 degrees southeast to nearly vertical. This fissure follows a line of jointing in the country rocks and in the vicinity of its juncture with the main lode contained a body of ore from which a considerable tonnage was stoped between the second and third levels. Other veins following fault-fissures trending more nearly in line with bedding planes of the sediments have also received some attention. These, however, are of minor importance except in guiding exploratory work towards the main lode, at the junction of which there are possibilities of more extensive mineralization. The main lode varies in width from a mere seam to over 6 feet and in places is marked by a foot or more of gouge. At one point on No. 4 Trade Dollar adit the lode swings with the bedding for a few feet before resuming its regular strike. The paystreak was probably quite wide in the upper, more productive, and at present inaccessible, sections of the mine. Elsewhere there is but little ore in evidence, and the paystreak at no point examined exceeded a few inches in width. Such ore as was seen was an intimate mixture of blende and a lesser amount of galena. Pyrite is also a common constituent in the lower Trade Dollar levels.

On the Sunset claim more or less stoping has been done between all levels, but the greatest tonnage was obtained between the second and third. On the Trade Dollar slope the second and third and the sixth and seventh levels were the productive ones. Recent work by lessees was confined to the vicinity of No. 7 level and included some underhand stoping. Over 100 tons of ore obtained from these workings in 1925 and 1926 ran 14 ounces in silver to the ton, 1·4 per cent lead, and 40 per cent zinc.

The ore mineralization at present in evidence on this property can hardly be regarded as attractive. The persistence of the main lode, however, is encouraging and there are certain sections of the mine where further

exploration would be justified, notably: (1) in and below No. 4 Sunset and No. 4 Trade Dollar levels in the massive rocks already described as forming a syncline in this vicinity; and (2) on Nos. 7 and 8 Trade Dollar levels on either side of and within the large belt of porphyritic intrusives previously referred to. In the first-mentioned place the massive rocks are favourable for the formation of a lode and its subsequent mineralization, and in the second place the porphyritic intrusives are favourable for the same reason and also because such ore as has been found in them is stated to have held somewhat higher values than that in the adjoining sediments.

BELL MINE

An important part of the production from the Sunset-Trade Dollar and Bell group came from workings on the Bell claim at the end of the wagon road up Jackson Creek valley at an elevation of 6,200 feet.

The workings include three short adits over a vertical range of 90 feet. When visited in 1927 the Bell workings were mostly inaccessible in the vicinity of hitherto productive sections. Production figures, maps of underground workings, and the report of the Zinc Commission clearly indicate that two bodies of nearly pure zinc ore were encountered in the uppermost or No. 1 adit, but that these did not continue far below this level. There are no apparent connexions from No. 1 to No. 2 level 60 feet below. On No. 2 a stope 40 feet long extends 15 feet above the level. The stoped ground contained small lenses and streaks of galena and, in places, as much as 3 feet of good zinc ore. This ore probably is a continuation, on a northwesterly rake, of the mineralized zone which included the ore-bodies on No. 1 level. The same zone continues to No. 3 level, 30 feet below No. 2, but at this lowest level mineralization is only narrow streaks of vein matter containing some sphalerite. A maximum width of from 1 to 2 feet of ore, composed chiefly of sphalerite but containing a little galena, was discovered between levels 2 and 3.

Work on No. 3 level, which is open throughout, includes over 400 feet of drifting along the main lode which strikes north 70 degrees west and dips 65 degrees southwest. This lode is a shear zone in carbonaceous, argillaceous rocks showing here and there fragments of drag porphyry. Some porphyry was noted in places on the south side of this drift within 60 feet of the face. This may have some connexion with the porphyry dyke which forms near or along the hanging-wall of a zinc ore-body encountered towards the face of No. 1 adit. From a point 100 feet from the face of No. 3 drift a crosscut has been extended to the south for 350 feet. It intersects massive argillaceous and quartzitic rocks which strike almost at right angles to the crosscut and dip southerly at 75 degrees. The crosscut was evidently projected to intersect the Sunset lode at a depth of about 200 feet below the No. 5 Sunset adit. It has not reached its objective.

About 30 feet from the portal of No. 1 adit the first ore-body along the main lode is terminated by a cross fissure striking northeast and dipping 32 degrees southeast. In following this fissure a second body of good zinc ore was encountered within about 50 feet of the main lode. From this point it continued for 50 feet to the face of No. 1 adit, in which distance it had an average width of 30 inches. At the face of No. 2 level the ore

terminated against a fault zone striking and dipping about parallel with the main lode.

In addition to the main lode, the parallel fault zone, and the cross fissures connecting them, the vein structure is further complicated by a number of cross fractures striking more nearly north and south and dipping east at various angles. These are probably pre-mineral and of some genetic importance as evidenced by the fact that near the portal of No. 1 adit the ore-body shows its maximum width of about 10 feet at the intersection of the main lode with one of these fractures.

The ore on the Bell is peculiar in that the productive shoots were composed of sphalerite carrying very little silver and almost no galena. A number of samples taken by the Zinc Commission gave very similar assay returns and averaged 2·2 ounces silver a ton, less than 1 per cent lead, and 45 per cent zinc. In all, several hundred tons of this ore have been shipped and, apparently, the productive portions of the shoots mostly exhausted.

The chief ore mineral is massive sphalerite brecciated in part and cemented by pale yellow siderite and cut by veinlets of pyrite. Some galena appears in the lower levels.

The ore-bodies have developed by replacement of limy quartzite whose attitude is nearly that of the main lode. There appears to have been some dislocation of the strata along cross fractures, so that termination of the ore-bodies has probably been largely caused by displacement of the strata favourable to mineral replacement rather than to the offsetting of any particular fissure. The sparsity of mineralization at No. 3 level may, in consequence, be due to a change in formation at this level to more argillaceous rocks.

SUNSHINE AND YAKIMA GROUP

This group, comprising Sunshine, Monday fraction, Monday, Kasa fraction, Yakima, Cuba, and Oregon Crown-granted claims, is situated in and to the east of Sunshine basin towards the head of the east fork of Howson creek and on both sides of and adjoining the Corinth group. The property is accessible by road and trail up Howson creek from Alamo via the Queen Bess mine. It is owned by Sunshine Mining Company, Limited, Sandon, B.C.

Production commenced in 1894, but returns for that year are unknown. In the following years shipments aggregated 45 tons of silver-lead ore carrying 78 ounces in silver to the ton and 56 per cent lead. Further shipments are recorded in 1905, 1906, 1908, and 1916, and amount to 62 tons of ore[1] that had an average content of 85 ounces in silver to the ton and 55 per cent lead.

The underlying rocks are Slocan sediments intersected by a few acid and basic dykes. In the vicinity of the Sunshine workings the sediments are quartzitic and limy argillites, limestone, and limy quartzites. They strike nearly north and dip from 40 degrees to 60 degrees to the east.

Workings include several adits on the Sunshine and Yakima claims and are partly inaccessible. In 1905 there were three adits on the Sunshine with an aggregate length of 405 feet and 300 feet of tunnelling on

[1] Probably incomplete.

the Yakima. Mining was continued in the following years, as evidenced from the fact that the lower main adit of the Sunshine workings, when visited in September, 1926, was over 565 feet long and was caved at that distance from the portal.

The Sunshine workings explore a fissure-vein lode cutting across the Slocan sediments on a strike of about north 65 degrees west and dipping 55 degrees to the southwest. The lode is partly occupied by a basic dyke about a foot wide with mineralization along both sides. The abundant gangue mineral is coarsely crystalline calcite; some quartz and siderite are present. The principal ore minerals are galena and blende. These form streaks, bunches, and disseminations chiefly in or alongside the calcite gangue. The ore has a brecciated appearance much resembling that from the Corinth mine. The galena is gneissic in part and in part coarse cube and both it and the zinc blende carry some grey copper. The vein matter is partly oxidized near the surface.

SURPRISE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 63; 1910, p. 99; 1911, p. 143; 1916, p. 197; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 208-209.

The Surprise group, comprising Surprise Extension, Surprise No. 2, and Summit Fraction Crown-granted mineral claims, was acquired in 1928 from the Rosebery-Surprise Mining Company by Noble Five Mines, Limited, owners of the adjoining Noble Five group.

The property (*See* Figure 1) occupies an area along the summit and north and south slopes of the high ridge extending west from Reco mountain. Workings range in elevation from about 6,800 to 7,700 feet above sea-level. They are most readily accessible by the American Boy-Last Chance trail from Sandon. This trail connects with No. 3 Last Chance tunnel which is also the lowest Surprise level. The Last Chance aerial tramway has been used in transporting ore from Surprise mine to the old K and S railway grade. From this grade a wagon road one mile long leads down Carpenter Creek valley to Sandon. Under recent arrangements the facilities provided by the Noble Five aerial tramway to, and mill at, Cody will be made use of in operations on this property.

The main lode was originally explored by three adits driven from the north slope of the divide at the head of the south fork of McGuigan creek. Of these three adits, only the lowest, or No. 3, is now accessible. No. 1 was a drift on the lode for 130 feet. No. 2 and No. 3 adits reach the same lode by crosscuts 85 and 315 feet long, respectively. The depth below the summit of the ridge to No. 3 level is about 250 feet. Subsequently an opportunity to explore the lode at greater depths was furnished by an arrangement made with owners of Last Chance and Noble Five mines whereby No. 3 Last Chance level, driven from the southern slope of the divide, was extended northeasterly into Surprise ground and the Surprise lode encountered over 700 feet vertically below No. 3 crosscut level. Raises now connect these two adits and intermediate levels have been run at intervals of about 100 feet.

Production began in 1893 with the shipment of 100 tons of ore averaging 229 ounces in silver to the ton. Returns for the following years are incomplete. Beginning in 1913 shipments were made each year up to and including 1926. The largest, totalling nearly 14,000 tons, were made in 1918, the ore for this year carrying an average of 45 ounces in silver to the ton, 13 per cent lead, and 8 per cent zinc. Altogether an output of nearly 50,000 tons, averaging 38 ounces in silver to the ton and 13 per cent lead, is recorded. Much of this ore was concentrated at the company's mills[1] at Sandon and Rosebery before being forwarded for reduction.

A complete section of the rocks encountered in underground workings is exposed in the lowest or "Tunnel" level, the extension of which on the Surprise property has a length of 1,600 feet. Within the limits of Surprise property and particularly across the more central and most productive section of the mine this level intersects a width of about 700 feet of quartz porphyry associated with, and in part almost indistinguishable from, bands of light-coloured, massive quartzite. On either side of the porphyry belt the rocks are mostly sediments of the Slocan series and include both slaty and more massive, argillaceous and calcareous types. The sediments and the porphyry have a general west-northwesterly strike. The sediments dip mainly to the southwest. The quartzite is most abundant within the more southwesterly 200 or 300 feet of the porphyry belt.

Two lodes have been developed. Of these the "main" or "Surprise" lode has been the productive one. It cuts across the sediments and porphyry on a strike of about north 65 degrees east, varying, in the more southwesterly workings, to about 20 degrees east of north. This lode is a well-defined fissure zone varying frem a few inches to over 15 feet wide. Its average dip is about 65 degrees southeast, but ranges from 45 degrees or less to over 75 degrees. Commonly the dip steepens in the more massive rocks such as the quartz porphyry and the quartzitic sediments and flattens in the less competent beds. In the lowest level the lode was first encountered about 2,500 feet from the portal. In this distance the Last Chance lode was followed from the Last Chance claim through Noble Five ground. Before reaching the Surprise property the lode swings gradually from a northeasterly to a nearly northwesterly direction and eventually encounters a strong shear or fault, striking about north 20 to 25 degrees east and dipping 35 degrees southeast, beyond which its continuity has not been determined. Commencing at a point about 300 feet along the drift from this fault, attempts were made to pick up the lode along its more general northeasterly course; the level was extended into the Surprise ground and there struck the Surprise lode at the point mentioned above. No direct connexion between the Last Chance and Surprise lodes was established, though it appears likely that the two are parts of the same fissure system.

About 100 feet northeast of the place where the Surprise lode was first encountered a main raise leads up No. 3 level, 300 feet above. Northeast of this raise much of the ground along the main lode has been stoped out. The most productive shoot occurred within the broad belt of quartz

[1] The owners of Surprise property built a concentrator at Sandon in 1916 on the site of the old Ivanhoe mill. The new mill was subsequently (1921) acquired by Silversmith Mines, Limited, and remodelled to form the present Silversmith mill.

porphyry and associated quartzite occupying a central position in the underground workings. Stoping was continuous on this ore-body from the lowest level to between levels Nos. 4 and 5 over 400 feet above. Within this section the lode has a comparatively steep dip, but between the upper levels it decreases to about 45 degrees. The wider and central portions of the main shoot were in part composed of almost clean ore carrying a large proportion of galena. Towards the borders of the shoot the ore became more zincy. Elsewhere along the lode the ore was mainly confined to narrow streaks following either the foot- or hanging-walls, or irregular cross fractures connecting these walls. In general the lode proved more regular and vein matter most persistent within the porphyry belt. Elsewhere some high-grade ore has been encountered both above the main shoot in the upper workings and to the southwest of this shoot below No. 2 level. In these sections the lode crosses argillaceous and slaty sediments within which vein matter and ore form scattered bodies of small dimensions.

The lode filling is composed of ore, gangue minerals, and crushed country rock. Strong evidence of replacement of the wall-rock is seen, particularly within the belt of quartz porphyry. The chief ore minerals are argentiferous galena and blende. Galena carries the higher silver values, but the zinc blende is also argentiferous, one assay giving 53·6 per cent zinc and 33·6 ounces silver to the ton. Pyrite is quite a common accessory mineral and some chalcopyrite is present. Siderite and quartz are abundant. Under the microscope minute veinlets of ruby silver were seen intersecting both blende and galena and the latter was observed to contain small, rounded masses of grey copper and one or more other, probably silver-bearing, polysulphides whose identity could not be satisfactorily determined.

Besides the Main or Surprise lode another lode known as the "Little vein" has been partly explored. This lode is nearly parallel with, and lies 100 feet or so northwest of, the hanging-wall of the main lode. It is reached by crosscuts from the three lowest levels and is drifted on from these levels and from the intermediate level about 40 feet below No. 1. The lode averages only a few inches in width; the walls are mostly "frozen" to the vein matter, and the ore is predominantly zincy. Raises connect the two lower levels, but are in poor repair. It is not known if any ore was obtained from these workings. The "Little vein" is possibly continuous with a quartz vein lode outcropping on both sides of the summit of the divide on Summit Fraction claim. The old workings there are inaccessible, but, from what could be seen on the north side of the slope, appear to have been in a quartz vein in part following a shear striking a few degrees south of east about parallel with the strike of the country rocks. Towards the summit of the divide the vein swings towards the east and northeast. An old shaft, now caved, was sunk on this vein where it crosses the summit.

In 1925-27 work at the Surprise mine was carried on by lessees working between levels 6 and 8, above the old stopes on the main ore shoot, and also above the lowest level to the southwest of this ore shoot. In both of these sections of the mine the main lode occurs in massive to slaty argillaceous sediments and has furnished some high-grade silver-lead ore. Be-

tween No. 5 level and the surface there remains to be explored a considerable block of ground in which in all probability ore occurs, although it is doubtful if any considerable ore-body is present. Below the lowest level and particularly along the line of rake of the main ore shoot, which is towards the northeast, a more important tonnage of ore may be present, but this ore, probably, is more zincy than that discovered above this level. Beyond the porphyry belt the more northeasterly workings, where these could be examined, indicate that in this direction the lode is pinching as it swings along bedding planes of the adjoining rocks. To the southwest of the porphyry belt there appears to be little chance of making important discoveries within the limits of this property. On the adjoining Noble Five ground, however, on either side of the Maud E-World's Fair boundary, where the Last Chance lode passes through a belt 300 feet or more in width composed largely of quartz porphyry, conditions seem more favourable for mineralization.

Within the limits of the Surprise workings certain structural features were observed which, doubtless, markedly influenced the location of the ore-bodies. A series of strong shears, striking about 15 or 20 degrees north of west and dipping 50 degrees or more southwest, follow more or less closely the strike of the rocks. These shears are pre-mineral and are crossed by the main lode. In certain cases they seem to have limited the extent of the ore shoots, and in others, as for example on Summit Fraction claim, to have formed channels for vein deposition. Other fractures, almost at right angles to the last and showing less evidence of movement, have, in places, guided mineralization along the main lode over distances of 100 feet or more.

VANCOUVER GROUP (VAN ROI MINE)

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 68; 1909, p. 112; 1911, pp. 148-151; 1912, p. 149; 1924, pp. 198-199; 1926, p. 254; and other years. Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 209-210.

Vancouver group comprises Humboldt, Zilor, Van Roi fractional, Ricardo, Napier, Vancouver No. 2, Vancouver fraction, Pelly, Mountain Boomer, Silver Star, Moccasin, and Mackinaw Crown-granted claims and is owned by Van Roi Mines, Limited, Alamo, B.C. The property is on the south slope of Silverton creek between Granite and Vancouver creeks and is accessible by road up Silverton creek from Silverton, a distance of 4 miles. Adits Nos. 5 and 9 are connected by aerial tramways with the Van Roi mill opposite the mouth of Granite creek.

The original claims of the Vancouver group, the Vancouver, Mountain Boomer, Le Roi, Iowa, and Doone, were staked in 1892. About 1916 the property was taken over by Clarence Cunningham under whose management it has since remained.

Production began in 1893 when two carloads of ore were shipped which ran 250 ounces in silver to the ton and from 40 to 55 per cent lead. In 1894, 15 tons assayed 233 ounces a ton and 60 per cent lead. Total shipments to January 1, 1899, were 720 tons, assaying 112 to 300 ounces in silver and from 28 to 55 per cent lead. During the years 1907 to 1914 the annual production was large, the largest shipments being made

in 1912 when 56,726 tons were produced, carrying an average of 9·6 ounces silver to the ton, 2·3 per cent lead, and 1·8 per cent zinc. Production in 1925 and 1926 amounted to 4,933 tons, running, on the average, 3·84 ounces in silver, 2 per cent lead, and 1·4 per cent zinc. Up to the end of 1926 the property is credited with a production of nearly 262,000 tons of ore. This carried, on the average, over 8 ounces in silver a ton, about 2·6 per cent lead, and 2 per cent zinc. The ratio of mill concentration to mill feed is in the neighbourhood of 1 to 10 to 12. For example, 54,115 tons of ore milled in 1912 gave 2,392 tons of silver-lead and 2,570·5 tons of silver-zinc concentrates, the former carrying about three times as much silver to the ton as the latter.

Van Roi mine has extensive underground workings. These comprise seven main levels of which the upper four, Nos. 1, 2, 3, and 4, were driven from the west or Vancouver Creek slope and the lower three, Nos. 5, 7, and 9, from the east or Granite Creek slope. No. 3 level opens on both slopes. A number of intermediate levels were run in developing the several ore-bodies and six or more short adits have explored outcrops of vein matter on the hill slopes.

On the Vancouver group the country rocks are chiefly sediments of the Slocan series and are mostly massive quartzitic types, some members showing remarkably fine bedding and banding. These quartzitic rocks vary in colour from light to dark, in texture from granular to dense cherty, and in composition from almost pure quartzite to more limy and argillaceous. Interbedded with the quartzitic strata are many limestone beds, varying from a few inches to a few feet in width, and some slaty, argillaceous beds. The attitude of the sediments is, on the whole, fairly regular; the average strike is north 49 degrees east and the average dip 73 degrees northwest. Variations in strike from north 35 degrees west to east and west were noted, but the wider variations from the average were exceptional and the dip in all cases was northerly. Intersecting the sediments are a few dykes and sills, the larger 50 feet or more broad, ranging in composition from diorite to more acid types. They are jointed in two directions, one about east (dipping 65 degrees northwest) and the other about north 40 degrees west (standing nearly vertically). Considering the nearness of this property to the northern boundary of the Nelson batholith the comparative paucity of dykes is rather surprising. The sediments have been noticeably metamorphosed by the batholith, as evidenced by the conspicuous development of epidote in some of the quartzite beds, the induration of the sediments in general, and the light colour suggestive of bleaching.

The veins worked on this property are in a zone of fissuring and shearing which has a general strike of north 70 to 75 degrees east and an average dip of 75 degrees northwest. Van Roi mine workings have followed this zone for nearly 3,000 feet and to a depth of nearly 1,200 feet. Farther west beyond the limits of this group the same zone has been explored by workings on the Hewitt mine. Still farther west it appears probable that the zone runs to the shore of Slocan lake in the vicinity of the Galena Farm mine. In the opposite direction, or east of the Vancouver group, some work has been done on an adjoining property, comprising LeRoi, Baltimore, and Silver Wedge fraction Crown-granted

claims owned by G. H. Dawson, Victoria, B.C. The results of this work are summarized by the Resident Engineer in the Annual Report of the Minister of Mines for British Columbia for 1918, page 171, as follows:

"The property is situated on Granite creek, the claims being staked along the easterly extension of the Van Roi veins. In the lower workings a considerable amount of drifting and crosscutting has been done on what is supposed to be the north vein, while farther up the hill a short tunnel has been driven and a shaft sunk on presumably the south vein. At these latter workings a vein 10 inches wide is exposed in the bottom of a 10-foot shaft; this vein is highly mineralized with zinc blende. . . . . In the lower workings there is a small showing of galena at the intersection of the main drift and a crosscut, but as yet no ore has been developed which might be considered of commercial importance, although the conditions appear favourable for further prospecting."

The width of this zone has not been fully investigated on any of the properties located along it, but it probably averages not less than 100 feet. Within it different lodes have been encountered and partly developed. Of these lodes one on each property has proved more important than the others.

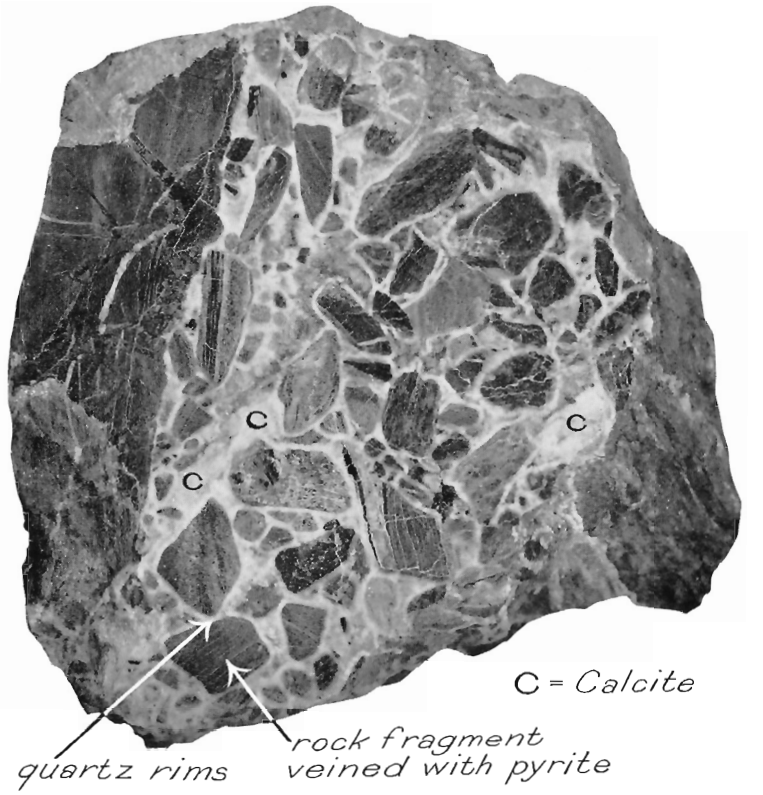
At Van Roi mine there are two principal lodes, of which the more important has been called the "North" or "Main" lode and the other the "South" or "Beryl." The former is coincident in strike and dip with the zone of fissuring and shearing just referred to. It is present on all the main levels and has been followed continuously for a distance of nearly 3,000 feet. The "South" lode has been picked up towards the western section of the mine by crosscuts driven from the Main vein on Nos. 3, 4, and 5 levels, and has been explored over a length of between 500 and 600 feet to No. 5 level. In these workings the south lode strikes about north 50 to 60 degrees east and dips northwest at from 65 to 75 degrees. It seems probable that it is the lode encountered in recent work on an adit "A" 160 feet vertically above No. 1 level. At the eastern, lower mine workings a lode corresponding in position to the South lode but striking more nearly parallel with the Main lode has been picked up on No. 9 level and drifted on for 250 feet. Between these eastern and western workings the continuity of the South lode has been partly established by diamond drilling, but no other explorations have been attempted. In addition to the two principal lodes, a third known as "No. 3" was encountered by a crosscut from the portal of No. 2 level and drifted on for over 100 feet. This lode lies 150 feet south of the north Main lode, strikes nearly east, and dips steeply to the north. It is possibly connected with the lode discovered in "A" level and on the south drifts on No. 1 level.

A number of ore-bodies have been discovered and worked out. These have occurred at irregular intervals along the North lode and in those sections where the South lode has been developed, at places corresponding in position with the ore-bodies in the North lode. The ore shoots have in general a steep westerly rake. Grooving on the hanging-wall of a lode on the "A" level indicates that there the rake, about 55 degrees west, is somewhat lower than the average. No explanation of the location of the ore-bodies at intervals along the lodes is forthcoming except possibly the fact that they occur where cross-fissuring is best developed. Most of the ore was extracted from shoots lying below and somewhat to the west of the summit of the divide within a length of about 1,200 feet. The

main shoot on the North lode continued from above No. 2 level to No. 5, had an average length between levels 2 and 4 of about 200 feet, an average thickness of 10, and a maximum of over 20 feet. East of this shoot and more or less continuous with it between levels 3 and 4 another important ore-body was worked to about midway of levels 4 and 5, its average stoped length between levels 4 and 5 being well over 100 feet. West of the main shoot and separated from it by an interval of 200 feet or more another large shoot or group of shoots extended from below level 3 to about 100 feet below No. 5 adit, a vertical depth of about 400 feet. Immediately above level 5 this shoot was stoped for 300 feet along the North lode. Above the level it narrowed rapidly and does not reach to level 3. Below level 4 the shoot includes a barren interval about midway of its length, but is mostly stoped on both sides of this to intermediate levels between 5 and 7. The average width of stoping ore in this composite shoot was from 2 to 3 feet. Opposite the main shoot was found the principal ore-body on the South lode. This shoot extended to 100 feet or more below No. 5, had an average length of over 200 feet, and a maximum length between levels 3 and 4 of over 300 feet. Most of it was 3 feet or more thick and the ore as mined assayed about 16 ounces in silver to the ton, 7 per cent lead, and 12 per cent zinc. An important ore shoot was also encountered on the North lode in the more easterly mine workings on level 9 and extending up to level 7, and having about midway between these levels a maximum stoping length of over 300 feet. Elsewhere in the mine workings a number of smaller shoots were encountered, mostly along the North lode. One shoot was picked up on the South lode on No. 9 level, opposite the larger shoot on the Main lode.

The mineralization in the different shoots was much alike. The average values of the ore obtained from each shoot were also alike. Here and there in almost all of the shoots rich lenses, bunches, and streaks were found. High-grade lead ore, where found, generally carried much silver. Where, too, the ore had been most fractured the fracture planes in places carried films of grey copper, ruby silver, and in some cases native silver. Very often a better concentration of values was found along or close to the hanging-wall of the lodes, with, in certain instances, a corresponding rich band following the foot-wall. Rich lenses of high-grade silver-lead ore were also found at intersections of the main lodes by cross fractures and fissures. In general, however, the ore was a milling ore because the valuable minerals were intimately mixed with a large proportion of quartz gangue and crushed wall-rock. Some of the richest ore was discovered near level 9 on both the North and South lodes and is stated to have averaged 100 ounces in silver. Three lessees took out $18,000 each in six months from a short adit 65 feet below No. 7 in No. 8 level. Hand-picked ore from these workings is said to have run 250 ounces in silver to the ton. Some high-grade ore and excellent mill-feed have been recently opened up on "A" level 160 feet above No. 1.

In general the boundaries of the ore-bodies are indefinite and represent the limits of commercial values rather than any structural break or pinching of the vein matter. In places, however, slips crossing a lode would terminate the ore without, apparently, effecting any displacement of the lode. Actual displacement of the lodes is a rare feature. Only in the upper workings, No. 1 and "A" levels, and towards the western face of



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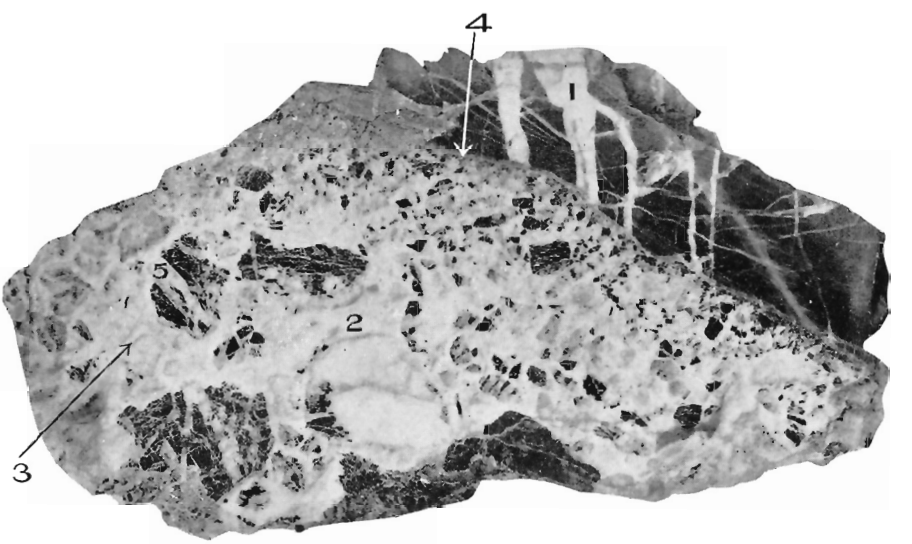
A. Ledge matter from Van Roi mine: showing narrow, even rims of quartz around brecciated fragments of wall-rock, the remaining interstices being filled chiefly with calcite.



72211

B. Vein matter from the Van Roi mine: illustrating different generations of vein quartz and their relations to associated ore and gangue minerals and wall-rock.

levels 5, 7, and 9, was any important displacement observed. In the upper workings referred to, a fault striking northwesterly and dipping steeply southwest appears to offset the South (?) lode about 30 feet to the right. In the lower workings the North lode terminates against a strong fault, known as the "Van Roi fault," striking about the same as the one above but dipping about 65 or 70 degrees southwest. This fault carries from 2 to 3 feet of gouge. West of this fault the workings on the property have failed to reveal a continuation of the lode, although some vein matter has been encountered. The amount or direction of throw is, consequently, uncertain, but cannot be great, as almost directly in line with the North lode and only a few hundred feet west of the Van Roi workings the North lode was found in the Hewitt mine. Whatever offset has occurred is probably to the right, as in the case of the fault on the upper levels. Possibly the shear zone drifted on for 500 feet on both sides of No. 4 crosscut adit represents the western continuation of the North lode.

The ore of the Van Roi mine consists essentially of galena and zinc blende in a quartz gangue. The vein matter commonly has a brecciated appearance with angular fragments of aggregates of ore minerals and others of the wall-rocks scattered through the quartz which generally constitutes a large proportion of the lode filling. The quartz is mostly massive, but in places is banded and in others is cellular and vuggy. Associated with the quartz is a minor amount of siderite and calcite (Plate II). Some if not all the siderite was deposited in advance of the quartz; the calcite is distinctly later than the quartz. Grey copper and ruby silver are sufficiently plentiful in places to be readily detected in the hand specimen and, under the microscope, invariably show on polished surfaces of the ore. Pyrite and chalcopyrite are common accessory minerals. In one specimen small crystals of pyrite were observed encrusting rhombs of calcite in a vug in vein quartz. Pyrite was in general, however, one of the earlier minerals to be deposited.

Recent work at the Van Roi mine has been done on the upper levels (A and 1), and in part on and from No. 9 level. In both of these sections important ore mineralization has been discovered. Between the surface and No. 3 level, along the general upward course of the south lode, there is a block of ground some 600 feet deep that seems worth further investigation. Possibilities in lower sections of the mine have been partly investigated by diamond drilling. So far as is known the results of this exploratory work have not been very satisfactory. A couple of winzes sunk below level 9 have, however, it is stated, disclosed more encouraging mineralization.

The occurrence of ore-bodies opposite each other on the North and South lodes has proved instructive in mining developments and has, to some extent, regulated the course of more recent exploratory work.

VICTOR GROUP

References: Ann. Repts., Minister of Mines, B.C., 1922, p. 199; 1923, p. 223; 1924, p. 196; 1926, p. 251; 1927, p. 270; 1928, p. 286.

The Victor group consists of the Victor and Victor fraction Crown-granted claims and the Archie and Clara claims held by location, and is owned by Dacy Petty of Sandon. It is on the western slope of Carpenter

Creek valley to the northwest of, and adjoining, the Lone Batchelor claim and is accessible by road and trail from either Sandon or Three Forks. The workings are principally on the Archie claim and lie about 1,500 feet northwest of the Lone Batchelor workings.

Production in 1923 and 1924 is recorded as 100 tons of silver-lead ore carrying, on an average, 274 ounces in silver to the ton and 53 per cent lead, and a total of 5 ounces in gold. An output of 238 tons is recorded for the years 1925 to 1928 inclusive. Altogether the property had, up to this time, yielded ore to the value of over $54,000, net smelter returns.

The property is a comparatively recent discovery. It lies on the northeastern extension of the lode system developed so successfully on the adjoining Queen Bess group, chiefly on the opposite slope of the broad divide between Carpenter and Howson creeks. The original discovery on the Victor was made by G. A. Petty in 1921 by trenching through a heavy accumulation of glacial wash, an operation facilitated by sluicing the overburden down the hillside. This work uncovered a vein of solid galena 6 to 8 inches wide for a length of about 12 feet. The vein was subsequently picked up in an adit (No. 1) 50 feet below the outcrop. This adit is about 425 feet long. It encountered the ore 50 feet from the portal and followed it for about 200 feet. Subsequently, the ore-body was stoped to the surface and yielded high-grade silver-lead ore. The lode in these workings has a general strike of north 40 degrees east and a nearly vertical dip, varying to about 75 degrees or 80 degrees to the northwest. It is a fault fissure lode developed along a plane of major jointing along which subsequent movement occurred at an angle of 30 degrees southwest into the hill. Near the face of the adit some galena and oxidized vein matter were discovered in the lode along a small fissure striking north 40 degrees east and standing vertically.

A second adit (No. 2), 90 feet lower than the first and commencing farther northeast, was driven for about 400 feet and along it a little vein mineralization was found here and there, chiefly along joint fractures striking about parallel with the course of the lode in the upper adit, and, presumably, representing the downward continuation of the lode.

No. 3 adit, 70 feet vertically below No. 2, was commenced in 1926 on what appeared to be a lode parallel to that followed by No. 1 adit. This lode was also uncovered by ground sluicing. Towards the portal of No. 3 adit it had a northeasterly strike and a steep dip to the northwest. The adit was in 65 feet when visited in August, 1926. It has since been extended and the results obtained are referred to in the Resident Engineer's report for 1928 as follows:

"The No. 3 level. . . . develops ore of varying width for almost its entire length of 300 feet, making, in places, nice lenses of clean galena. In the last 60 feet of the drift the ground is soft and loose, in which the ore is continuous, showing in one place a maximum width of 5 feet. . . . At the face a crushed zone had been encountered which contained a considerable percentage of groundup galena and zinc blende. . . . A sample of the massive galena exposed in the drift assayed: gold, 0·12 ounce to the ton; silver, 122·2 ounces to the ton; lead, 61·4 per cent; zinc, 4·8 per cent. A raise to the surface from this level unexpectedly missed the No. 2 level, which would indicate that the latter level is not on the same vein."

The latest and lowest working, No. 4 adit, 170 feet below No. 3, is reported by the Resident Engineer as having been "started on a nice showing of ore which was cut off by a strong porphyry dyke through which the tunnel has not been continued."

The underlying rocks are chiefly massive argillaceous and quartzitic sediments of the Slocan series having a general strike of north 40 degrees west and dipping southwest at angles of 35 degrees and lower. They are intruded by a few dykes and sills, some of quartz porphyry, others of granite, the largest being 25 feet wide.

The rocks are intersected by a system of joints striking northeasterly and standing vertically or inclined at high angles to the northwest or southeast. Movement has occurred along some of them causing brecciation of the wall-rocks and the development of gouge which is partly quite carbonaceous.

Mineralization has occurred within a zone perhaps 50 to 100 feet wide in which such jointing is well developed and movement along the joints, in places, pronounced. The boundaries of this zone have not been defined. It appears to line up with the lode system developed on the adjoining Queen Bess property and although continuity of particular fissures or veins from one property to another cannot be assumed the occurrence of parallel fissures is an important feature and is one to be expected. The geological conditions that have appeared most favourable to mineralization on one fissure or lode should be sought for on nearby parallel fissures.

The ore obtained from workings included a large proportion of clean galena, in part coarse cube and in part banded or gneissic. The galena is commonly associated with minor amounts of zinc blende and, generally, a lot of disseminated pyrite. Some chalcopyrite is also present. The galena carries grey copper. The principal gangue mineral is quartz, but locally siderite and smaller amounts of calcite are relatively abundant. The vein matter is notably oxidized near the surface and to a lesser extent to depths of 200 feet or more.

VICTORIA GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1925, p. 244.

The Victoria group comprises the Victoria No. 6 and Galt Crown-granted claims situated about half a mile north of Sandon. The group is owned by Sandon Silver-Lead Mining Company, Limited, % R. L. Edmiston, 540 Rookery Building, Spokane.

Production records indicate that 2 tons were shipped from this property in 1917 and yielded an average of 30 ounces in silver to the ton and 42 per cent lead. Since 1922 it is reported that some 450 feet of underground work has been done and about 5 tons of ore shipped. This ore is stated to have carried an average of 49 per cent lead and 112 ounces in silver to the ton.

The underlying rocks are massive and commonly banded, grey, quartzitic and black, argillaceous beds of the Slocan series intersected by quartz porphyry and medium-grained granite dykes. The sediments have a general northwesterly strike and form part of an anticline, the dips varying from about 40 degrees northeast to 45 degrees southwest.

The workings include three adits over a vertical range of 155 feet. The uppermost is about 210 feet long. It is driven in blocky granite porphyry and black argillites and follows a mineralized fault fissure striking about north 35 degrees east, dipping from 70 degrees southeast to vertical, and containing from 1 to 10 inches of crushed rock and gouge with here and there a little vein mineralization consisting of a mixture of galena, blende, abundant pyrite, and quartz. One small stope 10 feet long and 8 feet high was noted at 50 feet from the portal.

No. 2 adit, 95 feet below No. 1, has been driven for 40 feet north 30 degrees east and follows a mineralized fault fissure along the contact of argillites with quartz porphyry. The fissure dips 60 degrees to the southeast. It is marked along the hanging-wall by 2 inches of gouge against which from 2 to 10 inches of vein matter, carrying abundant pyrite, has formed.

No. 3 adit, 60 feet below No. 2, is 318 feet long. For the first 160 feet from the portal it follows a mineralized fault fissure, 2 to 30 inches wide, composed of gouge and crushed rock and containing a few small bunches of vein matter carrying ore minerals. The fissure strikes about northeast and dips 45 degrees to 75 degrees southeast. The wall-rock is chiefly broken, black argillites except at the portal where the adit passes through a few feet of quartz porphyry. At 162 feet from the portal the adit meets a cross-slip striking north 50 degrees west and dipping 40 degrees southwest. From about this point the adit was continued as a crosscut for 42 feet to a point where it meets the hanging-wall of the quartz-porphyry dyke; it follows this for a few feet to where another slip striking north 25 degrees west and dipping 45 degrees southwest was encountered. The adit follows this slip to the face, but no significant mineralization was discovered.

Lacking a survey connecting workings, and traceable outcrops no attempt was made to correlate the vein fissures from one level to another. The mineralization is similar in type to that on a number of properties on the lower northern slope of Carpenter Creek valley on either side of Sandon. Pyrite is an abundant and characteristic mineral. The ore occurs in small pockets or shoots commonly distributed along fissures or shear zones in contact with or close to one or other of the numerous minor intrusives penetrating the Slocan series. The abundance of pyrite suggests that only the lower portions of what may have been a more extensively mineralized zone remain for exploration, the upper portions having been eroded.

VIRGEL AND CHRISTINA

Reference: Ann. Rept., Minister of Mines, B.C., 1919, p. 131.

The Virgel and Christina Crown-granted claims, owned by P. H. and Henry C. Cosgrove, % P. H. Cosgrove, Kaslo, B.C., are situated on the high ridge west of Virgel mountain between the head of Paupo (North fork of Enterprise) and Silverton creeks and at an elevation of about 7,500 feet.

The property was staked many years ago by M. Murphy who did considerable surface prospecting and drove a couple of short adits. This work has explored a fissure-vein lode cutting in a northerly direction across

coarse-grained, porphyritic granite of the Nelson batholith. The lode is narrow but persistent and somewhat like that on the nearby Para claim. It is occupied chiefly by quartz carrying a little galena, pyrite, and high-grade silver minerals. Good silver values are reported to have been obtained from vein matter at intervals along the lode which has been traced for 1,000 feet.

WAKEFIELD GROUP

References: Ann. Repts., Minister of Mines, B.C., 1900, p. 828; 1903, p. 137; 1904, pp. 175-176; and other years.
Rept. of Zinc Commission, 1906, pp. 215-219.

The Wakefield group, consisting of the Wakefield, Wakefield fraction, Cazabazua, Beaver, The Ben, Ottawa No. 2, Kelso (?), Jenny Lind[1], and Robertson[1], and, probably, other Crown-granted claims, is owned by Wakefield Mines, % C. B. White, New Denver, B.C. The group occupies a considerable area on the northern slope of Silverton Creek valley west of Wakefield creek. The workings of the Wakefield mine lie mostly between 5,600 and 5,800 feet above sea-level. The property is most readily reached by road and trail from Silverton.

Mining commenced in 1897 and by late autumn of the following year over 2,000 feet of tunnelling had been accomplished. A concentrator with capacity of over 100 tons a day was completed in 1900. Records of production are incomplete. Prior to 1902 it is reported that the owners received $93,031.69 in net smelter returns for ores shipped. In May, 1902, the property was leased and before the end of 1904 about 1,400 tons of lead concentrates and 400 tons of zinc ore had been shipped. Records indicate that in 1903, 221 tons of ore were extracted and carried an average of 95 ounces silver to the ton and 65 per cent lead, and that in 1904, 4,500 tons, largely mill feed, were mined and had an average content of 3·2 ounces silver and 4·5 per cent lead. The ore also carried a considerable zinc content, figures for which are not recorded. The mill feed was concentrated in the ratio of from 12 to 15 to 1, producing a lead concentrate running 64 per cent lead and 50 ounces of silver to the ton and, at the same time, a zinc concentrate running about 45 per cent zinc and 20 ounces silver.

In 1905 the property was again leased and in the following year was acquired under terms of a long lease by the owners of the Hewitt mine. In 1905 and 1906 the production amounted to 900 tons of, chiefly, mill feed, yielding an average of about 18 ounces silver to the ton and 10 per cent lead. In 1907, 85 tons of silver-lead ore carried 95 ounces silver to the ton and 49 per cent lead. Thereafter no production is recorded for several years. During this period the Wakefield mill was burned down, in 1912, and replaced by the present Hewitt mill. In 1915 lessees shipped 35 tons of silver-lead ore carrying 111 ounces silver to the ton and 55 per cent lead. In 1919 another lessee shipped 41 tons of silver-lead ore of somewhat lower grade. More recently the property has received considerable attention by the Victoria Syndicate whose operations were largely

[1] For a description of these two claims, *See* the account of the Carnation group.

confined to the Jenny Lind and Robertson claims (*See* account of the Carnation group). In 1929 the Wakefield mine was leased by A. Jarvis who is reported to have shipped several tons of sorted ore.

The rocks in the vicinity of the Wakefield mine are carbonaceous argillites, grey quartzites, some limestone and calcareous argillites intersected by a few acid dykes and sills. The sediments have a strike varying from about north 40 degrees east to nearly east and an average dip of 15 degrees to the southeast and south. This structure does not continue very far and is contrary to the general trend of the Slocan series which is more nearly northwesterly. Local rolls and strong faults complicate the general structures so that correlations from point to point are exceedingly difficult.

The workings at Wakefield mine comprise seven adits over a vertical range of about 200 feet. As operated in the earlier and most productive years the lower adits, Nos. 6 and 7, were connected by a short tramway with the head of the main aerial tram to the mill on Silverton creek. No. 2 level, the principal upper working, was connected with this main tramway by a short aerial tram which spanned a deep draw between the upper and lower adits. No. 2 level, about 1,000 feet long, is the longest level. The six other levels according to mine plans represent about 1,700 feet of lineal work.

These workings develop a somewhat unusual lode. It conforms closely with the bedding of the enclosing rocks and has consequently a low dip to the south and southeast, averaging about 15 degrees. Between the highest and lowest levels it has a developed depth on the dip of about 1,000 feet. At the level of No. 7 adit the lode flattens and dips out of the hill. The lode, therefore, outcrops at two horizons on the valley slope. As explored, the lode has averaged about 6 feet in thickness above No. 3 level and about 4 feet below this level; the maximum breadth was 20 feet. The lode is composed of bands and lenses of coarsely crystalline calcite and ore minerals with films and bands of crushed rock, gouge, and, in places, small lenses of quartz. As followed, northerly, into the hill the lode narrows and the vein matter is more siliceous. Rolls in the lode are common and at such points much thicker lenses of calcite occur than elsewhere.

The ore for the most part forms narrow bands and lenses along or close to the hanging-wall side of the calcite bodies. In part the ore minerals are disseminated through the calcite, particularly in a section immediately underlying the hanging-wall paystreak. They consist, principally, of galena and zinc blende each of which contains some grey copper.

Most of the ore produced came from No. 2 level and higher parts of the lode. One ore-body about 40 feet long was encountered at the portal of No. 1 adit and stoped out above that level. A much larger shoot was intersected on No. 2 level about 40 feet from the portal. It has been stoped above this level over a length of 120 feet and about half-way to No. 1 level, 40 feet above, and also extended for some distance below the level. Mine plans indicate that stoping on a smaller scale had been conducted at a number of other points: as about midway along No. 4 level; towards the face of No. 6; and between 180 and 280 feet from the portal of No. 7. In general the proportion of blende increased as depth was attained and as the lode was followed into the hill. The ore shoots towards

the portals of Nos. 1 and 2 levels were largely of galena, in part coarse cube and in part finely banded or gneissic. The one on No. 1 adit included a large lens, formed on a roll in the lode and associated with abundant calcite, from which 700 tons of lead ore was extracted. In the main shoot extending above No. 2 adit the galena had a maximum thickness of 20 inches. This shoot forked below the level and carried comparatively little ore. On No. 6 the vein matter at one point comprises 5 feet of calcite with a 3-inch paystreak of galena and blende on the hanging-wall of the lode and thin bands of blende on the foot-wall side. Elsewhere on levels 6 and 7 clean galena from 1 to 2 inches thick has been discovered on the hanging-wall and is underlain by several inches of mixed ore brecciated and cemented by the calcite.

The walls of the lode are commonly well defined and, in places, well slickensided. Narrow paystreaks of finely banded galena or interbands of such galena with dark brown sphalerite commonly occur along these walls, particularly the hanging-wall. The body of the lode contains thick bands and lenses of calcite which, across most of their width, are barren of ore minerals. Towards and mostly within a foot of either wall, but separated from them by such narrow paystreaks as may be present, the calcite is commonly crowded with fragments of ore minerals and wall-rock. These fragments are of irregular size and shape with in part angular and in part rounded surfaces. The angular faces of nearby fragments of either ore or rock appear, in some cases, to correspond, suggesting that at one time they formed parts of a single fragment. The more rounded surfaces, on the other hand, seem to have resulted rather from replacement of the ore or rock fragments by the calcite. This width of ore-bearing calcite is in nearly every case separated from adjacent, pure calcite masses by a thin dark film or tiny seam of crushed carbonaceous rock. The main body of calcite may carry large fragments of wall-rock, but rarely contains ore minerals. It may be generally described as a series of overlapping lenses separated from each other by narrow seams of crushed rock or by comparatively thick plates or slabs of more massive rock. The foot-wall portion of the lode may have a similar structure to the hanging-wall, but the widths of ore and ore-breccia are generally less.

The ore is characteristic of a number of showings on properties adjoining the Wakefield group and is referred to particularly in reports on the Carnation and Mammoth groups. The mineralization at Wakefield mine is very similar to that on the Read and Jenny Lind claims farther up the same valley slope, and has undoubtedly formed at the same time and under similar conditions.

WASHINGTON AND SLOCAN BOY GROUP

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1,055; 1896, pp. 60-61; 1901, p. 1,024; 1911, p. 132; 1923, p. 225; and other years.
Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 31.

The Washington and Slocan Boy group, comprising Washington, Washington fraction, Slocan Boy, Wanacotti, Charlotte, Cross Roads, Major fraction, Carbonate King, I.C., and Lone Jack Crown-granted claims, is owned by Washington Mines, Limited, Kaslo, B.C. The property

is partly in the Washington basin and partly on the divide between Carpenter and McGuigan creeks, the mine workings lying between elevations of 5,800 and 6,400 feet. These workings are accessible by road and trail from Rambler station via the Rambler mine camp, or may be reached from Sandon via the Payne mine road.

Except for small and intermittent leasing operations the property has lain idle since 1902, but prior to that time it was one of the larger producing properties in the district. The original claims of the group, the Washington, Slocan Boy, and Carbonate King, were staked in 1891 and mining commenced almost immediately thereafter. Records of production are incomplete, but indicate that up to about the end of 1894 the Washington mine had produced 2,060 tons of crude silver-lead ore yielding, on an average, 140 ounces of silver to the ton and 60 per cent lead. In 1895 a mill was built. It had a daily capacity of 50 tons. Records indicate that in the following years some 6,000 tons of ore was milled and that this ore carried, on an average, 17·4 ounces of silver to the ton and over 10 per cent lead. Altogether, 1,263 tons of concentrates were produced. These were reported to average 95 ounces of silver and 60 per cent lead. In addition to the output of the Washington mine the Slocan Boy provided, to the end of 1905, and mostly in the years 1896, 1902, and 1905, 381 tons of sorted silver-lead ore carrying 116 ounces silver to the ton and 65 per cent lead. Intermittent operations in the years 1901, 1902, 1907, 1920, and 1923 on the Washington mine provided additional shipments of 408 tons, yielding an average of 80 ounces silver to the ton and 53 per cent lead.

The rocks of this group are sediments of the Slocan series intruded by a few dykes of quartz porphyry or allied rock. The sediments are interbedded quartzitic, argillaceous, and limy beds which on the whole are fairly massive and capable of sustaining important fissures. Their general strike is north 70 degrees west and their dip is in most places to the southwest at about 51 degrees. Northeast of the principal workings the structure is complicated by faulting and the strata dip northeast (*See* structure section EF, Figure 3, Memoir 173, in pocket) to form a syncline of rocks stratigraphically equivalent to those encountered in underground workings on either side of and beneath the centre of the ridge.

The Washington mine workings include a shaft near the top of the ridge on the Slocan Boy claim and six adits, the lowest of which is 560 feet below the uppermost, driven from the McGuigan Creek slope of the divide. The portal of the highest adit (Slocan Boy) is near the northeastern boundary of the Slocan Boy claim and the adit extends into the Washington. The other adits, with one exception, were commenced on the Washington claim but extend into the Slocan Boy. The lowest adit (No. 4) has its portal on the Washington fraction, but for most of its length is in the Washington claim. The highest adit is about 170 feet long, the other adits listed successively are 780 (to cave), less than 100, 750, 750, and 630 feet long, respectively, and, except for the lowest, are drift adits. The main levels are connected by raises and the highest adit but one may communicate with the shaft from the surface about 180 feet vertically above. The face of this adit (No. 1) where caved is about vertically beneath the centre of the ridge that lies about 200 feet southwest of, and somewhat less than, 100 feet above the collar of the shaft.

Other workings on the Slocan Boy claim include three adits driven from the Carpenter Creek slope and averaging about 225 feet in length. These adits extend to over 300 feet below the crest of the ridge. The lowest is driven into Slocan Boy ground from the adjoining Snowstorm claim of another property.

The Washington mine workings develop what may be referred to as the (main) Washington-Slocan Boy lode. This is a mineralized fault fissure zone, along which considerable shearing has occurred. The zone has a general strike of north 50 degrees east, and in most places dips steeply southeast, but locally is vertical, or, as in places between Nos. 1 and 2 levels, dips northwest. The principal productive section outcropped on the McGuigan Creek slope from above the highest adit to below No. 2 adit, a vertical distance of about 350 feet. This section has been largely stoped to the surface. It had an average pitch of about 48 degrees northeast; a maximum length, on the pitch, of about 750 feet; and a maximum width across the pitch of about 250 feet. In this section the lode varied in thickness from a few inches to 12 feet and was composed of crushed rock, quartz, and a little siderite, galena, zinc blende, and pyrite. The mined ore consisted of concentrating ore (blende with a little galena) and lenses of clean galena.

Beyond the productive section comparatively little mineralization is in evidence along either Nos. 1 or 2 adits. In this direction the lode loses definition, and vein mineralization, consisting mainly of quartz carrying a little pyrite and, more rarely, sparsely disseminated blende and galena, occurs sporadically along a series of cross fissures that tend to conform with the bedding structures. Both Slocan Boy and No. 3 adits were inaccessible at the time visited (September, 1926). The lowest adit (No. 4) is a crosscut at a small angle to the lode for 465 feet, to where it crosses a fault fissure striking south 50 degrees east and dipping about 35 degrees to the southwest. This fissure conforms closely with the bedding. A little ore mineralization was encountered on both sides of the crosscut intersection and a little stoping done. At 55 feet past the fissure a raise goes up and apparently connects with No. 3 level above. It is reported that as much as 8 feet of quartz with blend and pyrite were opened up within 30 feet above this level. Fragments of vein matter at the bottom of the chute are of vein quartz carrying considerable zinc blende. The adit was continued in a south to southwesterly direction for about 90 feet without discovering further encouraging vein matter. The fissure encountered at 465 feet from the portal has been drifted on to the southeast for 170 feet to where a slip carrying a carbonaceous gouge was intersected. This slip strikes north 20 degrees east and was followed for 25 feet without discovering mineralization.

According to early reports the Slocan Boy adit was driven southwesterly for 170 feet along a small streak of ore and at its face is about 100 feet northeast of, and 55 feet below, the collar of the shaft. The shaft is 200 feet deep. From the bottom a crosscut driven southeasterly for 70 feet apparently encounters and drifts for 50 feet or so northeasterly along the lode followed, about 20 feet above, by No. 1 adit. The same lode is reported to have been encountered in the shaft 100 feet below the surface. The ore taken from these upper workings is stated to have aver-

aged 100 ounces in silver to the ton and 68 per cent lead. At about 250 feet from the portal of No. 1 adit a mineralized fault-fissure leads to the northwest of the main lode and conforms closely with the bedding of the enclosing rocks. At about 80 feet to the northwest of the main lode this northwesterly fissure meets and appears to be intersected by a vein-bearing fissure striking northeasterly and dipping 70 degrees southeast. This latter fissure seems to be the one developed on the Slocan Boy adit and it might be worth while to investigate it northeast of its intersection with the northwesterly mineralized fault fissure. Some attempt was made to pick it up by a crosscut from near the face of No. 2 adit, but without success.

Ore and vein mineralization has been controlled by both bedding and jointing structures. The general course of the main lode follows the latter. It appears, however, that no one fissure is continuously mineralized, but that mineralization has been diverted from one to another by other fissures conforming closely with the bedding structures. Such cross fissures are common in these workings and in places contain a little ore. They may cut across both walls of the main lode or lodes, but commonly stop at the hanging-wall and run out into the foot-wall rocks.

The ore extracted was partly clean galena, but largely a mixture of galena, blende, and pyrite in quartz. The ore minerals were interbanded with one another or with quartz, or occurred as streaks or bunches in the quartz. Commonly the greater part of the width of the lode consisted of fragments of ore minerals and wall-rock cemented by quartz. On No. 2 level, about 300 feet from the portal, the walls are heavily coated with a recent accumulation of copper-sulphate, indicating that some copper minerals are present in the vein matter, probably in the form of grey copper or, in part, chalcopyrite.

The workings on the Slocan Boy lode on the opposite slope of the ridge are mostly inaccessible. This lode lies about 600 feet northwest of, and about parallel with, the main Washington-Slocan Boy lode. According to early reports it was narrow but rich, 30 tons shipped about 1896 having assayed 332·4 ounces silver to the ton and 68 per cent lead. Specimens of a variety of aragonite known as *mossottite* were observed on the dumps from the workings on this lode.

WILMER GROUP

The Wilmer group, comprising Wilmer fraction, Alps, Ivan, and Sweet Grass Crown-granted claims, is on the southern slope of mount Carpenter adjoining and lying to the west of the Capello group. The property is accessible by road and trail from New Denver and is owned by W. R. Will, New Denver, B.C.

Several small workings on this property have investigated a series of quartz veins intersecting the large stock of porphyritic granite which occupies a large area in this vicinity. The quartz veins carry high-grade silver-bearing minerals and are similar to, and probably in part traceable into, those on the adjoining Capello group.

Production returns are incomplete, but only a few tons in all have been shipped from the Wilmer group. Two tons produced in 1901 are recorded to have contained an average of 98·5 ounces in silver a ton.

WONDERFUL GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 52; 1922, p. 198; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 212-213.

The Wonderful group, including Wonderful, Lookout No. 2, Columbus, and Miller Creek fraction Crown-granted claims, is owned by Cunningham Mines, Limited, Alamo, B.C. The property is on the lower southwest slopes of Carpenter Creek valley 1½ miles from Sandon and is accessible by road and trail from this town. An aerial tram connects the Wonderful mine workings with the railway a mile below Sandon.

Operations commenced on the Wonderful group in 1894. Early shipments were won by ground-sluicing the surface wash. This work exposed a narrow zone of angular boulders of galena which appeared to be almost in place. One boulder is stated to have weighed over 2½ tons: another 1,300 pounds. Some 400 tons of galena ore assaying from 113 to 133 ounces of silver a ton and 70 to 76 per cent lead were obtained in this manner in 1895. Prior to 1896 total shipments were stated to have amounted to 600 tons. Shipments since 1895 have been chiefly from ore in place at the Wonderful mine. Altogether this mine has produced over 25,000 tons of ore averaging over 10 ounces in silver to the ton, nearly 5 per cent lead, and about 2½ per cent zinc. The largest output was in 1923 when 10,663 tons were shipped. This ore carried an average of nearly 12 ounces in silver to the ton, 5 per cent lead, and 3·3 per cent zinc. Production in 1925 and 1926 amounted to 4,127 tons assaying 8½ ounces silver, 0·8 per cent lead, and 6·3 per cent zinc.

The main lode is developed by five main and three intermediate levels. These workings have a vertical range of about 600 feet below the surface. The second lowest level is the longest, its main branch measuring about 2,300 feet. It is the main haulage level and it and the level below are the only adit levels. Raises and stopes connect the upper levels with the main haulage level.

The rocks are chiefly sediments of the Slocan series comprising slates and platy argillites interbedded with about an equal proportion of more massive argillaceous strata. They have a general strike of north 15 degrees west and in most of the workings dip northeast at an angle that is generally about 35 to 40 degrees but varies from nearly flat to over 50 degrees. The strata are thought to lie in the west limb of a syncline, as not far east of the mine workings the dip is southwest. Towards the west end of the workings again the dips seem to be changing to a southwesterly direction. The sediments are conspicuously jointed along a north 60 degrees east direction with high dips southeast. This direction is closely in line with certain sections of the main lode. The sediments in many places, particularly near the ore-bodies, are heavily mineralized with pyrite. Intruding the sediments at a number of points in the mine workings are granodiorite and quartz monzonite dykes varying in width from 4 or 5 feet to 50 feet. The dykes are pre-mineral and, so far as could be determined, the ore-bodies have not been influenced by them.

The structure is complicated by the presence of a number of faults and shear zones striking, in general, about parallel with the sediments,

but dipping in part at steeper angles to the east. Shearing is particularly pronounced in the more slaty rocks and along what is known as the "Big" fault a great deal of slipping and shearing were noted across a width of 50 feet or more. The faults and shear zones were probably initiated in pre-mineral time, but slipping has occurred along them since the period of mineralization, with the result that the main lode, which cuts across them, has been displaced for distances reaching a maximum of 160 feet in the case of the "Long" fault. Displacement is, in most instances, to the left, but in the case of the "Long" fault to the right.

The main lode has a general westerly strike varying to more nearly northeast in the easterly workings. The dip is southerly at an angle varying from 50 degrees or less to vertical. The lode is a mineralized fissure along which more or less shearing and displacement have occurred. No outstanding ore-bodies have yet been discovered along this lode in spite of the amount of detrital material discovered at the surface. The principal ore shoots, now mostly exhausted, have been found in the central and western mine workings, little mineralization having been encountered elsewhere. In the more productive sections the lode filling varied up to 8 or more feet in width and consisted of less crushed wall-rock, quartz, spathic iron, and ore minerals. The ore is brecciated and consists of fragments of galena, blende, and country rock in a gangue largely of quartz but containing, in places, quite a large proportion of spathic iron. In the less productive section the lode is marked by a few inches or so of gouge and crushed wall-rock with, here and there, bunches of quartz and traces of ore minerals. Pyrite and pyrrhotite are rather common and, in places, are quite abundant in both the productive and lean portions of the lode. Their oxidation products are conspicuous along the upper drifts and the eastern parts of the lower drifts. The ore has favoured the more massive rocks and there the dip of the lode is steeper than elsewhere. The walls of the lode are noticeably grooved, the grooves dipping about 40 degrees east corresponding to the rake of the ore-bodies. The grooves indicate that the hanging-wall has moved up with respect to the foot-wall.

The principal ore minerals are galena and blende, both of which carry silver at the rates of about 1½ ounces and 1 ounce of silver to the per cent of lead and zinc, respectively. Under the microscope the galena is seen to contain minute areas of a mineral resembling grey copper.

Production in recent years has been chiefly from the western section of the mine. The lower main level was extended about 1,200 feet to a point 175 feet west of the "Long" fault. On both sides of this fault ore of good milling grade was encountered and has been mostly worked out by stopes carried from this level to the next two main levels above. In 1927 there was estimated to be about 20 tons of zinc ore mill feed in the stope west of the "Long" fault. The main level above the lowest has been run about 650 feet and the next higher level 175 feet past the "Long" fault. On the former some sheared, slaty ground was met in the last 250 feet west of the fault, but at the face more massive rocks are exposed. The 250 feet of sheared ground seems to mark another fault similar to the "Long" fault. This possibility should be investigated as the more massive rocks at the face of the level and in which the faulted continuation

of the lode would, presumably, lie are such as in general have proved favourable to vein deposition.

No vein has been encountered below where the detrital galena was found at the surface, though long crosscuts were driven from the lowest level in search of it. Explorations from an adit, 100 feet vertically below this level, have likewise been unsuccessful. If the galena at the surface was derived from a nearby outcropping ore-body the ore-body must pinch out before reaching the lowest level and the exploratory adit. It seems more probable, however, that the galena boulders came from an ore-body outcropping higher up the hill and possibly not in the main lode developed by the mine workings. If this is the case, then somewhere in the large block of ground between the surface and the present inner mine workings there may remain a considerable part of the high-grade ore shoot whose outcrop supplied the boulders of ore.

CHAPTER II

DESCRIPTIONS OF PROPERTIES, SLOCAN CITY MINING DIVISION

ALICE S

References: Ann. Repts., Minister of Mines, B.C., 1915, p. 132; 1916, p. 198.

The Alice S and Paterson Crown-granted claims are owned by Chester W. Harper, 75 Myer street, Hackensack, N.J. They were located in 1905, and are situated towards the head of Bettina creek, the southeast fork of Springer creek, at an elevation of about 5,800 feet. A wagon road about 10 miles long leads up Springer creek from Slocan to the property.

The only shipment on record was made in 1915 when 16 tons of ore yielded an average return of 83 ounces in silver to the ton and 15 per cent lead.

The mine workings include four adits, a few small stopes, and one shallow shaft. These explore a fault-fissure lode over a depth of about 160 feet. The lode strikes north 85 degrees west and dips 70 degrees south. It varies from about 2 feet to 5 feet in thickness and carries a nearly continuous vein of ore averaging about 18 inches in width and reaching a maximum of 4 feet. The remaining ledge matter consists chiefly of massive siderite with some quartz and a little galena and sphalerite. The country rock is the typical, coarse-grained, porphyritic granite of the Nelson batholith.

ALMA (MYRTLE) GROUP

References: Ann. Rept., Minister of Mines, B.C., 1924, pp. 201-202; and other years.

The Alma, formerly Myrtle, group comprises Alma, McBride, and Howie claims held by location, and covers 105 acres. The claims are at present owned by J. E. Tattersall, of Slocan. The group is situated near the headwaters of Memphis (Twelvemile) creek at an elevation of about 5,400 feet. Access is provided by a road up Springer creek as far as the Ottawa mine, from which point a 2-mile trail leads to the property.

Production is reported to have comprised 2 tons of hand-sorted ore carrying 200 ounces of silver to the ton, and 15 tons assaying 128 ounces.

The lode is explored by a vertical shaft 100 feet deep, with workings therefrom. At a depth of 50 feet in this shaft a crosscut has been driven easterly for 70 feet to the hanging-wall of the lode. From the end of the crosscut a drift runs south for 85 feet to the point where it connects with a raise from the 100-foot level. The lode at the 100-foot level is reached by a crosscut adit driven easterly for 520 feet. From near the face of the crosscut drifts have been run 85 feet to the south and 30 feet to the north along the lode. At the face of the south drift is the raise connecting with the 50-foot level. The north drift discloses some high-grade ore which has been raised on for 25 feet. On the surface there are three open-cuts at intervals of about 100 feet along the outcrop of the lode.

The lode is a sheared and brecciated, mineralized zone striking north 3 degrees east and dipping 55 degrees east. It intersects porphyritic, Nelson granite and is claimed to have been traced on the surface for 1,000 feet. The lode matter includes an abundance of sheared and altered wall-rock carrying varying proportions of quartz and calcite. Ore minerals are developed chiefly in small shoots and include native silver, galena, zinc blende, and grey copper. Assay values vary from 5 to 200 ounces a ton.

ANNA GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1927, pp. 217-280.

Controlling interest in the Anna group, consisting of the Anna, Milda H., Milda H. fraction, and Hamilton fraction claims, is held by K. E. Zimmerman of Slocan. When examined (1927) the property was under lease and bond to N. Bertrandias of Portland, Ore. The property is not Crown-granted. The group is on the lower, northern slope of Springer creek west of Little Tim creek and east of the Ottawa property. A good road extends from Slocan to within a quarter of a mile of the mine workings and they are connected with the road by a wide, well-graded trail.

The property has been worked from three main adits and one prospect adit, of which only the lowest or main adit is now accessible.

There are two parallel lodes referred to as the "East" and "West" lodes. They strike about north 10 degrees east and dip about 35 degrees to the east. The East lode at the surface is a sheared and brecciated zone about 50 feet wide; it has been explored for about 100 feet vertically. So far it has yielded no ore. The West lode is a faulted zone about 15 feet wide, bounded by well-defined walls marked by several inches of gouge. This lode is traversed by a series of cross fissures and parallel fissures in which the ore occurs. The lowest adit was driven northerly along the East lode for about 240 feet, at which point a crosscut 50 feet long runs to the West lode and this lode has been drifted on northerly for about 300 feet. At about 175 feet along this drift a 50-foot winze has been sunk, the bottom being 300 feet below the surface on the dip of the lode from about the portal of the uppermost adit. At a depth of 35 feet in this winze the lode steepened and the winze broke into a 3-inch paystreak along the hanging-wall, carrying grey copper and native silver.

The country rock is the typical, coarse-grained porphyritic Nelson granite. The West lode is cut at a small angle by two parallel basic dykes.

Ore shoots have been encountered at a number of points along the West lode and quite a litle stoping has been done above the level south of the winze. The shoots crossed the lode from wall to wall along a northeasterly direction, averaged 50 feet in length, and had a maximum width of 2 feet. In most cases the end of a shoot at either wall is opposite the beginning of another shoot at the other wall. The lode requires careful prospecting by crosscuts, as small stringers of quartz in the cross-fissures may lead to valuable ore shoots.

The principal ore minerals are native silver, stephanite, grey copper, a little galena and zinc blende, and, in places, considerable chalcopyrite.

The native silver is either in wire or leaf form. Traces of arsenic and antimony are found and copper carbonate stains were noted in the upper workings. Quartz is the abundant gangue mineral and is associated with some barite.

An initial shipment of 4 tons made in 1912 averaged 80 ounces in silver to the ton and 30 per cent lead. Subsequent shipments show no lead content. Shipments in 1918, amounting to 17 tons, included 242 pounds of copper. In 1920, the year of heaviest production, 58 tons containing 12,885 ounces of silver were shipped. Total production to the end of 1924 included 126 tons averaging 209 ounces in silver.

ARLINGTON MINE

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 72; 1904, p. 165; 1921, pp. 139-140; and other years.

The Arlington mine is owned by Arlington Mines, Limited, % H. D. Curtis, Slocan. The property comprises the Stephanite fraction, Burlington No. 2, Arlington No. 1 fraction, and Arlington No. 2 Crown-granted claims, on the north slope of Springer Creek valley about 6½ miles by road from Slocan.

The mine was developed by eight adits over a vertical range of 647 feet. It is claimed that the two lower adits were driven along what was assumed to be the foot-wall of the lode and that as very little crosscutting was attempted the possibilities in this section, particularly towards the hanging-wall of the lode, are still relatively good. The workings were quite inaccessible at the time visited and the information here presented has been gained chiefly from earlier Government reports and from data and maps kindly furnished by Mr. H. D. Curtis of Slocan, liquidator for the company.

The property was worked extensively from 1899 to the end of 1903. In those years the adits were driven, and the bulk of shipments made. Most of the ore was taken from between the fifth and seventh levels and from the original discovery about the shaft near the surface.

It is understood that the Bayview Mining Company of Vancouver have prospected the foot-wall section of the lode by crosscuts from the two lower levels. The results of this exploratory work are not known.

The first shipment of ore was made in 1897 and consisted of 50 tons. Production reached a maximum in 1901, with the shipment of 5,283 tons containing 362,288 ounces of silver and 580,435 pounds of lead. Up to and including 1924, the property produced 12,795 tons averaging nearly 60 ounces in silver to the ton and about 5 per cent lead.

The Arlington lode is a mineralized crushed zone in coarse-grained, hornblende granite or granodiorite of the Nelson batholith. The zone includes a number of parallel fissures and maintains a uniform strike of north 34 degrees east and a dip of 65 to 70 degrees east. It has a width of from 60 to 70 feet.

The ore is largely replacement of the country rock. The chief ore minerals are galena and zinc blende, both of which are associated with disseminated stephanite, grey copper, and native silver. Pyrite and chalcopyrite are also present, but are of no commercial importance.

BATCHELOR CLAIM

The Batchelor claim, held by location and formerly known as the Midnight, is owned by Messrs. Wm. Clough and C. W. Tipping, both of Slocan, B.C. The claim is on the south side of, and close to, Memphis (Twelvemile) creek, about one mile from Slocan lake. Ore shipments made in 1906 and 1907 amounted to 22 tons, yielding 14 ounces in gold and 1,396 ounces silver.

The country rock is sheared and gneissic Nelson granite. Work has been done on a quartz vein stated to average 4 feet in width. The vein strikes northeasterly and dips steeply southeast. Some ore carrying a little gold but mostly silver has been found to date. Two adits have been driven to explore the vein. Only the lower is accessible; it is about 200 feet long.

B AND R GROUP

The B and R group includes four claims at the head of Arlington basin, at an elevation of about 6,000 feet. It is owned by F. A. Binnish, Slocan, B.C. The property is accessible from Slocan by 6½ miles of wagon road up Springer creek and 2½ miles of trail.

On this property quartz veins cut coarse-grained, porphyritic Nelson granite. One of these veins has been investigated by two adits, of which the lower was inaccessible at the time visited. It is stated to have intersected the vein at 150 feet from the portal and from there to have followed it for 400 feet, in which distance the vein averaged 2 feet in width and consisted of quartz carrying galena and blende. In the upper adit the vein is a few inches wide and lies between well-defined walls striking north 65 degrees east and dipping 45 degrees northwest. The vein has been drifted on for about 100 feet, in which distance a small body of ore was encountered. The ore consisted of fine-grained galena and zinc blende in a quartz gangue and has been partly stoped out.

BONDHOLDER GROUP

References: An. Rept., Minister of Mines, B.C., 1896, p. 70; and other years.

The Bondholder group consists of the Bondholder and Pine Log Crown-granted claims owned by G. W. Bartlett, Nelson, B.C., and Roy F. Ainslie, Silverton, B.C. The claims were located in 1894 and are situated near the summit of the divide south of Enterprise creek and southwest of Enterprise mine. The property may be reached from Springer creek via the Ottawa mine road and the Little Tim mine trail.

During the years 1900 to 1904 inclusive 72 tons of ore is reported to have been shipped from this property. This averaged about 100 ounces silver a ton and carried a little lead.

Most of the workings are old and partly inaccessible. They include three adits and a winze, giving altogether a depth of about 160 feet.

The workings develop two nearly parallel lodes about 300 feet apart. These strike north 65 degrees east, dip 58 degrees southeast, and intersect coarse-grained, porphyritic granite of the Nelson batholith. The lodes are fault-fissures, varying in width from 1 to 4 feet or more, and are

composed chiefly of vein quartz carrying in places a paystreak of galena or of mixed galena and zinc blende with high-grade silver minerals. The paystreaks favour the hanging-wall side of the lodes. The galena varies from coarse to fine cube and the zinc blende is resinous. The silver-rich minerals are grey copper and a little native silver in both leaf and wire forms. Some chalcedonic quartz accompanies the ore minerals and calcite is present. The lodes have been traced southwesterly across both claims and over the divide into Graphic and Rosebud claims on the Springer Creek slope where considerable work has been done and some ore shipped.

CALUMET AND HECLA GROUP

The Calumet and Hecla group, comprising Calumet No. 2, Hecla, Hecla fraction, and Buffalo claims, held by location, is owned by Nels Nelson and Wm. Clements, Slocan, B.C. The property was staked in 1895. It is on the ridge east of Dayton creek and is accessible by 3 miles of road up Springer creek from Slocan and 3 miles of trail.

The workings lie at an elevation of about 6,500 feet. An adit on the Calumet claim is a crosscut for 150 feet to a point where it intersects a lode striking about north 60 degrees east and dipping steeply to the northwest. The lode has been drifted on for 300 feet, partly in black quartzitic argillites and dark grey quartzites and partly in Nelson granite. In the sediments the lode is irregular and though it carries some quartz no ore mineralization was noted. In the granite it is more regular, averages about 5 feet in width, and consists of galena, zinc blende, and pyrite disseminated in a gangue of quartz and some barite. The best vein matter in this part of the drift is reported to average 12 per cent lead and 8 ounces silver to the ton. No shipments have yet been made.

CLUB CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1904, p. 170.

The Club claim, held by location, is situated towards the head of Scorpion creek, a northern tributary of Springer creek. It was first prospected in 1904. A shipment of 5 tons recorded for that year carried an average of 54 ounces in silver to the ton.

The claim is in an area of coarse-grained granite of the Nelson batholith and, according to the reference cited above

"apparently carries two distinct veins, nearly at right angles in strike. The first of these shows (1904) about 36 inches of quartz in which is included much crushed country rock which appeared to be a light coloured eruptive rock somewhat allied to granite. This vein strikes southwest and northeast and dips to the northwest at about 30 degrees. On the outcrop of this an open-cut some 30 to 50 feet long exposes the vein and from this an inclined shaft has been run down for 20 feet. From these workings some rich specimens have been obtained. Across a small creek from the workings just mentioned there is a second large outcropping of quartz 6 to 8 feet wide striking north 54 degrees west."

COLORADO AND SLOCAN BELLE CLAIMS

These two mineral claims, held by location and owned by Ralph Gillette, Silverton, B.C., were recorded in 1895. They are on Memphis (Twelvemile) creek about 4 miles from Slocan lake, and may be reached by 2½ miles of trail from the Slocan-Silverton highway.

A quartz vein in the Nelson porphyritic granite outcrops on the north side of the creek and has been explored by a 50-foot adit and several open-cuts. Shipments made in 1904, 1905, and 1915 aggregate 27 tons. The ore carried an average of 156 ounces in silver to the ton.

CORONATION CLAIM

The Coronation claim, held by location and owned by Jas. Smith, Slocan, is on the north side of the forks of Memphis (Twelvemile) creek about 1½ miles by trail from the Silverton-Slocan highway. The property was staked in 1896.

The country rock is sheared, coarse-grained, porphyritic granite of the Nelson batholith. The workings, including one adit 156 feet long, explore a quartz vein about 1 foot wide, striking east and dipping 65 degrees north. The vein contains many fragments of wall-rock, some galena, zinc blende, and pyrite and a little siderite and calcite. Native silver was also observed. A small basic dyke forms part of the foot-wall.

About 2 tons of ore are reported to have been shipped and to have carried between 19 and 20 per cent lead and as much as 380 ounces in silver to the ton.

DAISY GROUP

The Daisy group of three claims held by location is owned by D. McCuaig, Slocan. The property is on the north slope of Enterprise creek 500 feet above the Enterprise Mine road and 2½ miles from the Silverton-Slocan highway. No work of importance has been done for over ten years.

The claims are underlain by coarse-grained, porphyritic Nelson granite in which at least two lodes have been worked. One of these is a mineralized fissured zone and, near the principal workings, is at least 35 feet wide. It strikes north 15 degrees east, dips from 60 to 75 degrees southeast, and includes several, irregular, narrow fissures 1 to 2 inches wide filled with rock gouge, ore minerals, and gangue. Between fissures the rock is barren or very sparsely mineralized. The ore minerals are galena, zinc blende, pyrite, and chalcopyrite. The gangue minerals are quartz and calcite. The lode is explored by two adits. The lower was driven along or near the hanging-wall of the lode and is 300 feet long. A crosscut run from this drift towards the foot-wall is in 35 feet without reaching this wall. The upper adit is caved. It is reported that the lode has been traced northeast up the hill to a point 700 feet above the lower adit to where a fissure was discovered carrying, at one place, from 6 to 7 inches of galena and oxidized vein matter and, at another place, from 7 to 8 inches of zinc blende.

The other lode outcrops about 100 feet above the lower adit and was explored by a 35-foot inclined shaft, by an adit 100 feet long, and by several open-cuts along the strike southeasterly across the small valley of Beaverton creek. The lode strikes north 40 degrees west and dips from 20 to 25 degrees northeast. It consists mainly of a narrow quartz vein sparingly mineralized with disseminated galena, zinc blende, and chalcopyrite and probably other copper-bearing minerals.

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DALHOUSIE

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 70.

No work has been done on the Dalhousie for many years. It is on the southern slope of Enterprise creek between 2,000 and 2,500 feet above the road to Enterprise mine and about 1½ miles west of Enterprise mine.

The workings comprise two adits, 500 feet apart vertically, and both caved and inaccessible. The upper was driven for 110 feet on a vein which, near the portal, is 8 inches wide, strikes north 70 degrees east, dips 45 degrees southeast, and is composed chiefly of quartz and calcite carrying disseminated, resinous zinc blende, and a little galena. The vein conforms with the somewhat gneissic structure of the enclosing granite which here and there carries inclusions of older rocks. Farther along the adit, the vein was stated to have widened to include 2½ feet of concentrating lead ore. The lower adit is reported to have been driven as a crosscut to tap this vein and to be 600 feet long.

DAYTON CLAIM

The Dayton Crown-granted claim is owned by Matt P. Reid, Okanagan Landing, B.C. It was located in 1893. The claim is reached by 3 miles of wagon road up Springer creek from Slocan. It lies at an elevation of about 3,400 feet. The country rock in this vicinity is the coarse-grained, porphyritic, Nelson granite.

Workings include one crosscut adit. In a drift from this three or four stopes have explored a fault-fissure lode over an approximate vertical range of 70 feet. The crosscut continues past the lode for about 50 feet to a quartz vein 6 feet wide, striking north 25 degrees east and dipping 55 degrees east. This vein carries a little coarse cube pyrite. The principal lode strikes north 20 degrees west and dips 35 degrees northeast. It varies up to 5 feet in width and carries lenses of quartz, up to 18 inches thick, mineralized with pyrite, a little galena, and a little high-grade silver mineral including argentite and grey copper.

The only shipment of ore was made in 1903 and consisted of 12 tons yielding an average of less than 1·5 ounces in silver to the ton and about 9 per cent lead.

ENTERPRISE MINE

References: Ann. Repts., Minister of Mines, B.C., 1896-1928; 1896, pp. 69, 70; 1904, p. 171; 1924, pp. 200-201; and other years.
Rept. of Zinc Commission, 1906, p. 225.

The Enterprise property comprises the Enterprise, Enterprise fraction, Slocan Queen, and Iron Horse No. 2 Crown-granted claims. It is situated on the lower southern slope of Enterprise (Tenmile) creek about 2,200 feet above and 8 miles by road from Enterprise landing on Slocan lake. The property was acquired in 1928 by Yankee Girl Consolidated Mines, Limited, Vancouver, B.C.

The ore produced by the Enterprise mine exceeds in quantity and total value that of any other property in Slocan City mining division. The main Enterprise lode was located in 1894. The property was sold in

1895 or 1896 and then acquired by the Enterprise (B.C.) Mines Company, Limited, which held the property until 1928 when it was secured by the present owners. Enterprise Mines operated the property until about 1901 since when it has been operated at intervals by lessees.

The first production recorded was 160 tons of silver-lead ore shipped in 1896. This ore carried, on the average, 163 ounces in silver to the ton and 23 per cent lead. Up to the end of 1905 the property is credited with 6,212 tons of silver-lead ore carrying an average of 122 ounces in silver to the ton and about 19 per cent lead. The shipments of this period doubtless included considerable zinc, of which no complete record is available. According to the Zinc Commission the production up to 1906 included 8,215 tons of shipping ore, of which 2,466 tons were concentrates from the mill and 5,749 tons hand-sorted ore. Included in this tonnage was a middling product sold as silver ore, though containing 27·98 per cent zinc, 71·6 ounces in silver to the ton, and 2 to 4 per cent lead. Up to the end of 1919 shipments included 6,810 tons, averaging 121 ounces in silver to the ton and about 19 per cent lead. No shipments are recorded in the years 1920-1924 inclusive, but in 1925, 1926, and 1927 a total of 1,746 tons of silver-lead-zinc milling ore was shipped. Values of the 1927 shipments are unknown, but in the previous two years 929 tons of ore averaged about 20 ounces in silver to the ton, about 12 per cent lead, and 29 per cent zinc.

The underlying rock on this property is chiefly coarse-grained porphyritic granite of the Nelson batholith. In places both in the underground workings and at the surface more basic phases form irregular bodies of varying size, most of which appear to be either digested inclusions or differentiates of the granitic magma. The granitic rocks are intersected by a few, small, basic dykes, varying from hornblende porphyrite to olivine and olivine-diallage lamprophyres. One at least, and probably two, narrow dykes of the lamprophyre types were observed to cut across the Enterprise lode on No. 5 level. Others are pre-mineral and are involved in the faulting that disrupts this lode.

The main or Enterprise lode has been developed by nine adits, several intermediate levels, and two shafts on a slope facing northeasterly. One shaft was sunk on the lode about 50 feet above and 300 feet southwest of the portal of the uppermost level and the other on the lode from a point 35 feet below and a short distance northeast of the lowest adit. The lower shaft is on the Iron Horse No. 2 claim and is reported to have followed the lode to a depth of 214 feet. The difference in elevation between the collar of the upper shaft and the bottom of the lower shaft is in the neighbourhood of 1,100 feet and the two shafts are about 2,200 feet apart horizontally.

The lode is continuous between the two shafts and throughout this distance the mineralization has an encouraging character. It is narrow, in but few places exceeding 1½ feet in width and averaging less than 1 foot. The lode is a mineralized fissure striking north 50 degrees east and dipping from 60 to 80 degrees southeast. In the upper levels it was filled chiefly by varying proportions of quartz and ore minerals. Most of the ore has been stoped out above the sixth level and the workings above are largely inaccessible, though some work has been done in recent

years on the fourth level. Above the sixth level the ore minerals were largely galena carrying grey copper or other silver-bearing minerals. In the lower workings zinc blende became increasingly abundant. The zinc blende is claimed to carry better silver values than the galena and these are said to persist to the lowest workings, zinc ore carrying as much as 90 ounces in silver a ton having been obtained from the lower shaft on the Iron Horse claim. Other ore minerals are pyrite and chalcopyrite.

The Enterprise lode is interrupted by one major fault or fault zone and by minor faults. The major fault intercepts the lode nearly at right angles about midway between the two shafts and dips steeply northeast. It offsets the lode about 60 feet to the left. The other faults cause only slight displacements. On either side of the main fault vein matter formed an almost continuous ore shoot which pitched towards the northeast. Along the sixth level, stoping was continuous for 650 feet and, 100 feet above this level, for 325 feet. Coincident with the increase of zinc blende with depth siderite became conspicuous and is notably abundant on the lowest level. Towards the face of this level, however, quartz is again the predominant gangue, the vein matter including, in places, from 6 to 12 inches of chiefly banded, massive zinc blende and quartz.

Some stoping has been done above the lowest level over a length of 400 feet, but above this there remains a large block of ground yet to be explored. It would appear that work might be extended to investigate the lode below the sixth adit level west of the big fault, though the character of the lode on the lowest (No. 7), and the third lowest (No. 5), adit level indicates that mineralization below these older, more westerly workings is likely to be zincy in character.

Aside from the extensive developments on the main Enterprise lode, a little work has been done on a second lode outcropping 380 feet to the west and on a level with the portal of the seventh adit. In 1927 it had been drifted on for about 150 feet. It is a wide shear zone in the granitic rocks and is composed mostly of crushed rock, partly cemented by quartz gangue with a little calcite. It strikes about north 40 degrees east and dips 70 degrees east. The hanging-wall is particularly well defined. In character and width this lode bears some resemblance to that developed so extensively in the Arlington mine and with which it is presumed to be continuous, though the two have not been traced to a junction. It seems likely that both lodes at the Enterprise mine and those on adjoining properties are within a single, wide zone of fissuring, shearing, and brecciation, and that to the southwest this zone passes through the Arlington, Speculator, and intervening properties. It is more doubtful whether any single fissure persists for this distance. Exploratory work conducted within such a zone involves much crosscutting to assure that no important mineralized fissure is being overlooked.

EVENING STAR NO. 8 GROUP

This group consists of the Somerset, Columbia No. 5, Evening Star No. 8, Silver Crown fraction, Eclipse No. 2, Eclipse No. 2 fraction, and Unknown Group Crown-granted claims. It is east of Dayton creek, about 3 miles by trail south from the road up Springer creek. The property

belongs to Constance M. Sutherland, % National Trust Company, Limited, Winnipeg. It was staked in 1894.

A shaft and an adit 50 feet below the collar of the shaft explore a small quartz vein in a fault fissure, about 3 feet wide, intersecting coarse-grained, porphyritic, Nelson granite. The vein strikes from north 30 degrees west to north 5 degrees west and dips from 55 to 75 degrees northeast. No stoping has been done in the adit. The vein there carries a little galena and pyrite. The shaft is stated to be down 100 feet, but is inaccessible. It is probably from work on this shaft that small shipments, in 1896 (?) and again in 1918, were made. Total recorded production includes 24 tons of ore averaging 363 ounces in silver and $25 in gold to the ton.

EXCHANGE AND SILVER PLATE CLAIMS

These Crown-granted claims were located about 1894. After having changed ownership several times, they have reverted to the Crown. They are about a mile up Dayton creek at an elevation of about 4,000 feet and are accessible from Slocan by wagon road for 3 miles up Springer creek and thence by trail up Dayton creek.

Production figures are incomplete, but probably 50 tons have been shipped. A shipment of 5 tons in 1896 averaged over 1·2 ounces in gold and 150 ounces in silver to the ton.

A quartz vein on the Exchange claim has been explored by three adits, a shaft, and a 100-foot winze sunk from the lowest adit. This adit is 250 feet long. The vein is stated to average about 5 feet in width and carries pyrite as the chief ore mineral. Some silver-bearing minerals and a very little galena and zinc blende are also present. The country rock is granite of the Nelson batholith.

Referring to this property in 1894, Gwillim[1] states:

"Here there is first a band of opaque milky quartz some inches in thickness. Next to this comes an inch band of iron pyrites (always well crystallized) mixed with silver sulphide dust. An inch from this, in a clearer quartz, there occurs a distinct broken lamina of native silver. This arrangement is repeated four times. The pyritous band assays 270 ounces in silver. There are no pyrites in the native silver band."

HAMILTON GROUP

The Hamilton, Hazelton, and Little Chief claims held by location form a group owned by Ralph Gillette, Silverton, B.C. This property is on Memphis (Twelvemile) creek, about a mile from Slocan lake. The country rock is broken and foliated porphyritic granite of the Nelson batholith.

When visited in 1927 the workings, including two or more adits, were caved or otherwise obscured and no information was obtained as to the vein matter encountered.

In 1903 two tons of ore were shipped. This, the first shipment, yielded 1 ounce of gold and 145 ounces of silver. Further shipments were made in 1913 and 1915. The total recorded production is 36 tons, averaging about 54 ounces in silver to the ton and 6 per cent lead.

[1] Gwillim, J. C.: Can. Rec. Sci., vol. 6, 1894, p. 497.

HAMPTON GROUP

References: Ann. Rept., Minister of Mines, B.C., 1922, p. 203; and other years.

The Hampton group consists of the Ethel K, Ping Pong fraction, and Hampton Crown-granted claims and is owned by Mrs. N. F. McNaught and V. E. McNaught, Silverton, B.C. The property was located in 1899. Recently it has been worked under lease by P. Bruin, of Slocan.

The group lies near the head of the main or northeast fork of Springer creek at an elevation of about 5,500 feet. It is accessible from Slocan by road and trail, 6½ and 2 miles long respectively.

An initial shipment of 5 tons, averaging 600 ounces in silver to the ton, was made in 1900. In 1906, 18 tons were shipped and averaged over 1,000 ounces in silver. Altogether the mine is credited with a production of 92 tons, yielding on the average over 500 ounces in silver to the ton and a small percentage of lead.

Four, possibly more, short adits explore a lode over a vertical range of about 100 feet. The lode has a northeasterly strike, dips steeply southeast, and is a shear zone varying from a foot or so to several feet wide, intersecting coarse-grained, porphyritic Nelson granite. It contains a narrow streak or streaks of vein matter widening out in lenses up to 2 feet thick and composed of quartz and some calcite, galena, sphalerite, and high-grade silver minerals including some native silver.

HAPPY MEDIUM GROUP

The Happy Medium group consists of the Happy Medium, Vevey, International, and Eclipse No. 2 Crown-granted claims, owned by the estate of the late Lucius A. Cole, % M. Douglas Cole, 111 Broadway, New York city. The property is on Van Tuyl creek about one mile from the Slocan-Silverton highway.

Shipments made in 1905 and 1906 amounted to 13 tons, averaging 150 ounces in silver and 8½ per cent lead to the ton.

HIGHLAND LIGHT AND VICTOR CLAIMS

These claims, owned by Swan and Clough, of Slocan, are on the high divide north of Enterprise creek and west of the headwaters of Beaverton (Highland Light) creek. They are accessible by road up Enterprise creek to the foot of the trail leading up the slope to the mine workings between 2,400 and 3,000 feet above. The property is underlain by granitic rocks of the Nelson batholith and by a large remnant of older sedimentary rocks.

Shipments aggregating 11 tons were made in 1904, 1906, and 1918. This ore carried an average of 258 ounces in silver to the ton.

On the lower or Victor claim and at an elevation of about 5,300 feet, an adit 75 feet long crosscuts to a fractured zone in porphyritic granite or granodiorite. The zone is over 25 feet wide, strikes north 60 degrees east, dips 60 degrees southeast, and includes a series of fractures filled with vuggy quartz carrying disseminated galena and zinc blende. Another adit 65 feet above and 210 feet long explores the same zone and encounters a few quartz stringers but little or no ore mineralization.

On the Highland Light claim, at an elevation of about 5,800 feet, an adit has been driven on a fault fissure as much as 2 feet wide. This fissure strikes north 50 degrees west, dips 75 degrees northeast, and intersects banded quartzitic rocks which trend north 50 to 56 degrees east and dip 70 degrees southeast. The fissure carries a little quartz and calcite, and a couple of small kidneys of barite. Except for a little pyrite no ore mineral was seen. The vein matter is partly stained with iron oxide.

HOWARD FRACTION GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 72; 1919, p. 127; and other years.

This group consists of the Howard and Tiger fractions and Bland No. 2, Deadwood, and Tiger No. 7 claims, all Crown-granted. The Deadwood is owned by P. Maguire, Slocan, B.C.; the others have reverted to the Crown. The property was located in 1895, and most of the work on it was done in that and the following year. It adjoins the Meteor group on the southern slope of the divide between Springer and Lemon creeks at an elevation of about 6,500 feet, and is reached by wagon road from Slocan City about 6½ miles up Springer creek and thence by a trail 2½ miles long.

The workings, comprising three adits and an incline shaft, are inaccessible, but according to earlier reports explore a quartz vein running east, dipping from 10 to 15 degrees north or into the hill, and intersecting coarse-grained, porphyritic granite of the Nelson batholith which, in this vicinity, is traversed by many dykes. At intervals along its dip it is faulted for distances of from 3 to 8 feet. According to W. A. Carlyle, this vein was 12 to 20 inches wide and was composed of honeycombed quartz with crystalline argentite disseminated through it. Seven tons shipped in 1895 gave 163 ounces silver and $16 in gold to the ton, and 12 tons in 1896 carried 206 ounces in silver and $26 in gold to the ton.

KALISPELL GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 71.

The Kalispell, Kaiser, and Kalmar Crown-granted claims are on Enterprise creek about 1 mile by road from Slocan lake. They are owned by Mrs. E. C. Lardner, Deadwood, S.D.

Two adits aggregating over 250 feet of tunnelling have been driven along a sheared and faulted zone in a small inclusion of sediments in coarse-grained porphyritic granite. The zone strikes from north 40 degrees east to about north 15 degrees east and dips 50 to 60 degrees east. It is about 30 feet wide and has well-defined walls. The portal of the main adit is on the south bank of the creek. In the first 150 feet the adit traverses dark-coloured, limy, and quartzitic argillites, and for the remainder of its length is in granite. The zone contains much brecciated wall-rock partly cemented by milky quartz which carries a little galena, ruby silver, zinc blende, and pyrite.

Shipments were made in 1896 and 1897 and consisted of 16 tons averaging 240 ounces in silver to the ton.

LILY B CLAIM

References: Ann. Repts., Minister of Mines, B.C., 1918, p. 195; and other years.

The Lily B claim, owned by Nate Tucker, N. Mauer, and Geo. Long, the last of Slocan, B.C., is about 7 miles from Slocan and is accessible by wagon road up Springer creek. It lies at an elevation of about 5,300 feet on the south slope of Springer Creek valley.

The initial shipment was made in 1913 and amounted to 15 tons of ore containing 909 ounces of silver and 2,862 pounds of lead. In 1918 a shipment of 15 tons gave 750 ounces of silver and 7,500 pounds of lead. Altogether, this mine has provided 38 tons yielding an average of 70 ounces in silver to the ton and 14 per cent lead.

The workings, consisting of a shaft and adit, explore a fault-fissure lode cutting coarse-grained Nelson granite on a strike that varies from south 75 degrees west to north 75 degrees west, and a dip of 55 degrees south. The lode is largely crushed country rock and gouge and has a maximum width of 5 feet. Small lenses of ore up to 3 feet in width have been found along the course of the fissure. This ore consists of galena and zinc blende with a little pyrite and chalcopyrite in a quartz gangue. Some native silver occurs along fracture planes in the ore.

LITTLE TIM MINE

References: Ann. Repts., Minister of Mines, B.C., 1918, p. 195; 1919, p. 126; and other years.

The Little Tim or L. T. Mine property, held by location, is owned by D. B. O'Neail of Slocan. It is at the head of Little Tim creek, a northern tributary of Springer creek, and is accessible by 5 miles of road up Springer creek as far as Ottawa mine, and 2 miles of trail from there.

The property is underlain by coarse-grained, porphyritic granite of the Nelson batholith. The granite is intersected by two, nearly parallel fissure-vein lodes on each of which considerable work has been done. The lodes are 300 feet apart, strike north 55 to 70 degrees east, and dip 45 to 70 degrees southeast.

The mine workings range from 6,700 feet to 7,000 feet above sea-level. Those on the northwest lode comprise a shaft and three adits and those on the southeast lode three adits and an intermediate level. The shaft is the lowest working. It is down 50 feet and was inaccessible in July 1928. It is reported to have followed a vein about 1 foot wide of vuggy quartz containing disseminated, black, silver-bearing sulphides. The other workings on the northwest lode are partly caved, but indicate that a considerable amount of stoping has been done. Some of these stopes reach the surface at a point about 300 feet above the shaft. The vein matter was chiefly of quartz carrying galena, zinc blende, pyrite, and, probably, grey copper.

Most of the recent work has been confined to the southeast lode. The main adit on this is about 250 feet long and follows a fissure which is strong at the face though not mineralized. At this level an ore-body 25 feet long was stoped to an intermediate level 40 feet above where ore was exposed for 50 feet across a width of from 4 inches to 1 foot. This

ore forms a streak of nearly solid galena, zinc blende, conspicuous grey copper, and a little chalcopyrite. The gangue is principally quartz, but a little calcite and barite are also present. Some of the quartz has that chalcedonic appearance noted in certain properties at the headwaters of Keen and Enterprise creeks.

The productive period of this property extends from 1918 to the present, during which some 61 tons have yielded an average of 185 ounces in silver to the ton and 14 per cent lead.

On the Cub fraction Crown-granted claim, below the Little Tim property, vein quartz outcrops along the trail at an elevation of 6,500 feet and carries a conspicuous dissemination of ore minerals.

MABOU AND OHIO GROUP

References: Ann. Rept., Minister of Mines, B.C., 1919, p. 130; and other years.

The Mabou, Ohio, Empress fraction, and Summit fraction claims are on the south slope of Enterprise Creek valley, above Enterprise and Neepawa mines and reach to the summit of the divide between Enterprise and Springer creeks. The Mabou claim is owned by D. A. Grant and R. I. Kirkwood; the Ohio by E. M. Kirkwood; and the two fractions by R. I. Kirkwood, New Denver, B.C. They are accessible by trails from Neepawa and Enterprise mines and contain lodes which are, presumably, the southwesterly extensions of the Neepawa and Enterprise lodes. These lodes intersect the porphyritic Nelson granite and have been investigated by several short adits and many open-cuts. Unfortunately this work has fallen into disrepair.

Referring to conditions on this property in 1919 the Resident Engineer states:

"Besides a number of open-cuts along the strike of the vein (Mabou vein) there are three adit levels, of 75, 50, and 15 feet in length respectively. The formation and ore occurrence is similar to that of the Neepawa, and apparently the vein lies in the same zone of shearing . . . . At a short distance above the cabin the trail to the summit passes the portal of a 75-foot tunnel driven on the extension of the Enterprise vein, which has a strike of south 55 degrees west and a dip of from 70 to 80 degrees to the southeast. The ore here is of a distinctly different character from that of the Mabou vein, and consists of a fairly coarse-grained galena, with which is mixed varying quantities of zinc blende. A sample of the cleanest looking ore from a pile of 3 or 4 tons at the portal of the tunnel ran as follows: gold, trace; silver, 266·2 ounces; lead, 18·5 per cent; zinc, 17 per cent."

METEOR GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 72; 1904, p. 168; 1915, p. 133; 1916, p. 199; 1918, p. 171; 1919, pp. 126-127; and other years.

The Meteor group, comprising Meteor, Ottawa, No. 5, and Cultus Crown-granted claims is owned by E. Murphy and M. S. Mayfield, % E. C. Wragge, Nelson, B.C. The property is on the northwesterly slope of the divide between Springer and Lemon creeks. The workings lie between elevations of 6,700 and 7,000 feet and are reached by wagon road to a point about 6½ miles up Springer creek from Slocan, and thence by trail for 2½ miles.

The Meteor Crown-granted claim was staked in 1895. Initial shipments, amounting to 75 tons, were made in 1897, and provided 38 ounces of gold and 15,000 ounces of silver. The largest shipments, amounting to 90 tons, were made in 1919. This ore yielded over 100 ounces of silver to the ton and a total of 32 ounces in gold. Records show that this property has produced 431 tons of ore containing 236 ounces in gold and an average of 238 ounces in silver to the ton.

The underlying rocks are the coarse-grained, porphyritic granite of the Nelson batholith, intersected here and there by acid and basic dykes. The granite is sheared and altered near the mine workings.

Workings comprise six adits, only two of which were accessible at the time of examination. The adits explore a vein that strikes about north 75 degrees west and dips about 35 degrees north. The vein has proved somewhat difficult to follow as it is dislocated by a series of nearly parallel vertical faults, the throw being, in each case, down and towards the south. The vein is largely of quartz carrying a little zinc blende and galena, grey copper, stephanite, argentite, and native silver. Pyrite and chalcopyrite are present and with them may be associated the important gold content. Scheelite was also discovered in the Meteor vein. It is stated to have formed a mass of about 500 pounds on No. 2 level where it occurred as a wedge-shaped body about 12 feet long and 4 inches thick at the base. A small kidney of scheelite, amounting to about 25 pounds, was also found on No. 4 level.

MOLLY CLAIM

The Molly claim, held by location, is the property of D. McCuaig, Slocan, and is about 3,000 feet west of the Little Tim mine workings high up on the northern slope of Springer Creek valley.

Workings include one or two adits and a shaft and are mostly inaccessible. They explore a quartz vein cutting porphyritic Nelson granite on a strike of north 50 degrees east and a steep southeasterly dip. No production is recorded. Specimens of vuggy quartz were seen that carried considerable disseminated pyrite and, probably, silver-bearing sulphides. Samples of selected vein matter are reported to have given good assay returns in both gold and silver.

NEEPAWA (PEG LEG) GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 70; 1919, p. 129; and other years.

The Neepawa property comprises the Neepawa, Boisevan, Edith, Mervin, and Trio claims, the first four of which are surveyed but not Crown-granted. The group is on the lower southern slope of Enterprise Creek valley adjoining and to the west of the Enterprise group. It is owned by E. Shannon, New Denver, and is accessible by road up Enterprise creek.

The Neepawa claim was located in 1895, since which time the property has been operated at intervals by several individuals and companies, chiefly on a leasing basis. In 1928 it was acquired under option by Glasord Mining Corporation, Limited. Records of production are probably incom-

plete for the early years. The first recorded shipments, 83 tons, were made in 1904, and averaged 121 ounces in silver to the ton and about 5 per cent lead. Production continued in the following three years and, as in 1904, the values were chiefly in silver. In 1911, a shipment of 7 tons carried 86 ounces in silver to the ton and 50 per cent lead. A production of 70 tons of silver ore is recorded in 1913 and a few more tons in 1919 and 1923.

The property is underlain by coarse-grained, porphyritic granite and granodiorite of the Nelson batholith cut by a few, small, dark-coloured dykes like those on the adjoining Enterprise property.

Developments comprise quite extensive underground workings as well as considerable surface work. The former include four adits ranging in elevation from 4,200 to 4,800 feet (barometric) above sea-level. The lowest lies about 300 feet above Enterprise creek. The two upper adits were inaccessible in 1928. No. 3 adit, exclusive of crosscuts, is about 900, and No. 4 adit, 430, feet long.

The Neepawa property is on two or more shear zones, parts of a group of such zones characterizing a belt of territory as much as half a mile or more wide and including both Neepawa and Enterprise mines. The belt extends northeasterly through the Westmont property and southwesterly through the Mabou and Ohio, and, presumably, the Speculator and Arlington, properties. The shear zones have been proved to have lengths measured in hundreds of feet, but it is less certain whether single zones persist from one property to another.

On the Neepawa property two zones of shearing and brecciation are recognizable in the lower two levels, separated by about 80 feet of comparatively massive granite. Each zone averages several feet in width and consists of crushed rock, impregnated with and partly replaced by vein minerals. The zones strike about north 30 degrees east and dip southeasterly at about 65 degrees.

The chief vein mineral is quartz. It cements the crushed rock and forms lenses and veins of irregular dimensions. Associated with the quartz is some siderite, and, generally, a slight visible impregnation of sulphides, chiefly pyrite and a resiny zinc blende with, more rarely, a little galena. In No. 4 adit a few inches of banded zinc blende and gangue minerals with lesser amounts of galena, were noted over distances amounting to only a few feet. Raises from No. 3 level may have encountered somewhat similar material. Work between adits 3 and 4 is stated to have discovered an important ore shoot and a large dump at the portal of No. 3 carries some well-mineralized vein matter.

The vein mineralization gives but little idea of the contained values, for good silver values are stated to be carried by vein matter which to the eye holds little ore mineral. That high-grade silver minerals are present is evident from returns on shipments. Early operations are reported to have encounted as much as 16 inches of solid, fine-grained galena and zinc blende, with from 3 to 4 feet of concentrating ore alongside. The future of the property appears to depend on the possibility of developing large quantities of low-grade milling ore rather than on discovering small shoots of comparatively high-grade material.

NORTHERN LIGHT CLAIM

The Northern Light Crown-granted claim was located in 1902 and has recently reverted to the Crown. It is at the extreme headwaters of Scorpion (Robinson) creek at an elevation of about 4,300 feet and is accessible by road and trail from Slocan City.

The country rock is typical, coarse-grained, porphyritic Nelson granite. The workings include two adits both of which in 1927 were caved and, judged from the size of the dumps, are short.

No information could be obtained as to the character of the mineralization, if any, discovered on this property which, presumably, includes the northeasterly extension of the Republic-Slocan Bob lode system.

OTTAWA GROUP

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 164; 1921, pp. 137-139; and other years.

The Ottawa group of some twenty-one claims and fractions, most of which are Crown-granted, lies on the northern slope of the valley of Springer creek about 1,000 feet above the creek bed, and is accessible by road 6 miles long, from Slocan. The property is owned by Consolidated Mining and Smelting Company, Trail B.C.

The Ottawa claim was located in 1900 and in 1902 was acquired by a Pittsburgh syndicate. This company bought a number of adjoining claims and obtained bonds on others. In 1913 the property was acquired by the present owners and worked by them until 1918. Subsequently it has been worked under lease.

Production commenced in 1904 with the extraction of 152 tons of ore averaging nearly 200 ounces in silver a ton. From this year onwards shipments have been recorded each year up to and including 1926. The most profitable year was 1904 when 1,331 tons were shipped. This ore assayed, on an average, 185 ounces in silver to the ton and 20 per cent lead. Shipments of 545 tons in the following year carried 204 ounces in silver to the ton and 20 per cent lead. These, however, are the only years in which any lead is recorded. In 1921, 1,440 tons of mill feed averaging less than 5 ounces in silver were extracted. Production of all other years has been of higher grade material and has, exclusive of 1921, amounted to 4,758 tons of ore with an average content of 159 ounces in silver a ton.

The property is developed by five adits driven at vertical intervals of about 100 feet. Below the lowest adit is a sixth level. When visited in 1927 the upper three adits were inaccessible from the surface and the other levels were partly caved.

The workings explore a wide, sheared, and brecciated zone in coarse-grained, porphyritic, Nelson granite. The zone trends nearly north and dips easterly at angles varying from 25 degrees to 45 degrees. It comprises two rather well-defined lodes known as the West or Noble and the East or Ottawa veins, respectively. Mining work at the surface and underground indicates that these lodes are not exactly parallel, but approach each other towards the south and may join in that direction. On No. 5 level they are about 30 feet apart.

Most of the work has been done on the East lode and most of the production has come from it. The lode varies from 2 to at least 20 feet wide and is composed of gouge, crushed and broken granite, and, locally, vein matter—the latter having been stoped in places across a width of as much as 8 feet. Most of the ore has been extracted above No. 5 level, but possibilities at greater depth are believed to be good, inasmuch as there has been no evidence of deterioration in values or shrinkage of the lode in this direction.

The West lode is very wide in the lower two adits. It is reported to have produced some very good ore in the uppermost workings and has been stoped on a little from the second lowest adit level. Crosscuts connect the two lodes in the two lower adit levels and from the lowest crosscut a drift extends northerly along the foot-wall of the West lode for about 300 feet without, apparently, encountering important mineralization, although some quartz lenses as much as 2 feet thick were observed. A winze south of the crosscut was full of water. In the crosscut the sheared and brecciated zone representing the West lode was about 50 feet wide.

The gangue of the discovered ore-bodies was chiefly quartz and the valuable constituents high-grade, silver-bearing minerals such as argentite, native silver, and, probably, grey copper. In part, the quartz formed veins or lenses up to several feet in width and, in part, it occurred as a cement to fragments of country rock. The ore minerals were mostly disseminated through such materials, but also formed veins and irregular-shaped concentrations. Besides the high-grade ore minerals, more or less galena, pyrite, and a rather resiny zinc blende were present. In places barite was a predominant gangue mineral and is stated to have been associated with good ore. In general the ore was somewhat difficult to sort, as unattractive looking ledge matter might carry much silver.

The property has prospective merit in view of possibilities at depth, further developments of the West lode, and possibilities for ore concentration where and if the two lodes come together. The large dumps are reported to carry appreciable silver and zinc values and, in addition, there are quantities of low-grade vein matter in the old workings which, under favourable conditions, might be mined at a profit.

PARA CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1919, p. 131 "Royal Group."

The Para Crown-granted claim was located in 1896. It has reverted to the Crown.

The workings are on the southerly slope of the ridge encircling the headwaters of the first north fork of Enterprise (Paupo) creek, and at an elevation of about 7,000 feet. They are most readily accessible by wagon road from Slocan lake for 10 miles up Enterprise creek. From this road a good trail 3½ miles long leads to the mine.

The country rock is typical, coarse-grained, porphyritic Nelson granite. Workings comprise three adits, the two lower of which are caved (1927). The upper follows a fault-fissure lode for about 260 feet and runs from one side of the ridge to the other. The lode in this tunnel varies from a few inches to 3 feet in width, strikes north 5 degrees east, and dips

35 to 40 degrees east. It is exposed at the surface for 100 feet below the top of the hill and has a well-defined hanging-wall marked in places by a few inches of gouge. A quartz vein in places as much as 2 feet wide follows this wall and carries a little galena, zinc blende, chalcopyrite, pyrite, grey copper, and ruby silver. A few tons of ore were, in 1927, stacked at the portal of the upper adit. Altogether, 17 tons of ore have been extracted from these workings.

PORT HOPE CLAIM

The Port Hope is a Crown-granted claim, owned by Mrs. Mary McCallum and H. L. Fife, Slocan, B.C. It is about 3 miles by trail from Slocan, on the north slope of Springer creek. A shipment of 11 tons in 1904 yielded an average of 0·72 ounce in gold and 136 ounces in silver to the ton.

RADIO GROUP

The Radio group of five claims, held by location, is owned by J. Wafer, Slocan. It is at the head of Memphis (Twelvemile) creek about 3,000 feet northeast of the Alma property and 9 miles by road and trail from Slocan. Only surface exploratory work has been attempted and has been mostly confined to investigating a mineralized shear zone cutting north to northeasterly across coarse-grained, porphyritic, Nelson granite. The zone is several feet wide and carries a variable proportion of vein quartz in which some sulphide mineralization has been discovered.

REPUBLIC GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 73; 104, pp. 170-171; and other years.

The Republic group consists of the American Eagle and Bell No. 2 Crown-granted claims owned by P. Maguire, Slocan, and the Republic No. 2 Crown-granted claim and the Slocan Bob surveyed claim owned by C. W. and C. B. Tipping, Slocan, B.C. The claims were located in 1895.

The group is on the divide between Slocan lake and the headwaters of Climax and Scorpion (Robinson) creeks at an elevation of 4,500 feet, and is accessible from Slocan by a 3-mile wagon road. The country rock is chiefly foliated to massive, coarse-grained, porphyritic, Nelson granite.

Three veins have received attention, namely, the "Republic," "Bell," and "Small" veins. Most work has been done on the Republic vein. This strikes north 85 degrees east to about northeast, and dips 25 to 40 degrees north. It is a quartz vein averaging probably 2 feet in width and has been traced from the Republic No. 2 claim easterly over the divide onto the American Eagle, and possibly the Slocan Bob, claims. The quartz carries a little argentite, native silver, pyrite, and, possibly, free gold. The vein has been explored by three adits and two inclined shafts, over a vertical range of about 250 feet. The deepest shaft is sunk 74 feet on the summit of the ridge. Ore from this shaft is stated to have carried over 300 ounces in silver and $40 in gold to the ton.

It is estimated by the owners that about 700 tons have been shipped from this property, and that this averaged $17 in gold. Government statistics show shipments of 164 tons averaging over $9 in gold and 74 ounces in silver to the ton.

RICHMOND (BOOMERANG) CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1919, p. 130.

The Richmond, formerly Boomerang, claim, owned by Jos. Franz, 519-W. 5th Avenue, Spokane, is situated on Enterprise creek about 2 miles above the confluence of the North fork (Paupo creek) and at an elevation of approximately 5,400 feet.

A mineralized quartz vein on this claim follows a fault fissure intersecting coarse-grained, porphyritic granite. The vein strikes from a few degrees west of north to nearly north and dips steeply to the east. It has been explored by two adits, 100 feet vertically apart, and both partly inaccessible in 1927. Specimens from the dumps indicate that the ore minerals included galena, resinous zinc blende, argentite, and pyrite. Some ore was extracted and samples are reported to have run as high as 3,900 ounces in silver to the ton. A specimen on exhibit in Slocan shows a conspicuous amount of native silver.

RIVERSIDE GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1919, p. 130.

The Riverside group, comprising the Almeda, Riverside, Autumn, and Lailey fraction Crown-granted claims, is owned by R. I. Kirkwood, New Denver, B.C. The group lies towards the summit of the southern slope of Enterprise Creek valley, in the pass between this creek and Arlington basin. Access is possible by trails from either the Arlington or Enterprise wagon roads.

On this property three adits spaced about 200 feet vertically apart and aggregating about 400 feet of lineal work, have explored a quartz-filled, fissure-vein lode cutting coarse-grained, porphyritic, Nelson granite on a northeast strike and with a steep dip to the southeast. The drifts have disclosed small pockets of mineralized quartz carrying a silver-bearing mineral or minerals associated with a little pyrite, zinc blende, and galena. No shipments have been recorded from this property, but in 1919 it was reported that a couple of tons of ore had been extracted from the uppermost adit.

RUBY AND MABLE (CRIPPLE STICK) CLAIMS

These claims, held by location and owned by John Wafer of Slocan, are in the valley of Scorpion (Robinson) creek, a northern tributary of Springer creek, and are reached by trail from Slocan.

The workings, comprising a 300-foot adit and raise, explore a quartz vein in coarse-grained, porphyritic, Nelson granite. In 1903 and 1904, 11 tons of ore was shipped and carried an average of 19½ ounces in silver and about $2 in gold to the ton.

SPECULATOR GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1904, p. 166.

The Speculator group, comprising Speculator, Mineral Mountain, Eda fraction, and Nancy Crown-granted claims, is owned by Edmund C. and Helen U. Wragge, Nelson, B.C. The Speculator claim was located in 1894. The group adjoins and lies north of the Arlington group.

The only recorded shipments were made in 1901 when 11 tons yielded an average of 47 ounces in silver to the ton and 55 per cent lead.

The workings are on the Speculator claim and are 7 miles by road from Slocan. They comprise three adits, none of which was accessible in 1927. These workings explore the extension of the Arlington lode system which, on the Speculator, is about 150 feet wide and within which mineralization is stated to occur chiefly in a series of parallel fissures. The lode, as a whole, strikes north 34 degrees east and dips 65 to 70 degrees east.

TAMARACK GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1921, p. 139.

The Tamarack group comprises Tamarack No. 2, Falls View No. 2, and Essie fraction Crown-granted claims and is owned by Tamarack Group Development Syndicate, % E. T. Richter, 1718 W. Pacific Avenue, Spokane, Wash. It lies on the north slope of Springer Creek valley, to the west of the Ottawa group. The workings are about 900 feet above Springer creek and are accessible by a trail from the road up Springer creek at a point 3½ miles from Slocan City.

Records of production are incomplete. Shipments amounting to 20 tons are recorded in 1899 and 5 tons in 1901. In 1906 and 1907, 92 tons were shipped and yielded an average of 129 ounces in silver to the ton and 10 per cent lead.

Workings include three adits driven at vertical intervals of 80 feet. These explore a mineralized shear zone cutting coarse-grained, porphyritic, Nelson granite on an east strike and with a dip of from 25 degrees to 35 degrees south. In the uppermost adit the lode is drifted on for over 200 feet. As much as 2 feet of vein quartz carrying local concentrations of ore minerals was encountered. In No. 2 level the lode is cut off by a fault about 210 feet from the portal and has not been picked up past the fault. On this level mineralized quartz occurs in lens-like masses with barren intervals between. Near the portal an ore shoot had a length of 30 feet and was stoped to a point 45 feet above No. 1 adit. No. 3 level is about 400 feet long and at the face encounters what is probably the fault that cut off the lode in the level above. The fault zone strikes nearly north, dips 50 degrees to the east, and is about 3 feet wide. It was followed on No. 3 level for 75 feet to the north without picking up the lode.

The principal lode filling is sheared and brecciated rock. The abundant vein mineral is quartz and it forms veins, stringers, and lens-like bodies. The quartz is associated with a little calcite and barite and carries galena, zinc blende, pyrite, chalcopyrite, and grey copper or other high-grade silver minerals. Silver is associated principally with the grey copper, etc., the galena being reported to have a low silver content.

The lode strikes almost at right angles to the lodes on the adjoining Ottawa group. The ore on the two properties is, however, similar. These features suggest that should the Tamarack lode be picked up beyond the north-south fault, some effort might be made to locate its intersection with the Ottawa lodes on the chance of encountering important mineralization where the lodes meet.

TWO FRIENDS AND BLACK PRINCE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 71; 1904, pp. 166-168; 1919, pp. 127-128; and other years.

The above group, comprising the Two Friends, Slocan Prince (formerly Black Prince), Black Prince fraction, Bank of England, Montreal, and Moonraker Crown-granted claims, is owned by the Empee Mining Company, Limited, 525 Seymour Street, Vancouver. The property is at the headwaters of Springer and Crusader (second north fork of Lemon) creeks and is accessible by road up Springer creek from Slocan, a distance of about 11½ miles. The principal workings range from 6,200 to 6,500 feet in elevation.

This property was among the first staked in the Slocan City mining division and much work was done on it prior to 1900. The first production recorded was in 1896 from the Two Friends claim and consisted of 40 tons of ore averaging 300 ounces of silver to the ton and 50 per cent lead. Twenty-five tons produced in 1897 carried 200 ounces in silver to the ton and 50 per cent lead, and 60 tons of similar ore was shipped in 1900. Much the greater part of the output from this property has come from the Slocan Prince and Black Prince fraction claim which, except for the years 1902 and 1920, made shipments each year during the periods 1899 to 1906 and 1912 to 1922 inclusive, the total production amounting to 1,608 tons (including a minor tonnage from the Two Friends claim) and averaging 156 ounces in silver to the ton and about 5 per cent lead. Many shipments carried very little lead, whereas others averaged as much as 50 per cent.

The underlying rock is chiefly coarse-grained, porphyritic, Nelson granite. Locally more basic phases of this intrusive are present. The granitic rocks are intersected by a few acid and basic dykes. The rocks are cut by many faults and shear zones, along some of which important vein mineralization has occurred.

The workings comprise seven or more crosscut adits driven northerly to northwesterly and distributed from west to east across the group. They are mostly inaccessible or partly so. The more recent work has been done on the Slocan Prince and Black Prince fraction.

The workings develop, principally, two sheared, fissure-vein lodes which may be referred to as the North and the South lodes. The North lode outcrops on both the Bank of England and the Two Friends claims and has been traced for 1,500 feet along an easterly direction almost parallel with the north and south boundaries of these claims. It is reached by two adits on what is judged to be the Bank of England claim and farther east by two or three adits on the Two Friends claim. The upper adit of the two western adits has been driven from a point above the road and about 200 feet east of the trail that leads south down Crusader creek. This adit is caved. The other adit, driven from a point below the road and 485 feet east of the upper adit, encounters the lode where it is about 18 inches wide between solid granite walls. The lode strikes north 60 degrees to north 70 degrees east and dips steeply to the north. Mineralization is nearly continuous along the drift which is several hundred feet long and consists of quartz with some calcite, carrying galena, zinc blende, and,

probably, high-grade silver minerals. The blende is light coloured. The lode intersects and slightly displaces a small, basic dyke.

About 445 feet east of the workings mentioned above are two more adits, now caved, one driven from beside, and the other about 70 feet above, the road. These are Two Friends workings, situated, probably, near the western boundary of the claim. According to early reports these adits are crosscuts to the North vein lode, 4 to 12 feet wide, with, along one wall, ore in a well-defined body, varying in width from a narrow streak to 12 or 14 inches and composed of blende and galena carrying from 250 to 380 ounces in silver to the ton and 38 to 52 per cent lead. Incomplete returns up to 1904 indicate that 215 tons had been shipped from these workings and averaged 188·5 ounces in silver to the ton, 24·6 per cent lead, and 23·7 per cent zinc.

The workings on the more easterly claims are on the South lode. An adit driven from the Slocan Prince claim from the level of the Black Prince trail at a point about 900 feet to the northeast of, and 150 feet or more above, the end of the road, is a crosscut 419 feet long to the lode which strikes north 20 degrees to north 30 degrees east and dips 60 degrees northwest. The lode has been drifted on for 400 feet (1919), is about 20 feet wide, and has ore along both walls, but mainly the hanging-wall. A second adit is about 160 feet above the first, is on Black Prince ground, and is in bad repair. It is a crosscut for 129 feet, beyond which it follows the lode for about 400 feet (1919). The lode where explored by these workings is a strongly crushed zone as much as 35 feet wide in places. Abundant quartz partly cements and replaces the crushed rock and partly forms veins. Ore minerals occur both as disseminations and concentrations included in and associated with vein quartz, some siderite, and a little calcite. They comprise argentiferous galena, blende, grey copper, and probbly other silver-rich minerals, and pyrite. No appreciable gold occurs in the ore, but specimens showing native silver have been found.

A third adit known as the "Moen," has been driven from the Moonraker claim, situated west of and adjoining the Black Prince fraction, to intersect the south lode. This adit was inaccessible because of water, at the time visited. It is possibly the adit referred to in the Resident Engineer's report for 1919 as having followed the (South) lode for 1,300 feet. It is situated at the end of the wagon road about 140 feet vertically below, and 900 feet southwest of, the lower of the other two adits.

V AND M CLAIM

The V and M Crown-granted claim is on the north side of Memphis (Twelvemile) creek about a mile from and 1,700 feet above Slocan lake. It was staked in 1896 and has since reverted to the Crown.

Records indicate that a shipment of 12 tons in 1901 averaged about $7 in gold and 58 ounces in silver to the ton. The presence of appreciable, and in certain instances high, gold values in the ores in the vicinity of this property caused considerable excitement in the late nineties and resulted in the staking of a large part of the basin of Memphis creek.

The property is underlain by porphyritic, granitic rocks of the Nelson batholith and is in the vicinity of the gradational contact between the Nelson foliated granite and the Nelson porphyritic granite.

The workings include four short adits driven into the north slope of Memphis Creek valley, about 200 feet above creek bottom and over a vertical range of less than 100 feet. The most easterly, at an elevation of about 3,400 feet, is driven for 60 feet on a quartz vein striking nearly north and dipping 25 to 30 degrees east. This vein is about 6 inches wide and is mineralized by pyrite, chalcopyrite, and a little galena. At 108 feet west from this adit and at about the same level, a second adit, 120 feet long, follows a quartz vein striking and dipping about parallel with the vein in the other adit and mineralized in much the same way. Whether these are entirely separate veins or are faulted sections of one vein was not determined. A small stope near the portal has been carried to the surface and from it some of the ore shipped in 1901 may have been extracted. At 30 feet from the face of this second adit the vein is offset to the left for 3 feet by a fault along which a small, basic dyke was subsequently intruded.

At 120 feet westerly, from the second adit, a third has explored a quartz vein having the same attitude as the others. Between the second and third adits two or three small quartz veins were observed. A fourth adit, about 200 feet westerly from the last and 90 feet long, investigates a parallel quartz vein varying up to 18 inches in width and carrying a little pyrite. This vein follows a fault fissure in the coarse-grained, porphyritic granite and the wall-rocks are traversed by several small quartz stringers which, in places, carry a little pyrite.

WESTMONT GROUP

References: Ann. Repts., Minister of Mines, B.C., 1919, p. 128; and other years.

The Westmont group, comprising Westmont, Eastmont, Eastmont fraction, Oddfellow, White Cloud, White Cloud fraction, Lily G., Yankee Girl fraction, and Clipper Crown-granted mineral claims, is owned by the Ellis Silver Mining Company, 302 Bay Street, Toronto. The property is on the north slope of Enterprise Creek valley opposite the Enterprise and Neepawa groups and is accessible by road up Enterprise creek from Enterprise landing on Slocan lake, a distance of about 8 miles.

Development work was commenced in the nineties, but no production is recorded until 1907, from which year until 1914 the property was worked continuously. Production during this period amounted to 1,816 tons of ore averaging 171 ounces silver to the ton and 9·2 per cent lead. The average value of fifty-two carloads ran: gold, 0·049 ounce; silver, 169·82 ounces; lead, 9·39 per cent; zinc, about 20 per cent. The property lay idle until 1918 in which year and again in 1919 further shipments amounting to 122 tons were made by lessees. In 1928, 44 tons were won by another lessee.

The underlying rock is chiefly coarse-grained, porphyritic, Nelson granite. The granite is intersected by basic dykes along which some faulting has occurred, the relation, in places, strongly suggesting that these dykes followed lines of weakness along which subsequent movement has taken place. Faulting follows two principal directions, one striking about northeast and standing nearly vertically and the other trending about west-northwest and dipping steeply northeast.

98270—13½

The mine workings consist of four or more adits which in 1928 were partly inaccessible. They range in elevation from about 500 to 1,300 feet above the main road along Enterprise creek.

The main lode, as exposed in the lower two drift adits, is a fault-fissure zone striking about northeast and standing vertically or with a steep dip to the northwest. At about 400 feet from the portal of the upper of these two adits the lode swings to more nearly east and dips 70 degrees north. It varies up to 8 feet in width and averages about 4 feet. The lode is composed of broken and crushed rock partly cemented with and replaced by vein quartz which also forms veins and lenses 2 feet or more thick. The quartz is partly banded and shows some comb structure. It carries disseminations, pockets, and streaks of galena, blende, pyrite, grey copper, ruby silver, and native silver intimately associated with one another in varying proportions. The richest ore is stated to have formed narrow streaks in small cross fissures near their intersection with the main lode and principally between the second and third levels. Some shipments of high-grade ore are reported to have carried as much as 438 ounces in silver to the ton. Very little ore mineralization could be seen in 1928. According to the Resident Engineer's report for 1919, it varies in different parts of the lode. In some places the high silver values were associated with galena in the form of grey copper and ruby silver; in other places the predominant minerals were grey copper associated with zinc blende and native silver. Except in the high-grade streaks the ore is an intimate mixture of pyrite, blende, and galena in a quartz gangue. The blende is fairly light coloured. Specimens seen on the dumps much resemble vein matter noted on the Neepawa property on the opposite side of Enterprise creek.

WHITEHOPE (PAYSTREAK) GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1928, pp. 296-297.

The Whitehope group, formerly known as the Paystreak, comprises six claims and one or two fractions held by location, and is owned by P. Strand and C. W. Tipping of Slocan. It is on the Slocan-Silverton highway on the east side of Slocan lake about 5 miles from Slocan.

In 1897 and 1902 an aggregate of 14 tons of ore was shipped carrying on an average over $28 in gold and 44 ounces in silver to the ton.

The group is underlain by both the banded gneiss and foliated granite members of the Nelson batholith. The gneiss carries abundant partly to completely digested inclusions of older rocks whose attitudes conform closely with those of the foliated and banded structures of the intrusives.

The workings on this property are described by B. T. O'Grady, in the Minister of Mines report for 1928, from which the following is quoted:

"The workings near the cabin (800 feet above Slocan lake), consisting of short tunnels and open-cuts, develop showings in altered silicified limestone which strikes from north 65 degrees west to north 75 degrees west (magnetic) and dips from 26 degrees to 30 degrees to the northeast. The mineralization conforms to the bedding of the limestone. Back and easterly from the cabin there is a gulch, on the southern side of which some cuts have been made, in which are exposed attractive showings of ore in oxidized ledge matter. . . . Continuity of the vein on the (this)

southern side of the gulch cannot be expected until the vein is traced beyond the area of subsidence and erosion which has taken place to a certain extent along the plane of the vein. On the northern side of the gulch the vein is exposed in the face of a short tunnel. Here the vein, about 3 feet wide, is in place. A sample across 8 inches, where the mineralization was concentrated, on the hanging-wall side of the vein in this working assayed: gold, trace; silver, 2·6 ounces to the ton; lead, 33·4 per cent; zinc, 9·5 per cent. On the foot-wall side of this paystreak there is 28 inches of sparsely disseminated galena and zinc blende which assayed: gold, trace; silver, 1·1 ounces to the ton; lead, 0·5 per cent; zinc, 0·5 per cent. The vein here is well defined, striking and dipping in correct relation to the general attitude of the limestone beds in the vicinity.

"A few hundred feet southerly from the cabin and at a slightly lower elevation there is a tunnel driven about 150 feet in limestone, which in places is considerably pyritized and silicified. . . A grab sample of quartz containing pyrite on the dump of one (of two) open-cuts above assayed: gold, 0·24 ounce to the ton; silver, 24·8 ounces to the ton. . .

"The White Hope is very conveniently situated for economic operation and the showings examined indicated interesting possibilities for further exploration."

Large specimens of nearly pure, steel galena from this property are on view in C. W. Tipping's office, Slocan. This ore does not carry high silver values, the maximum being about 30 ounces to the ton. Other specimens contain much fine-grained, light-coloured zinc blende. The principal gangue mineral is quartz.

CHAPTER III

DESCRIPTIONS OF PROPERTIES, AINSWORTH MINING DIVISION

BALTIMORE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 156; and other years.

The Baltimore group, consisting of Granite, Maple Leaf, and Grafton Crown-granted claims and the Baltimore fraction, is owned by Jas. and Wm. English and R. F. Green, Kaslo, B.C. The property is on the southern flank of Woodbury mountain about 3,000 feet above Woodbury creek and is accessible by road and trail from Kootenay lake, distant about 7 miles.

The productive history of the property extends from 1902 to 1907 inclusive, during which period 54 tons of high-grade silver ore was shipped. This ore averaged 206 ounces in silver to the ton and 11 per cent lead. Little or no work has been done on the property since.

The following account is derived from a report by the Provincial Mineralogist written in 1904.

" The development work has been done on a well-defined quartz vein, cutting through a country rock of schist and shales.[1] The vein has a strike of south 70 degrees west and a dip of almost 80 degrees.

"The ore has been taken out mostly from shallow workings, within 25 feet of the surface, along the outcrop of the vein, but a shaft is down 110 feet, connecting with an adit level below, 220 feet long on the vein. From, and above, this level a raise has been started which was up 12 feet, and a stope 10 feet high by 20 feet long had been made, both in what was apparently a continuation of the pay chute of the upper workings. Along the side of the shaft stoping had been done on one side to a depth of 25 feet, and about 30 feet from the shaft, and on the other side of the shaft, to a depth from the surface of 50 feet by 30 feet wide.

" The ore is essentially galena in quartz, but as the vein is much crushed and soft, much of the lead in the upper portions is in the form of carbonates. The " paystreak " in the vein is not clearly defined, but was estimated at about 6 inches wide. The workings extend along the vein for 200 or 300 feet, but the vein has been traced for a long distance on the surface by shallow crosscuts and pits."

BEAVER GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1893, p. 1059.

The Beaver group, comprising the Beaver, Comet, Lone Star, and Lone Star fraction surveyed claims and the Cliff, Vancouver, Meteor, and Key fraction Crown-granted claims, lies at the head of Beaver creek on the

[1] The prevailing rock except in the immediate vicinity of the workings is coarse-grained, porphyritic, Nelson granite.

summit and, principally, southern slope of Beaver Mountain ridge. It is reached by trail from Kaslo creek about a mile below Blaylock. The Beaver and Comet claims are owned by A. Jardine and J. Allen, Kaslo, B.C.; the Cliff claim by J. A. Jardine, Kaslo; and the Lone Star and Lone Star fraction by the Royal Trust Company, Victoria, B.C. The other claims have reverted to the Crown.

The original group was staked in 1891 and much of the work on the claims was done within the next two years. In 1893 it was recorded that between 50 and 60 tons were ready for shipment. There are, however, no Government records of production from the property.

The principal workings are two adits 100 feet vertically apart. The upper is inaccessible. The lower is 425 feet below the summit of Beaver mountain, is open to the face, and is about 550 feet long. A few tons of ore are piled at the portals of these workings.

The country rocks are chiefly massive Kaslo greenstones with, towards the summit of Beaver mountain, small intercalations of darker, probably tuffaceous, sedimentary beds.

The main lode as seen in the lower adit has an average strike of north 55 to 60 degrees east and a dip of 60 degrees southeast. At the face of the adit, which is driven northeasterly, two fractures in rather decomposed rock show a little sulphide mineralization associated chiefly with quartz gangue. Elsewhere along the lode, which varies up to 3 feet in width, ore minerals occur in bunches or pockets. About 60 feet from the face a vertical fault strikes across the adit on a course of north 35 degrees west. Between the fault and the portal of the adit little vein mineralization was noted, but a considerable part of this section of the adit is lagged. The lode appears to turn towards the east and run out into the southeast wall of the adit at a point about 20 feet south along the drifts from the fault. In a crosscut to the northwest about 50 feet southwest from the fault a slip parallel to the main lode was noted but no mineralization seen.

The ore of the dumps at the two portals consists of galena, chalcopyrite, copper carbonates, pyrite, anglesite, and linarite in a gangue composed of quartz and crushed and silicified greenstone. The galena is stated to carry from 26 to 204 ounces of silver and the ore runs as high as 400 ounces of silver to the ton.

An outcrop of a vein paralleling the main lode was noted on the summit about 460 feet east of the signal on the peak of Beaver mountain.

BIG BEN AND MARBLE ARCH CLAIMS, AND CALIFORNIA GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 266.

The Big Ben and Marble Arch claims and the California group are adjoining properties that can best be described together. The first-mentioned claims are the property of W. R. Hunter and O. A. Tapanila. The California group, consisting of the Tunnel Site, Lead Horn, and California claims, belongs to John Koski, of Kaslo, B.C.

These properties are not Crown-granted. They are on the northwest slope of Twelvemile Creek valley and are accessible by road and trail

from Adamant. The workings lie partly within a stock of coarse-grained granite representing an apophysis from the Nelson batholith which outcrops to the south. The apophysis intrudes slaty, argillaceous sediments and limestone beds of the Slocan series striking northwesterly and dipping to the northeast at moderate to steep angles. The sediments are traversed by a few porphyry dykes and sills.

On the California group some disseminated galena-blende-pyrite occurs along a band of fractured limestone and limy argillites and has been explored by a shaft and three short adits on the Lead Horn claim. The outcrops are partly oxidized and possibly provided certain mineralized "float" which first drew attention to the property.

The following accounts are from the annual report of the B.C. Minister of Mines.

"The Big Ben faces Twelvemile creek and adjoins the Lead Horn to the southwest. On this claim there is a vein mineralized with galena, in granite. The vein, which is from 18 to 20 inches wide where examined, strikes north 75 degrees east towards the California group vein. The dip is 67 degrees to the northwest. The mineralization occurs in stringers and masses of clean galena associated with iron pyrites and small amounts of quartz in a granitic gangue. At 5,250 feet elevation a shaft was sunk 20 feet on ore, which pinched out at the bottom.

"The Marble Arch is started on the upper or northwesterly extension of the California vein, which, however, has not been opened up on this claim. A shallow shaft and two short tunnels develop a quartz-filled fissure containing streaks of high-grade ore. At the top of the shaft the vein is merely a seam which widens out at the bottom of the shaft where some 4 inches of clean galena and grey copper assayed: gold, 0·14 ounce to the ton; silver, 393·6 ounces to the ton; lead, 70·3 per cent; zinc, trace. This vein is striking north 70 degrees east towards the extension of the California group vein which lies a short distance away from and below it. The dip is 50 degrees to the southeast."

BISMARK GROUP

Reference: Report of Zinc Commission, 1906, pp. 266-267.

The Bismark group, comprising Bismark, Mountain Goat, and Highland Laddie Crown-granted claims and the Black Bear surveyed claim, are owned by R. F. Taylor, G. B. Gerrard, and H. Giegerich, Kaslo, B.C.

The property is east of Briggs creek, a tributary of Keen creek, at an elevation of about 6,400 feet.

Up to 1924 the Bismark had shipped 1,063 tons of ore averaging 102 ounces of silver to the ton and 87·5 per cent lead. In 1900 clean ore averaged 290 ounces of silver and 72·5 per cent lead, and oxidized ore carried 190 ounces silver to the ton and 14 per cent lead.

The property is mostly within a belt of interbanded argillites and limestone beds or otherwise limy strata of the Slocan series which is flanked and intruded by granitic rocks of the Nelson batholith. The sediments strike south 55 degrees west, dip 70 degrees to the northwest, and are intruded by a few dykes.

The workings comprise three adits over a vertical range of about 400 feet. They develop a lode that conforms nearly with the enclosing sedi-

ments, though in places it appears to strike more to the west. The workings were inaccessible in 1927, but it is reported that since then the Consolidated Mining and Smelting Company conducted some exploratory work on the property. Early reports and mine maps indicate that a shoot of oxidized lead ore, some 30 feet long, exposed at the surface and encountered near the portal of the uppermost (No. 1) adit, persisted in chimney-shaped form to No. 2 level 112 feet below No. 1; that what was probably an extension of the same shoot was encountered near the face of No. 3 level, at an additional depth of 238 feet; and that at this lowest level the vein matter had a width of 2 feet. A crosscut 135 feet from the portal (over 300 feet from the face) had also exposed the lode across a width of 3 feet. A sample taken by Mr. Garde across a width of 6 inches of heavy sulphide ore in two cuts (top and bottom) gave 38·4 per cent zinc, 26·8 per cent lead, and 196·3 ounces silver to the ton. Subsequent work, including a shaft and upraise at this point, have shown continuous mineralization across a width of as much as several feet.

At the surface the lode is 3 or 4 feet wide and is of calcite with bunches of galena, a little quartz, and pyrite, and considerable oxidized material. Above No. 2 level ore has been stoped to the outcrop above the portal of No. 1 adit. The ore-bodies have formed partly by replacement of one or more limestone beds outcropping in the vicinity of the workings.

BLACK BEAR CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1920, p. 123.

The Black Bear claim, property of Geo. Bentley Gerrard, % Bank of Montreal, Montreal, is situated on the northern side of Keen Creek valley. It adjoins and lies east of the Liberty group. The workings are reached by a short trail from the road up Keen creek.

In 1920 an attempt was made to get the old workings in shape for further work. These include a 35-foot shaft sunk on a vein that appears to be following the bedding of metamorphosed, slaty argillites of the Slocan series. The vein in the shaft varies from 1 to 1½ feet in width and carries galena and pyrite in a quartz gangue. Other workings comprise a short crosscut adit below and an open-cut above the shaft.

In 1922 a shipment of 5 tons of ore carried an average of 12 ounces in silver to the ton and about 21 per cent lead.

BLACKBURN AND WALLACE CLAIMS

A little exploratory work has been done on these Crown-granted claims situated north of Kaslo lake on the divide between the headwaters of Keen and Enterprise creeks at an elevation of about 6,300 feet. The claims have reverted to the Crown.

The workings comprise two short adits, one on either side of the divide, and two small open-cuts on the summit. The southern adit is apparently almost on the boundary between the two claims. It is driven along a mineralized crush zone in coarse-grained Nelson granite. Along this zone vein quartz occurs in stringers and small, irregular lenses and carries a sparse dissemination of sulphides. The lode strikes north 65 degrees west and dips

steeply southwest. Its hanging-wall is partly defined by a narrow, fine-grained basic dyke.

The second adit is 1,700 feet northwest of the first mentioned and is on the Enterprise side of the divide and on the Blackburn claim. It is short and follows a small quartz stringer in sheared, pinkish granite. The vein strikes north 10 degrees east and dips 60 degrees east. No sulphide mineralization was observed. The open-cuts likewise fail to disclose anything of value.

BLACK FOX GROUP

References: Rept. of Zinc Commission, 1906, pp. 267-268.
Ann. Rept., Minister of Mines, B.C., 1899, pp. 704-705.

The Black Fox group is the property of Laura M. Dunsmuir, Hatley park, Victoria, B.C. The group consists of the Daisy, Black Fox, and California Crown-granted claims situated on the south side of Keen creek about 5 miles by road from Zwicky station. The property is west of, and adjoins that of, Cork-Province Mines and apparently lies on the extension of the same lode system.

The Daisy claim was located in the early nineties and some work done on it before the Black Fox, and probably also before the California, claim was added to the group in 1898. Altogether some 1,000 feet of lineal work was done in the nineties, all of it within a few hundred feet of the main road and chiefly on the Daisy and California claims near the eastern boundaries. The workings have fallen into disrepair and are partly inaccessible.

The rocks on this group are Slocan argillaceous sediments in which andalusite is conspicuous as a result of metamorphism produced by the Nelson granite batholith whose border is only a few hundred feet to the northwest, on the opposite side of Keen creek.

A number of lodes carrying quartz veins have been found and with one probable exception have a general strike of north 60 degrees east and dip southeast at an average angle of 65 degrees. These lodes vary in width from a few inches to 10 feet, the wider ones, at least, marking sites of extensive faulting and shearing.

The largest lode is exposed in the northwest corner of the Daisy claim 400 feet southeast of the main road up Keen creek. Here it has a maximum width of 10 feet and is composed mainly of quartz carrying fragments of wall-rock and an irregular dissemination of zinc blende, galena, and pyrite. This lode has been traced for some 200 feet on the surface. A shaft was sunk on it for 57 feet and a small quantity of lead ore, assaying 50 to 70 ounces in silver and $2 to $7 in gold to the ton, extracted. About 350 feet northwest of the shaft, just above the road, a crosscut was driven for 340 feet in a south 35 degrees east direction tapping the lode 35 feet from the face of the adit and 130 feet below the outcrop. The crosscut intersected five or more quartz veins between the portal and the main lode and another 30 feet beyond the main lode. From the crosscut, drifts have been run on the main lode for 36 feet to the west and 140 feet to the east. Some stoping was done above the east drift within the first 100 feet from the crosscut and, from the eastern end of the stoped portion, a short crosscut was run south to pick up the parallel lode encountered near the face of the main crosscut. A little quartz was encountered and drifted

on for about 40 feet to the west. The same parallel lode was also drifted on for 100 feet west of the main crosscut. A second crosscut adit was driven from a point a little east of the lower adit and 110 feet above and 180 feet southeast of its portal. This adit is 65 feet long. Some vein quartz in the face of the adit apparently represents the main lode, but no work has been done on it. Very little ore mineralization was noted in any of these underground workings. They are west of the mineralized outcrop by the shaft head. If the main east drift from the lower adit is continued another 70 feet or so it will be in the part of the lode down the dip from the mineralized outcrop.

Of the quartz veins encountered in the lower crosscut north of the main lode, the largest is crossed 103 feet from the portal. Here it occurs in a lode 4½ feet wide composed chiefly of quartz and sheared wall-rock with a few inches of zinc blende assaying 36·6 per cent zinc and carrying 2·3 ounces of silver. This lode also outcrops at the surface 100 feet south of, and 75 feet above, the portal of the crosscut. It strikes north 52 degrees east and dips 70 degrees southeast. At the surface the filling is mainly quartz, but includes fragments of wall-rock and some siderite. Ore minerals, chiefly zinc blende but including some galena and pyrite, are irregularly distributed through the gangue.

An old shaft near the portal of the lower crosscut is in a vein that was exposed in the early years of development and was known as the "California vein." This vein was said to strike almost at right angles to the others and the shaft struck some good ore in it. An old open-cut less than 200 feet to the north, just below the road, is reported to have uncovered 4 inches of clean galena in this vein and a crosscut adit was started 15 feet above the creek to intersect this showing. The intersection of this vein and the main lode, and also the intersections with the other veins, are worthy of exploration as affording favourable chances for the discovery of workable deposits. It might also be advisable to prospect for outcrops of limestone because, as demonstrated on the adjoining Cork-Province group, the ore deposits tend to occur where lodes intersect limestone strata. On the Black Fox property, however, the veins so far discovered, with the exception of the California, nearly follow the bedding of the strata and are not in contact with limestone beds in the underground workings.

The only other workings observed on or near the Black Fox group are nearly 300 yards southwest of those described and are just west of the Black Fox claim. They consist of one adit 100 feet above the main road and some open-cuts about 70 feet higher up the slope. The portal of the adit is close to the east bank of Briggs creek and the open-cuts are on both sides of the creek. The adit has been driven for 100 feet south, 20 degrees east, across massive, argillaceous rocks. At 60 feet from the portal a slip was crossed and has been drifted on to the east for 90 feet without encountering anything of interest. On the dump at the portal are specimens of heavily pyritized vein matter carrying galena and sphalerite. Where these came from in the adit was not determined. The open-cuts are on a fault in black argillites. The fault strikes north 75 degrees east and dips 60 degrees southeast. No mineralization was observed.

B.N.A. GROUP

Reference: Rept. of Zinc Commission, 1906, pp. 268-269.

This property, consisting of B.N.A., Onoka, Humming Bird, and Lynx fraction Crown-granted claims, is owned by B.N.A. Mines, Limited, % S. H. Green, Kaslo, B.C. It is a few hundred feet above and to the east of Keen creek on the north side of the valley of Kyawats (Lake) creek and is accessible to within a mile of the workings by a road 14·7 miles long from Kaslo.

The workings lie within a narrow belt of Slocan sediments flanked by granitic rocks of the Nelson batholith, the same belt that to the southwest includes the Silver Bell and Silver Bear and, in the opposite direction, the Daybreak, Gold Cure, and Bismark properties.

The workings were inaccessible in 1927. According to reports they explore a lode striking north 20 degrees east and standing vertically or dipping steeply northwest, an attitude that corresponds nearly with that of the enclosing sediments. The lode is as much as 15 or 20 feet wide and in it argentiferous galena and zinc blende form a series of small shoots, also a paystreak averaging several inches in width. Some of the zinc ore is stated to have carried as much as 4 ounces of silver a ton to the per cent zinc, a feature partly attributable to secondary native silver.

In 1909, the only year in which shipments have been reported, 3 tons of ore carried an average of 165 ounces in silver to the ton and 17·4 per cent lead.

BOADICEA CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 265.

The Boadicea Crown-granted claim is on the eastern side and towards the head of Robb (Spring) creek. It is owned by Jos. J. Streit, New Denver, B.C.

The greater part of the claim is underlain by part of a granodiorite porphyry stock invading Slocan sediments. The intrusive occupies the central part of the claim. Along the northeast sedimentary strata occupy a width of about 100 feet and extend northerly beyond the claim boundary for about ¼ mile. A wider band of sediments underlies the southwestern part of the claim and a tongue-like body of these measures projects northeasterly from the western limit of the claim. The Slocan strata consist of interbedded limestone, slate, and andalusite schists and are cut by porphyry dykes.

In the sedimentary strip along the northeast claim line, three adits have been driven in a southeasterly direction parallel with, and within a few yards of, the northern edge of the body of granodiorite. The three adits are nearly in line and have been driven into ground rising steeply to the east. The uppermost and lowermost are about 250 feet apart vertically and over 300 feet, horizontally. The intermediate adit is caved and the adit above is accessible for 80 feet; its length is not known. The lowermost adit is about 300 feet long. The adits follow a lode striking south 60 degrees east, dipping 85 degrees southwest, and lying along the contact of a narrow bed of limestone with andalusite schist. The lode has a maximum width of 2½ to 3 feet and is largely composed of

crushed and fractured rock sparingly impregnated with sulphides and containing a discontinuous streak 2 to 3 inches wide, of vein matter, mostly coarse, cubical galena.

The entrance to a fourth adit lies 375 feet west of, and nearly 400 feet below, the lowest adit of the group of three just referred to. This fourth adit is in the area of sediments projecting easterly from the west border of the claim. It is inaccessible and has been driven under an outcrop of oxidized vein matter about 10 feet wide. Specimens on the dump consist of galena and sphalerite in siderite. The relation of this lode to the easterly lode explored by the three adits is unknown, but it seems likely they are different lodes.

BON TON CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1896, p. 64.

The Bon Ton Crown-granted claim, owned by W. H. Brandon, 613 Home Street, Winnipeg, is situated on the west side of Jackson Creek valley about 7 miles from Retallack station and about a quarter of a mile east of the Dardanelles group. The claim was located in 1892 and a small shipment in 1893 is stated to have given returns of between $300 and $400 a ton. Small shipments of high-grade ore were also made during the period of 1915-19, average values in the last three of these years running about 213 ounces in silver to the ton and 28 per cent lead. Since 1919 little if any work has been done and the workings, consisting of four short adits and a 40-foot shaft, are mostly inaccessible. They lie between elevations of 6,125 and 6,240 feet. The country rocks are argillaceous sediments of the Slocan series. They strike north 55 degrees west, dip at about 50 degrees southwest, and are intersected by sills and dykes of quartz porphyry and by a basic dyke carrying a little greenish mica (mariposite?). The workings investigate a fissure-vein lode, partly occupied by vein quartz, carrying galena and grey copper. The lode strikes north 55 degrees east and dips 50 degrees southeast.

CABLE CLAIM

References: Geol. Surv., Canada, Ann. Rept., vol. IX, 1896, pt. R, p. 31.
Munition Resources Commission, Canada, Final Rept., 1920, pp. 169-170.

The Cable claim, owned by the estate of the late Alfred Cameron, % Mrs. Catharine Cameron, 1735 11th Avenue, West, Calgary, Alberta, is on the high divide between Sunrise and Woodbury mountains near the headwaters of Woodbury creek. It may be reached from the trail up Silver Spray creek to the Violet property.

So far as is known no work has been done on this claim for many years and when visited (June, 1927) the old workings were obscured by snow. Topographical maps show one adit, driven northerly, near the summit of the ridge at an elevation of about 7,500 feet. The country rock is the Nelson granite.

The workings investigate a quartz vein in which values in silver and platinum and trace of gold have been reported.

CALEDONIA CLAIM

References: Ann. Rept., Minister of Mines, B.C., 1926, p. 265.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 191.

The Caledonia claim is situated at Blaylock to the east of the mouth of Rossiter creek. It is owned by Geo. E. McCready, Kaslo, B.C.

Production to the end of 1924 is recorded as 11 tons of silver-lead ore carrying an average of 70 ounces in silver to the ton and 47 per cent lead.

The principal lode on this claim is a mineralized fault fissure zone striking a little south of east and dipping to the south at about 75 degrees. It cuts across laminated, slaty rocks and several beds of limestone varying from 3 to 15 feet in thickness. These sediments strike northwesterly and dip southwest at an average angle of 70 degrees. The lode had been prospected by open-cuts and two shafts and is tapped by a crosscut adit driven northeasterly for 140 feet and from which drifts have been run for 100 and 75 feet to the west and east, respectively. An ore-body lay on either side of the crosscut intersection with the lode where the latter cuts across the widest limestone bed. A raise driven a few feet east of the crosscut encounters this ore-body about 30 feet above the level, from which point it has been stoped to the surface a farther distance of about 35 feet. Faulting along the hanging-wall of the lode has abruptly terminated both limestone and mineralization. Some scattered vein mineralization also occurs along the lode where the wall-rock is not limestone.

The ore has resulted mainly from replacement of the limestone and is composed of clean lenses of galena and mixtures of galena, zinc blende, and pyrite, in a gangue chiefly of vein calcite and siderite with, in places, a little quartz. The same limestone bed is exposed at the surface and has been traced northwesterly for several hundred feet, in which distance it is intersected by a number of small cross-fractures striking a few degrees east of north and carrying a little mineralization.

CARBONET No. 2 CLAIM

This Crown-granted claim, owned by A. T. Garland of Kaslo, is on the southeast side of, and towards, the head of Robb Creek valley and is reached by trail by Robb creek from Blaylock.

The southern part of the claim is underlain by Slocan sediments; the northern part by part of a granodiorite stock, the sedimentary-igneous contact running about southeast. A few yards north of the contact an adit has been driven southeasterly to intersect a lode outcropping higher on the hillside. At a point 150 feet east-northeast, a second adit has been driven easterly, presumably with the intention of exploring the lode along its strike. This adit has caved and the southern adit is also in poor repair. The lode as seen in outcrop strikes north 60 degrees east and dips 50 degrees southeast. It is a fault zone about 6 inches wide and consists of crushed granodiorite partly cemented by quartz carrying galena and other sulphide minerals. A little stoping on the lode has been done but no shipments are recorded.

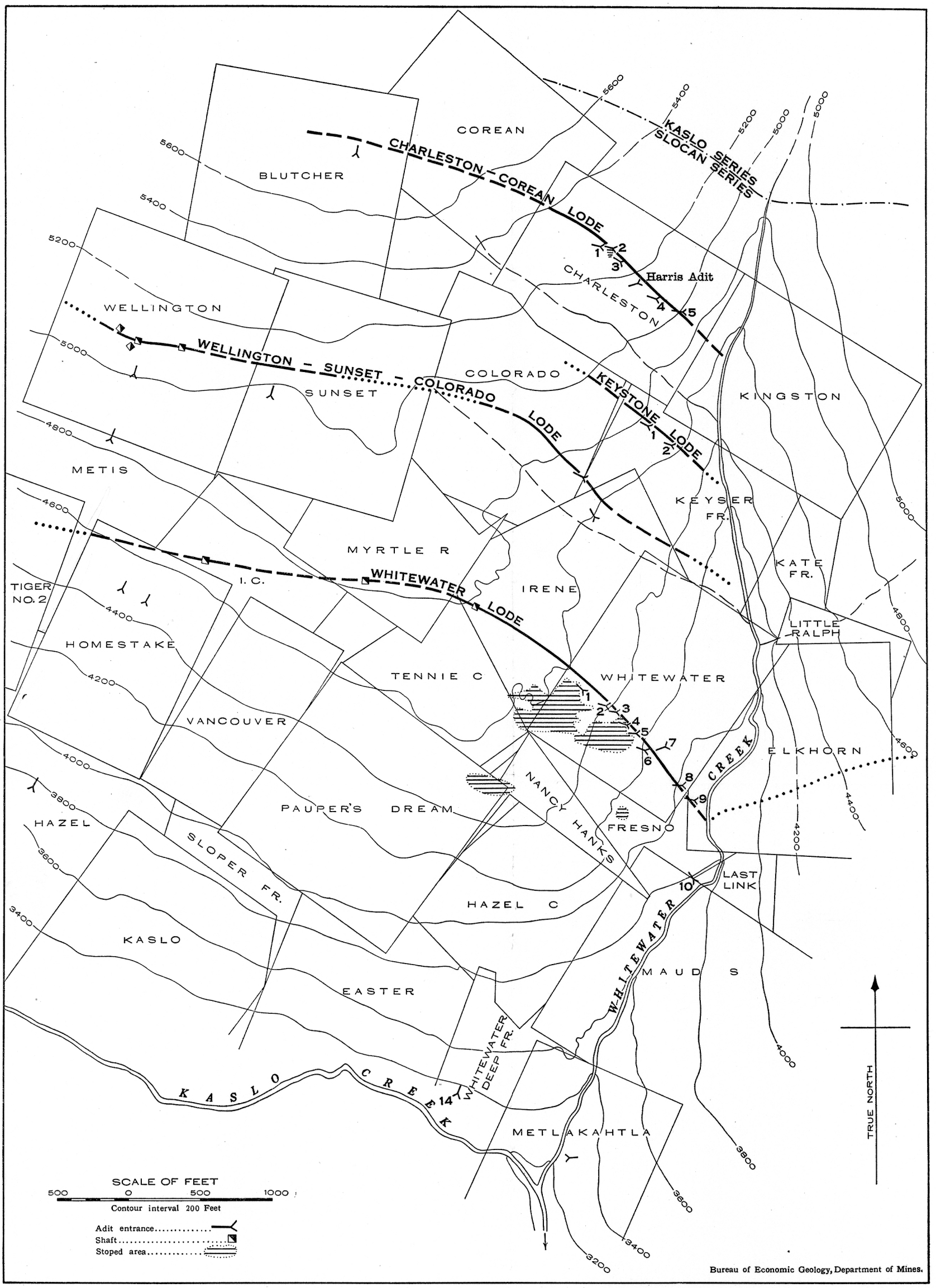

Figure 14. An area near Retallack showing claim boundaries, lode system, and principal stoped areas.

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CHARLESTON GROUP

References: Ann. Repts., Minister of Mines, B.C., 1896, p. 65; 1923, p. 210; 1926, p. 262; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, p. 192.

The Charleston group (*See* Figure 14) comprising the Charleston, Keystone fraction, Kingston, Colorado, and Corean Crown-granted claims, was acquired in 1926 by Keystone Charleston Mines, Limited, % A. J. Harris, Zincton, B.C.

The group is in the valley of Whitewater creek and adjoins the property of Whitewater mines lying to the south. A wagon road about ¼ mile long connects the lower Keystone tunnel with the Whitewater wagon road, 2½ miles long, to Retallack station.

The Charleston and Corean claims were staked in the early nineties and considerable work was done on them and adjoining claims before the end of that decade. The most important discovery was made on the Charleston claim where in 1896 a width of 4 feet of high-grade ore was found 300 feet from the portal of No. 5 adit. In the following year some eighteen men were employed on the property. Its history from 1900 to 1910 is less certainly known, but there are records of shipments in five different years, totalling 56 tons, chiefly of silver-lead ore including, in 1906, 15 tons of zinc ore. Further shipments totalling 58 tons of silver-lead and 31 tons of silver-zinc ore were made up to the end of 1926.

The most extensive work has been done on the Charleston lode on the Charleston claim. Some important mineralization has been proved on the Keystone lode on the Keystone claim, and a little exploratory work has been done on the Colorado lode on the Colorado claim and the adjoining Irene claim of the Whitewater group. The westerly extension of the Charleston lode has also been explored on the Corean claim.

The Charleston group is underlain by the slate belt of the Slocan series immediately overlying the Kaslo greenstones whose southern edge lies just north of the property. The prevailing rocks are fissle, black argillite and slate, with occasional, narrow beds of quartzite and other massive argillaceous strata. Narrow limestone beds were observed on the Keystone claim where also two small, green-spotted dykes were seen in No. 2 Keystone adit. These dykes are similar to those on the adjoining Whitewater property. The sediments have a general west to northwesterly trend and southwesterly dip (*See* cross-section CD, Figure 3, Memoir 173, in pocket). Contrary dips are not uncommon, due partly to local folding and faulting, but principally, it is thought, to creep of the outcrops of slaty rocks down the hill.

Three well-defined vein-lodes have been worked on this property. These have a general strike of north 60 degrees west and a dip southwest at angles varying from 50 to 65 degrees. The lodes are mineralized fault-fissure zones cutting at small angles across the sedimentary rocks. They vary in thickness from a few inches to many feet and contain lenses and more irregular bodies of silver-lead-zinc ore from which a small tonnage has been mined. Sphalerite is the most abundant ore mineral and in places is associated with an unusually large proportion of grey copper. Galena is also an essential ore mineral. Quartz and siderite are

the chief gangue minerals and the lode fillings include a large proportion of crushed and broken wall-rock.

The Charleston lode has been developed by five adits distributed over a horizontal distance of 650 feet and a vertical range of about 350 feet along the strike of the lode on the lower slopes of the western side of Whitewater Creek valley. The longest adit measures 800 feet and the total length of all five adits is over 2,000 feet. The lode is in slaty sediments. It strikes about north 60 degrees west and dips 50 degrees to the southwest. Vein matter carrying concentrations of ore minerals has been discovered at a number of places, but sufficient work has not been done to prove its continuity over any considerable vertical range.

The uppermost adit is short and has revealed nothing of importance. The next adit below, No. 2, is 110 feet long and is connected by a raise with No. 3 adit 50 feet below. It opens an ore shoot that commenced near the portal and extended about 25 feet along the level. This shoot has been stoped out to a height of 10 feet above the level and to a depth of 20 feet below. It raked steeply to the east. No. 3 adit is over 200 feet long.

The portal of the next adit below, the Harris adit, is 130 feet southeast of, and about 50 feet lower than, No. 3. The Harris adit commences southwest of and above the outcrop position of the lode. It was driven southwest for 80 feet to where it encountered a fracture which was followed for 200 feet along a northwest direction to where it intersected the lode. A little ore was found along the fracture between 45 and 90 feet from where it was first entered and is stated to have carried high silver values. The adit for the remaining distance follows the lode. At about 40 feet beyond the intersection of the fracture and the lode, the lode splits. The hanging-wall section of the divided lode strikes southwest and has a low dip southeast. This section of the lode is followed by a drift about 40 feet long and displays some mineralization. The foot-wall or main section of the lode has been drifted on for 500 feet. It has a general strike of north 55 degrees west and dips 50 degrees southeast. A small body of ore was found in it a few feet beyond the point of splitting. This body is about in line with the ore shoot stoped out from No. 2 level above. A second, much larger body was found to commence about 250 feet beyond the split and to extend for about 200 feet along the adit. The best showing is in a stope near the east end of the shoot where there is a breadth of 3 to 4 feet of ore consisting of sphalerite, galena, and grey copper in siderite, quartz, calcite, and rock.

No. 4 adit, the next below the Harris adit, is about 150 feet long and is connected by a raise with No. 5 adit 80 feet below.

No. 5 adit is 190 feet below the Harris adit and its portal lies 350 feet to the southeast. The adit was 450 feet long in 1927 and apparently follows the same sheared zone as that holding the ore-bodies on the higher levels. This zone on No. 5 level is for most of the way mineralized by stringers of quartz carrying pyrite. One small ore shoot was found between 260 and 300 feet from the portal and has been partly stoped out from above the level and a winze had been sunk a few feet in it. The ore is a mixture of galena, sphalerite, and grey copper in a gangue of quartz, siderite, and rock. In 1927, this adit was being extended to the west to reach a point below the long ore shoot that had been found in the Harris adit.

The outcrop position of the Keystone lode is 1,200 to 1,500 feet south of that of the Charleston lode. The Keystone lode has been partly explored by two adits on the Keystone claim. The upper adit is 170 feet long and is a drift on the lode which, in this distance, is remarkably straight, striking north 55 degrees west and dipping to the southwest at an angle varying from 70 degrees at the portal to 60 degrees at the face. The lode is about 4½ feet wide and lies between well-defined, slickensided walls. Most of this part of the lode is vein matter reported to be ore of milling grade. It consists chiefly of siderite and blende with a liberal dissemination of galena and pyrite. The gangue material includes some calcite and fragments of wall-rock. The lower adit, 85 feet below the upper, is a drift 400 feet long. It encountered less mineralization than the upper and in a short raise shows better vein matter than on the adit level. At about 320 feet from the portal the lode splits, the hanging-wall portion striking north 65 degrees west with a steep south dip and the foot-wall division, which was followed for 75 feet past the split, striking north 20 degrees west and dipping 55 degrees southwest. The foot-wall split towards the face of the drift appears to be entering more broken ground with, consequently, better chances for mineralization.

The Colorado lode is about 850 feet south of the Keystone lode. It outcrops on the Colorado claim and extends east across the northern corner of the Irene claim, part of the property of Whitewater Mines, Limited. On the Irene claim an adit has been driven to investigate the lode which here strikes north 65 degrees west and dips 55 degrees southwest. The lode is a shear zone in slaty rocks and in places shows several inches of gouge on the hanging-wall. The filling, as far as could be seen, is chiefly quartz in lenses or stringers carrying fragments of wall-rock. It is reported that a higher, now inaccessible adit on the Colorado claim followed the lode and encountered some rich silver ore and that the lower adit would not have to be extended far to get under this shoot. Some specimens purported to have come from this shoot and carrying large lumps of grey copper associated with zinc blende, galena, and pyrite in a siderite and calcite gangue were observed on the dump in front of the portal of the lower adit.

COMSTOCK-VIRGINIA GROUP

This property, including Comstock, Virginia, and Erie Crown-granted claims, is at the head of Long creek and is accessible by road and trail from Zwicky. Ownership has reverted to the Crown.

The group lies within an area underlain by coarse-grained, porphyritic Nelson granite. A fault fissure lode cutting the granite has been explored by three short adits, 100 feet apart vertically. The lode varies from a few inches to 2½ feet wide. It strikes north 30 degrees east and dips about 75 degrees northwest. The walls are well defined and are marked in places by narrow seams of gouge. The lode consists chiefly of vein quartz which cements fragments of the wall-rocks and is mineralized with galena, blende, pyrite, grey copper, ruby silver, and argentite. Of the ore minerals galena and blende are the most abundant. Fragments of a basic dyke were noted on one of the dumps, but the dyke itself was not seen in place.

A shipment of five tons made about 1909 carried an average of 100 ounces in silver to the ton and 60 per cent lead. It is reported that 1 ton of zinc ore was also shipped from this property.

CONTACT (BLACK PRINCE) CLAIM

References: Geol. Surv., Canada, "Manganese Deposits in Canada," Ec. Geol. Ser. No. 12, pp. 112-114.
Ann. Rept., Minister of Mines, B.C., 1931, pp. 144-146.

The Contact claim, formerly known as the Black Prince, is the property of A. J. Curle, Kaslo, B.C. It is on the southwestern slope of Kaslo Creek valley, 200 feet above the railway and about 14½ miles by rail from Kaslo.

A bed of limestone about 150 feet thick strikes north 35 degrees west and dips southwest at 45 or 50 degrees. The limestone is bordered by shaly and slaty, dark grey to brownish, argillaceous rocks all belonging to the Slocan series. Within a few hundred feet of the mine workings the sediments are intruded by at least one porphyritic body of uncertain but apparently small dimensions. The limestone bed appears to be continuous to the northwest with a large limestone outcrop near the mouth of Lyle creek, and probably represents the same horizon as the thick limestone bed encountered still farther northwest in the Whitewater Deep mine. On the Contact claim the limestone has been extensively replaced, particularly along the hanging-wall side, by manganiferous siderite that carries here and there a little galena, blende, and pyrite and is much oxidized near the surface.

The workings comprise two adits and much surface trenching and stripping. This work has been designed chiefly to investigate the mineralization along the hanging-wall side of the limestone bed and has proved the continuity of a body of partly oxidized siderite over a distance of at least 200, and probably 600, feet. Its thickness, where most closely investigated above and to the west of the underground workings, averages at least 20 feet and in one trench, where work has been extended since the property was visited, is reported to be 90 feet. The adits are 50 feet apart vertically. The upper adit, 170 feet long, encounters the siderite body near the portal and the lower intersects it near the face, 170 feet from the portal. An open-cut along the foot-wall of the limestone bed has exposed very similar siderite replacement across a width of 30 feet. The linear extent of this body has not been investigated.

At the surface the siderite has been largely altered to oxides of iron and manganese (analysis No. 2), but at a depth of a few feet (as indicated by analysis No. 1) the alteration is comparatively slight. The following analyses by A. Sadler, Mines Branch, Ottawa, illustrate the character of the siderite as exposed at the surface and in the upper adit.

—	No. 1	No. 2	No. 3
Mn	10·03	(12·15)[1]	8·36
MnO	.....	None	.....
MnO_2	(15·86)	19·23	(13·22)
SiO_2	.....	8·04	.....
Fe_2O_3	43·56	59·93	62·66
P_2O_5	.....	0·11	.....
NiO	.....	None	.....
CoO	.....	None	.....
CaO	4·20	0·42	None
MgO	2·62	0·08	0·20
S	.....	0·10	.....
CO_2	36·30	0·76	.....
$H_2O+105°$ C	.....	8·92	.....

[1]Figures in brackets have been calculated from the analyses.

No. 1. A sample of but slightly oxidized manganiferous siderite from the face of No. 1 adit.

No. 2. Sample of oxidized manganiferous siderite taken across a width of 15½ feet exposed in a trench above the portal of the upper adit.

No. 3. A composite sample of oxidized manganiferous siderite taken from several trenches in vicinity and west of the underground workings.

From analysis No. 1, A. Sadler of the Mines Branch has calculated the composition of the less altered siderite in terms of the carbonates which compose it, as follows:

	Per cent
Iron carbonate	63·20
Lime carbonate	7·49
Magnesium carbonate	5·47
Manganese carbonate	20·98

A little sulphide mineralization had also been found. The sulphides, galena, zinc blende, and pyrite, occur mostly in small stringers following lines of fracture crossing the limestone belt both within and beyond the limits of the siderite bodies and even extending out into the hanging-wall rocks of the limestone bed. Most of these fractures cross the formation at a sharp angle, the prevailing direction being northeasterly with southeasterly dips. They vary in width from a fraction of an inch to several inches, and include considerable oxidized material and streaks and bunches of galena or of sphalerite, or mixtures of the two minerals associated with some pyrite. A sparse dissemination of these sulphides was also noted in both upper and lower adits where these workings encounter the main siderite body. A sample taken by Mr. Curle across 35 feet of siderite in No. 1 adit was reported to carry 0·4 per cent lead and 0·3 per cent zinc.

COPPER PRINCE AND STANDARD CLAIMS

These claims, held by location, are owned by Wm. Anderson, Kaslo, B.C., and are near the head of Tenmile creek southeast of Iron mountain. The property is accessible by trail from the railway about 2 miles below Keen.

The claims are underlain by Kaslo greenstones near their contact with underlying Milford group rocks.

On the Standard claim, at an elevation of 6,600 feet, an adit 110 feet long has been driven westerly along a fissured zone holding up to 2 feet of oxidized vein matter carrying some galena. A 10-foot winze has been sunk on this near the face of the adit.

On the Copper Prince claim, which lies northeast of the Standard, some work was done years ago on showings of vein quartz stained with copper carbonates and carrying some pyrite and conspicuous amounts of chalcopyrite.

CORK-PROVINCE MINE

References: Report of Zinc Commission, 1906, pp. 169-173.
Ann. Repts., Minister of Mines, B.C., 1900-1928.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 192-193.

The Cork-Province mine is owned and operated by Cork-Province Mines, Limited, % B. F. Palmer, Kaslo, B.C.

The property comprises thirteen surveyed and partly Crown-granted claims covering 479 acres. The mine is on the south side of Keen creek 9 miles by road from Kaslo and 4½ miles from Zwicky station.

The property is a consolidation of the Cork and Province groups of claims. The Cork group was acquired about 1900 by the Silver Star Mining Company, Limited, with headquarters at Lisle, France. By 1904 considerable development work had been done, including the lowest crosscut with drifts for over 200 feet east and west. Raises had been started from each drift and a fair-sized body of ore developed in the western upper levels.

The adjoining Province group was being operated independently at this time and a promising ore-body had been developed on the eastern extension of the Cork lode, close to the eastern boundary of the Cork claim.

Both the Cork and Province mines were examined and reported on by Philip Argall of the Zinc Commission in 1905. At that time Argall considered that the Province "had a better shoot of zinc ore than anything yet developed in the Cork," although in the latter property there was one good showing of zinc ore west of the lower crosscut between levels 1 and 3. This showing was subsequently developed as No. 3 ore-body of the Cork-Province mine.

In the years 1906 to 1913, inclusive, the two mines continued to be worked independently. In this period the underground workings of the two properties were connected and in 1907 arrangements were made whereby the Province mine could use the lower main adit and mill of the Cork mine. Most of the development of this period, however, was done on the Cork property, in the eastern section of which important discoveries had been made and several thousand tons of ore mined. There is no record of any zinc production and the number of changes in management and ownership suggest that no real success had yet been achieved in its operation.

Consolidation of the Cork-Province groups was effected in 1914. Development work was renewed in the following year. In 1918 a flotation plant was added to the mill in the hopes of securing a better lead and also a zinc concentrate. The developments of this period were not, however, very satisfactory and in 1920 the property closed down. Operations were renewed in 1922 and a shaft was sunk to explore a lower level. These explorations proved that the ore-bodies continue to this depth and maintained their grade. Since this discovery production has been mainly from this lower or No. 4 level.

Production commenced in 1903 and shipments were made each year up to and including 1909. During this period nearly 16,000 tons of ore were mined, carrying an average of between 4 and 5 ounces in silver to the ton and 5 per cent lead. The next period of production extended from 1913 to 1919, during which time over 24,000 tons were shipped and averaged about 3 ounces in silver and over 4 per cent lead. The shipments of 1918 and 1919 contained 115,000 pounds of zinc. Production was resumed in 1923 and following years and included, to the end of 1926, nearly 18,000 tons carrying between 4 and 5 ounces of silver to the ton, over 5 per cent lead, and about 2½ per cent zinc. During 1929, the Cork-Province mill treated nearly 6,000 tons containing net recovered metals as follows: gold, 9 ounces; silver, over 20,000 ounces; lead, nearly 413,000 pounds; and zinc, over 518,000 pounds.

The workings of the Cork-Province mine lie entirely within Slocan sediments. The contact with the Nelson batholith lies 1,000 feet or so to the north of the mine on the opposite side of Keen creek. This contact plunges south and probably underlies the Cork-Province group at no great depth and the sediments in the vicinity of the mine are very considerably metamorphosed. The strata tend to dip away from the batholithic contact, thereby assuming a position almost at right angles to the general northwesterly trend. Their strike here varies from north 55 degrees east to nearly east and west and the dip is to the south at angles varying from 50 degrees to vertical and averaging 75 degrees. The sediments include a large proportion of argillaceous types mostly characterized by a greater or lesser amount of andalusite and commonly referred to as andalusite schists. Interbedded with these are some quartzitic beds and a number of crystalline limestone and other beds notably limy in composition. At the intersection of these limestone and limy strata by the main lode the principal ore-bodies have been developed. Consequently any information regarding the position or correlation of these beds is of prime importance. Unfortunately the paucity of outcrops and the irregularities in the attitudes of the sediments and variations in the sediments along their strike as indicated in the underground workings make correlation difficult.

The best available section of the sediments is along the No. 3 crosscut. This adit commences at an elevation of 3,293 feet, is 1,230 feet long, and runs south 28 degrees east or about at right angles to the main lode. The crosscut exposed five important beds of crystalline limestone with which are associated other, impure, limy strata. The first three beds are crossed in the interval extending from 200 to 320 feet from the portal and have an aggregate thickness of nearly 90 feet. The fourth bed lies between 505 and 530 feet from the portal and is intersected by a narrow lamprophyre dyke. The fifth bed lies between 1,030 and 1,055 feet from the portal, or between 100 and 125 feet south of the intersection of the crosscut and the main lode. Other comparatively narrow limestone beds were observed. It seems likely that the fifth bed extends west to the ore-body west of the crosscut. It is less certain with which limestone beds the ore-bodies east of this crosscut are related because of irregularities in strike, the prevalence of faulting, and the varying width of individual beds. It appears probable, however, that the zone including the three limestone beds intersected by the adit between 200 and 320 feet from the portal crosses the main workings

east of the adit in the vicinity of the east end of No. 4 level and the ore-bodies developed there and in the upper levels. If this is so, then the fourth limestone bed crossed by the adit is probably represented at the ore-body lying farther west.

A bed of crystalline limestone is exposed in the bed of Ben Hur creek about 1,000 feet east of the portal of the crosscut adit. It has a width of about 60 feet and may be the same limestone bed as that encountered near the eastern end of No. 3 drift.

A much thicker bed of crystalline limestone is exposed farther up Ben Hur creek, 800 feet vertically above the road and about 1,400 feet from the portal of the Province adit. This bed is at least 100 feet wide and, where observed, stands vertically and strikes west-northwest. If continuous to the northwest it should meet Cork-Province lode somewhere on the Dublin claim. The size of this bed renders it particularly worthy of exploration at those points where it is intersected by the main and Dublin vein-lode on this property.

The ore-bodies of the Cork-Province mine have been formed along a well-defined lode, designated the "main vein," that strikes about north 50 degrees east and dips southeast at an average angle of 65 degrees. This lode is a fault-fissure zone cutting obliquely across sedimentary beds of the Slocan series.

The ore-bodies in each case have their most pronounced development where this lode intersects beds of crystalline limestone or other notably limy strata. This characteristic has long been recognized and has had a considerable bearing on the course of exploratory and other work. The lode, however, follows the course of a fault and, consequently, the limestone beds are displaced, the hanging-wall section of the lode being offset, relatively to the foot-wall, about 80 feet to the west. The apparent displacement varies somewhat from one limestone bed to another, due to complications set up by numerous other faults of minor throw which angle across or run parallel with the main lode.

The shape of the ore-bodies and extent of ore deposition appear also to have been influenced by cross-fracturing running mostly in an east direction. These cross-fractures run either from wall to wall of the main lode or connect this lode with nearby faults. They have both directed and facilitated the upward course of ore-bearing solutions originating from the neighbouring batholithic intrusives. Where these solutions have come in contact with limestone or other limy strata they have effected an important replacement of these rocks for distances in places as great as 100 feet or more from the walls of the main lode, the distance being largely determined by the extent of cross-fracturing involving the limy beds.

Important ore-bodies have been discovered in three principal sections of the Cork-Province mine—two to the east and one to the west of No. 3 crosscut. The most extensively mineralized section falls on either side of the boundary between the Cork and Province claims and affords the principal reason for the consolidation of the Cork and Province properties. A number of limestone beds some 30 feet or more in thickness are included in this section within a zone 100 feet or more wide. This zone appears to correspond to that including the first three limestone beds encountered in

No. 3 crosscut. Important ore-bodies, Nos. 1 and B, have been found in this section and a large production recorded from them. B ore-body has not been investigated below No. 3 level where it appears small and is composed chiefly of spathic iron carrying a little blende and less galena. No. 1 ore-body, however, has been stoped to No. 4 level where exceptionally good ore has been discovered and was being sunk on at the time visited.[1]

These two ore-bodies are particularly important in that they indicate the distance from the main lode at which important mineralization may occur when the necessary limestone beds and cross-fractures are present. No. 1 ore-body has also proved to carry equally good or better values at No. 4 level than higher up and has consequently encouraged exploration and development below this level.

No. 2 ore-body lies midway between No. 3 crosscut and No. 1 ore-body and has produced considerable ore between Nos. 4 and 2 levels. In 1927 a stope at the east end of this ore-body above No. 4 level showed between 2 and 3 feet of interbanded zinc blende and siderite and was referred to as the zinc stope. Quite a lot of stoping has also been done above No. 3 level between this ore-body and No. 3 crosscut, but the vein matter found in this section is bunchy, carries a lot of iron pyrites, and is rather low grade.

West of No. 3 crosscut connexions have now been made between Nos. 3 and 4 levels below No. 3 ore-body, whose continuation to the lower level was proved. At No. 4 level the ore is low grade and though showing a width of several feet was composed chiefly of siderite associated with quite a high proportion of pyrite. This was the first ore-body developed on the property, an important chimney-shaped shoot of zinc ore extending from No. 3 to above No. 2 level.[2] During the winter of 1925-26, twenty-eight cars (about 1,120 tons) of crude ore were mined from this No. 3 ore shoot and netted from $12 to $15 a ton.

The ore at the Cork-Province mine consists of an intimate mixture of zinc blende and galena with minor proportions of pyrite and chalcopyrite in a gangue composed largely of siderite but including varying amounts of quartz and calcite associated with altered wall-rock.

When last visited (1927) work was being confined chiefly to the vicinity of No. 4 level. Ore was being extracted from the "Zinc stope" above No. 4 on the easterly extension of No. 2 ore-body. Near the east face of this level a shallow winze had been sunk on a width of from 3 to 4 feet of lead-zinc ore carrying better values than most of the ore found at higher levels.

In addition to the main lode there are two others on this property, one of which at least appears to be worthy of early consideration. This is the "Superior" or "Dublin" lode which outcrops on the Dublin claim some 1,900 feet south and 900 feet vertically above the portal of the No. 3 cross-

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[1] Since visiting the property in 1927 the writer has been informed that the shaft commenced on the No. 1 ore-body below No. 4 level has been continued and that as much as 5 feet of nearly solid galena was encountered 125 feet below the level. The vein matter at this new or No. 5 level included over 20 feet of siderite carrying disseminated galena and blende.

[2] Zinc Commission—4 feet solid zinc sampled—ran 6·7 ounces Ag; 13·7 per cent Pb; and 28·5 per cent Zn.

cut. A shaft and crosscut, 200 feet below, with short drifts in either direction, have opened up the lode. These workings are caved. They are credited with a small production in early days. The projection of No. 3 crosscut for an additional 300 feet or so should encounter this lode whose exploration at the intersection of limestone beds might be worth while.

A third lode, of doubtful importance, was encountered in No. 3 crosscut 200 feet north of the main drifts and a few feet of exploratory work was done on either side of the crosscut without revealing noteworthy mineralization.

Above No. 2 level most of the ore previously developed had been worked out, nor did it appear that anywhere in the mine had any important reserve been blocked out. On the other hand, and although the richer portions of the ore-bodies between levels 2 and 4 have been depleted, there still appeared to be possibilities in this section in the way not only of high-grade material but also of low grade, which a more efficient system of mining and milling might make pay. Stoping and crosscutting in the vicinity of No. 1 ore-body have opened up that section of the mine to easy exploration of the limestone bands, whose intersections with cross-fractures or with the main lode itself have not been thoroughly explored. Recent work below No. 4 level has been encouraging as indicating the strength and high-grade character of mineralization at these greater depths. Such discoveries should encourage prospecting the main lode at the extreme east end of No. 3 level where limestone is known to occur, and also investigating other parallel lodes where these may be expected to cross important limestone beds. In the meantime efforts might well be concentrated on blocking out a sufficient tonnage below No. 4 level where good ore has been discovered.

CORRIGAN GROUP

The Corrigan group consists of the Morning Star No. 2 claim and Rio fraction, Gladstone, Boon, Winona, Albatross, and Ada fractions, all Crown-granted, and the Custer fraction and Tarbolten, Maybole, and Craigie claims held by location. The group belongs to the estate of the late Phil Corrigan, % W. J. Corrigan, 552 West 52nd street, Chicago, and A. Shilland, New Denver, B.C. It extends from the lower west slopes of Jackson Creek valley westerly across the summit of the divide between Jackson and McGuigan creeks. The Crown-granted portion of the group, except for the Morning Star No. 2 claim, lies to the south and west of and adjoins the Jackson group and extends into the basin of McGuigan creek where it adjoins and lies south of the Dardanelles group. The non-Crown-granted claims of the Corrigan group and the Morning Star No. 2 Crown-granted claim are entirely on the Jackson slope to the north of and adjoining the Jackson group.

There are no extensive workings on the Corrigan group. A number of vein exposures have been explored by open-cuts, short adits, and shafts which aggregate several hundred feet of underground work. A considerable proportion of the work has been done on the claims held by location and which originally formed part of the New Era group operated by a French company. The Craigie claim was then known as the "Florida." The New Era group was subsequently restaked as the Custer-

T.P. group. The T.P. claim of this group covered the same ground as the Florida and recently has been re-named the Craigie. No information is available as to the quantity or grade of shipments made from the Custer and Craigie claims. Operations on the Winona and Boon fractions in 1902 and again in 1917 and 1918 have, it is stated, yielded three shipments of silver-lead ore collectively valued at between $5,000 and $6,000.

The group of claims is underlain by Slocan sediments which have a general strike of north 30 to 40 degrees west, but dip in part northeast and in part southwest. Along the northeastern flank of the group and again about midway between Jackson creek and the summit of the divide are belts of comparatively massive quartzitic and argillaceous rocks. Elsewhere the sediments are chiefly slaty, fissile, or thinly banded types interbedded with some limy and quartzitic strata. The whole is penetrated by a great number of quartz porphyry dykes. These are abundant where they intersect a belt of slaty rocks that strikes northwesterly through the Winona and Boon fractions along the precipitous slopes flanking the high summit of Reco mountain on the northeast.

Owing to marked irregularity in the strike and dip of the vein-lodes, the limited amount of work done on them, and their widely scattered positions, a satisfactory correlation is difficult. The Jackson lode on the adjoining Jackson group appears to continue on its westerly to northwesterly strike into the Craigie and Custer claims of the Corrigan group. Two crosscut tunnels 35 feet apart vertically and only a short distance west of the upper workings of the Jackson mine, were driven to this lode where it strikes south 35 to 40 degrees east and dips southwest at 60 degrees. Some stoping on the lode has been done just southeast of the crosscut on the lower level and on either side of the crosscut in the upper tunnel. The country rock is mostly blocky carbonaceous argillite intersected by one or more dykes of porphyry. In the upper adit a cross-fissure striking about south 65 degrees east and dipping steeply northeast was encountered a short distance southeast of the crosscut. Its intersection with the main lode is also exposed at the surface where, in tracing the cross-fissure to the southeast, some steel galena was discovered where the fissure intersects a porphyry dyke. Underground, a drift on this fissure was extended to get into this porphyry and has barely reached it without yet exploring the course of the fissure through it. Up the hill to the west another fissure is exposed in two open-cuts about 250 and 350 feet respectively above the upper tunnel. A short crosscut had also been driven just below the upper open-cut to tap this fissure, but had not reached its objective. Very little vein matter was noted in these small workings. Still farther up the hill and 100 feet vertically above the short crosscut is the old New Era shaft on the Custer claim 16 feet from the Dublin Queen claim line. Here the shaft, which is 16 feet deep, follows a lode that strikes south 70 degrees west and dips steeply southeast. This lode is well defined, has a hanging-wall of much altered, greenish, basic dyke rock and carries some fine-grained galena. To the southwest of the New Era shaft the lode is possibly continuous with one or other of two closely parallel lodes crossing a tributary of Jackson creek near the Dublin Queen-Winona boundary. Of these the southeasterly, known as the "Dublin Queen vein," crosses the creek at about 6,750 feet elevation and

is referred to in discussing the Jackson group. The other lode crosses the creek more than 100 feet higher up, near the Winona-Boon cabin, has a general strike of north 65 degrees east, dips steeply to the southeast, and is developed in this vicinity by two adits. The lode contains a vein composed largely of galena. It varies from 2 to 8 inches in thickness and follows a line of jointing in the enclosing argillites. Some faulting was encountered in these workings and towards the face of the upper tunnel the lode appears to swing with the bedding along a strike of north 40 degrees west. In this direction the lode matter was mostly calcite and crushed country rock with a little pyrite. Some 11 tons of ore has been shipped from these workings since 1916. It was stated to carry 58 per cent lead and 168 ounces of silver to the ton.

About 200 feet above these workings and near the south boundary of the Winona claim is a short adit along a small fracture carrying a little vein mineralization. This fracture strikes north 65 degrees east, dips southeast, and seems to line up with the Dublin Queen lode farther down the hill.

Over 500 feet higher up the hill is the Boon tunnel driven on a fissure that strikes nearly east with the country rocks which here include an intimate association of slaty argillites with numerous dykes and sills of quartz porphyry. Occasional lenses of limestone were observed. A narrow stringer of clean lead ore was found in the fissure near the portal of the adit, but farther in the chief ore mineral is zinc blende and the fissure widens out to include considerable brecciated porphyry. This vein-fissure crosses the ridge about 300 feet above the Boon tunnel and has been explored by open-cuts. It was claimed that 3 tons of ore had been shipped from this "Boon" vein. The galena ore carries much silver, attributable in part to associated high-grade silver minerals such as grey copper, ruby silver, etc.

CROCUS CLAIM

The Crocus claim, property of Mrs. Daniel Cosgriff and associates, Kaslo, is south of and about 500 feet above Keen creek, a short distance from Zwicky. The rocks here are limestone, limy sediments, and argillaceous beds of the Slocan series striking about north and standing nearly vertical or at high angles to the east.

Three short adits and some open-cuts explore an irregular lode carrying lenses of quartz in which copper carbonate stains and a little grey copper may be distinguished. It is reported that some ore has been taken out, but there is no record of the content.

CROWN POINT AND KOOTENAY BELLE CLAIMS

These adjoining claims extend across Twelvemile creek, are 1,000 feet by trail from Kaslo creek, and are near Keen station. They are owned by H. H. Armstead, % Utica Mines, Limited, Vancouver, B.C.

The claims are underlain by Slocan strata including limestone, limy quartzites, platy argillites, and slaty rocks, the whole striking about north 35 degrees west and dipping 70 degrees southwest.

On the Kootenay Belle claim, lying mostly east of the creek, high rock bluffs come down to the water's edge and farther upstream from the work-

ings form a deep canyon. The workings comprise one branching adit and open-cuts above. The adit includes 285 feet of lineal work and explores two small fissures, one coinciding with the bedding of the enclosing rocks and the other cutting across the sediments on a strike of north 82 degrees east and a dip of 50 degrees south. A little vein quartz follows both fissures and is most abundant at their intersection. Very little mineralization was observed at this level, but in an outcrop 20 feet above a little galena is disseminated across a width of 1½ to 2 feet of vein matter, and 25 feet higher some oxidized ledge matter carrying galena and spathic iron replaces limy quartzite along the bedding planes.

Work on the Crown Point claim on the other side of the creek includes one adit 125 feet long and possibly another adit 30 feet higher up. This work shows no mineralization.

CUBA GROUP

The Cuba No. 2 and Boston Crown-granted claims, owned by P. J. Keogan and A. Looby, Kaslo, B.C., are about half a mile north of the mouth of Schroeder creek and 350 feet above the west shore of Kootenay lake.

A 60-foot shaft and a 140-foot adit, driven from a point 70 feet below the collar of the shaft, explore a vein striking north 55 degrees east and dipping 45 degrees southeast. This vein crosses a wide belt of crystalline limestone that strikes north 40 degrees west and dips 50 degrees southwest. In the shaft the vein varies from 6 inches to 2 feet in width, and is composed of quartz carrying much disseminated galena, zinc blende, and pyrite. At the adit level the vein has narrowed to about 2 inches of quartz carrying galena and zinc blende. It was drifted on for 30 feet, to a fault beyond which the vein has not been picked up.

In 1926 about 5 tons of ore from the shaft was ready for shipment. No previous production is recorded.

DOHERTY AND IRON DUKE CLAIMS

Reference: Ann. Rept., Minister of Mines, B.C., 1898, p. 1080.

The Doherty and Iron Duke Crown-granted claims are situated on opposite sides of the mouth of Lyle creek, between Blaylock and Retallack stations. The Doherty claim, to the east of Lyle creek, is owned by Geo. McCready and A. T. Garland, Kaslo, and the Iron Duke claim by R. D. Winstead, 228 Munsey Building, Washington.

On the Iron Duke an iron capping along the face of a limestone bluff marks the course of a mineralized shear zone that is 5 to 6 feet wide and follows the bedding of a wide limestone bed striking north 60 degrees west and dipping 50 degrees southwest. This zone lies near or at the top of the limestone bed and is mineralized by abundant pyrite associated with a little galena in a gangue of crushed rock, calcite, and siderite. Post-mineral movements have, in places, given a very fine natural polish to this material. Workings include two short adits and considerable surface work. Some shipments are said to have been made, but no records are available.

On the Doherty claim two adits, partly inaccessible, have explored calcite veins, carrying a little galena, intersecting the same limestone bed as appears on the Iron Duke claim.

ECHO AND ALMEDA CLAIMS

Reference: Rept. of Zinc Commission, 1906, pp. 182-183.

The Echo and Almeda Crown-granted claims are in the upper basin of Jackson creek to the northeast of and adjoining the Bell-Sunset group. The property belongs to the Geo. Alexander interests of London, England, % Jas. Anderson, Stock Exchange Building, Vancouver, B.C.

In 1903 about 14 tons of silver-lead ore carrying about 120 ounces silver to the ton and 60 per cent lead was produced.

The workings include two shafts and eight adits, of which four are driven from Almeda and four from Echo ground. The adits are short and are now largely inaccessible as the property has been idle for many years.

The country rocks are chiefly slates and fractured, black argillites whose attitude is difficult to determine but is probably nearly north with easterly dips of from 50 degrees to vertical. The sediments are intersected by dykes and sill-like bodies of quartz porphyry which at places in the underground workings appear to have directed the concentration of ore minerals.

The principal Echo-Almeda lode (*See* Figure 13) has a strike of about north 20 degrees east and dips east at about 55 degrees. This lode was productive near the Echo-Almeda line where it underlies and cuts across tongues from a large sill-like body of quartz porphyry. The lode has been explored over a length of about 150 feet and a maximum depth of 175 feet. In the Almeda drift adit, driven southwest along the lode, the lode was first encountered about 20 feet from the portal beneath the porphyry sill and was followed southwestward for about 60 feet to a shaft from the surface on the Echo-Almeda line. This adit apparently extended for only a short distance south of the shaft to a fault, beyond which no attempt had been made to pick up the lode. Just south of the shaft stopes extend to the surface.

About 68 feet lower and 200 feet to the west of the portal of Almeda drift is the portal of the "Old Original" Echo adit running southeasterly along a fault fissure dipping 45 degrees southwest. The adit is about 400 feet long and at 250 feet from the portal a branch drift runs south 55 degrees west along a small slip for 118 feet to a point where the fissure swings to a south 20 degrees west direction. Here some vein matter was encountered, represented (1927) by about 4 inches of mixed blende, galena, and pyrite. At 15 feet south from the turn in the fracture a strong fault striking north 35 degrees west and dipping 50 degrees southwest was encountered and is nearly parallel with the fault fissure followed from the portal of the adit and which is, presumably, the fault encountered at the face of the Almeda drift adit above. No attempt was made to explore the continuation of the lode matter to the southwest of either of these faults.

Other workings on this property were inaccessible. What appeared to be the collar of an old shaft is 150 feet east and 50 feet higher than the portal of the upper Almeda adit. A short distance east of the shaft are what appear to be a series of stopes breaking through to the surface. The location of these features indicates work on a lode with an east to

southeast strike and a dip of about 45 degrees south. This lode may represent the faulted, eastern continuation of the fault fissure drifted on from the portals of both the "Old Original" adit and the Echo crosscut adit, the offset occurring along the line of the main, Echo-Almeda lode.

Nearly 500 feet north 15 degrees west from and over 300 feet below the collar of the old shaft, an adit 80 feet long has been driven easterly in fairly massive, black, argillaceous rocks in an effort, evidently, to locate the northern continuation of the lode followed by the upper Almeda adit. No mineralization has been encountered in this adit. Assuming an average strike of north 20 degrees east and a dip of 55 degrees for the lode, this lower crosscut would still be about 250 feet short of its objective.

According to earlier reports on this property, and in particular that of the Zinc Commission, the main, Echo-Almeda lode was also reached by two other adits. The portal of one of these, the upper Echo "crosscut" adit, is on Echo ground 25 feet lower and 120 feet southwest of the portal of Almeda drift. It was driven southeasterly, for 110 feet, along what is apparently the strong fault that has interrupted the southern continuation of the main lode. The latter was encountered at 110 feet from the portal and from it a drift was run northerly to the shaft, on the Echo-Almeda line, and for 20 feet or so beyond. The other adit, the main Almeda crosscut, is driven from a point 90 feet northwest of, and 150 feet lower than, the portal of the upper Almeda adit. It is a crosscut for 170 feet "and then follows the assumed course of the vein, without, however, having anything like mineral to follow, so at 60 feet the crosscutting was resumed and continued for a farther distance of 140 feet easterly, without, however, finding anything of value. Drifting was then resumed along the course of the vein and some mineral encountered from 110 to 140 feet south of the last described crosscut. The mineral occurs as two small lenses of siderite showing some zinc blende with a slight sprinkling of galena."[1]

It is unfortunate that so many of the workings were inaccessible at the time visited. The impressions left with the writer, however, were that the formation here being mostly of a slaty or broken character was hardly conducive to important mineralization; that if the principal lode, as seems probable, is the one followed in the main Echo crosscut tunnel the mineralization is evidently playing out rapidly with depth; that the good ore which was reported as occurring against the fault may have banked there as a consequence of the comparatively impenetrable layer of gouge accompanying this fault, and that consequently a continuation of the ore on the other side of the fault is not necessarily to be expected. The same consideration applies to the mineralization referred to as having been encountered in the "Old Original" adit.

EMERALD HILL GROUP

The Emerald Hill and Ray fraction Crown-granted claims are situated towards the head of Emerald creek, a northern tributary of Kaslo creek which it enters a short distance above Keen station. The Emerald

[1] Zinc Commission Rept., p. 183.

Hill claim is owned by J. A. Riddell, Kaslo, B.C. The other has reverted to the Crown.

The property is underlain by Kaslo greenstones intersected in the vicinity of the workings by granitic dykes.

The workings are on both sides of Emerald creek between elevations of 6,200 and 6,500 feet, or about 3,400 feet above the railway. They comprise two adits, one on each side of the creek, and considerable surface work. These workings are on a lode about 4 feet wide striking north 80 degrees east and dipping 65 degrees south. The lode is a crushed zone filled with fragments of rock cemented by rather coarsely crystallized, vuggy quartz carrying galena and grey copper and stained with copper carbonates.

A shipment of four tons was made from this property in 1907. This ore averaged 242 ounces in silver to the ton and 32 per cent lead. Several more tons were lying at the workings in 1926.

EUREKA GROUP

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 33.
Ann. Rept., Minister of Mines, B.C., 1898, pp. 1079-80.

The Eureka group of seven claims, held by location, is on the divide between Rossiter and Lyle creeks on either side of the northern boundary of the Sandon map-area. It is accessible by trail from either Blaylock or Retallack stations. The distance from Blaylock is about 4 miles. A three-fourths interest in the group is owned by the estate of J. C. Ryan, 612 Columbia Building, Spokane, Wash.

This property was productive in the nineties when it is reported that several carloads of ore were shipped. The ore shipped in 1893 was stated to assay 125 ounces in silver to the ton and 77 per cent lead.

The property is underlain by Kaslo greenstones and allied basic intrusives cut by quartz porphyry and other granitic dykes.

The workings range from about 6,500 to 7,750 feet above sea-level and are mostly above timber-line. In addition to surface prospecting they include four adits, of which only the main upper crosscut at elevation 7,500 feet was accessible in 1925. The crosscut is 198 feet long to where it enters a lode striking north 45 degrees east and dipping 70 degrees northwest. From the end of the crosscut a drift runs 63 feet southwest and a second about 800 feet northeast. Considerable stoping has been done above the northeast level over an aggregate length of about 160 feet. Most of this has been done within 220 feet of the crosscut. From a point on the northeast drift about 400 feet from the crosscut a raise extends to the surface. A winze has been sunk an unknown distance from a point 135 feet northeast of the crosscut. About 375 feet from the crosscut a cross-fissure from the north was encountered and has been drifted on for 85 feet without, however, revealing any mineralization.

The lode in the northeast drift is narrow but persistent. It contains very little visible ore minerals, though at one point near the raise a stringer of coarse cube galena about 1 inch wide was observed. Several sacks of ore were stacked near the portal of the adit. This ore is largely oxidized material carrying some galena.

Above this crosscut adit is a short drift adit, now caved, at or near the portal of which are specimens of oxidized vein matter consisting of vuggy quartz and some galena. About 250 feet above the crosscut adit is the summit of the divide where a fissure was observed striking northerly down the precipitous slope leading into Lyle creek. It holds very little mineralization and could not be correlated with certainty with either the main lode or branch fissure in the crosscut adit.

About 700 feet below the summit, to the southwest of the upper workings, is the portal of a caved adit which is reported to be a drift on the main lode for 1,600 feet. At 475 feet lower down another adit, caved 70 feet from the portal, but stated to be 700 feet long, was started as a crosscut to tap the lode followed in the 1,600-foot adit. It follows a shear striking nearly north and dipping 68 degrees west.

FLINT

References: Ann. Repts., Minister of Mines, B.C., 1906, p. 143; 1911, p. 132; 1916, p. 196; 1917, p. 157.

The Flint mine property, held by location, % J. A. Carter, Kaslo, B.C., is at the head of Dago creek, a northwestern tributary of Keen creek which it enters a short distance below the Cork-Province mine. The property is accessible by road up Keen creek from Zwicky and by trail up Dago creek.

The property was staked in 1898. In 1926 and 1927 it was operated under lease. The first recorded production was in 1905 when a shipment of 12 tons yielded 85 ounces in silver to the ton and 31 per cent lead. Aggregate production to the end of 1917 was 317 tons, of which the returns on shipments of 150 tons in 1909 are not available. The remainder averaged 66 ounces in silver to the ton and 40 per cent lead.

The underlying rock is coarse-grained, porphyritic Nelson granite. This is intersected on the Flint property by two mineralized shear zones known as the Flint and Granite King lodes, of which the first only is explored at the Flint mine. The Flint lode follows a direction of principal jointing on a strike of about north 10 degrees east and dips westerly at from 60 degrees to vertical.

The Flint lode has been opened up by three crosscut adits driven westerly. The lowermost adit reaches the lode at 220 feet from the portal and has been extended past the lode for 235 feet and at the face is supposed to be within 50 feet or so of the Granite King lode (*See* account of the Granite King group). No. 2 crosscut adit portal lies about 150 feet southwest of, and about 80 feet above, the portal of the lowest adit and the portal of the uppermost or No. 1 adit is 150 feet above and 500 feet southwest of the portal of the lowest adit. No. 2 adit reaches the lode at 50 feet and No. 1 crosscut is about 100 feet long (according to a plan of the mine workings). At each adit level drifts have been run southerly along the lode for distances of 600, 280, and 60 feet at levels 3, 2, and 1, respectively. From near the face of the 600-foot drift a raise extends to the surface.

The Flint lode varies in thickness from a few inches to over 11 feet. The filling is crushed granite, gouge, quartz, siderite, and ore minerals. The principal ore-body formed a composite shoot, containing lean or

barren portions, extending from the surface to the lowest crosscut level. It had a maximum length of at least 150 feet on the intermediate level, and was stoped above the level to a height of from 25 to 35 feet. Most of the richer portions of this shoot have been stoped out. A paystreak in this ore-body varied from an inch to over 3 feet thick and provided lenses and bunches of galena on the hanging-wall side and also some clean blende. In places, the paystreak occurred along the foot-wall. On the lower crosscut level vein matter occurs in long lenses in the lode and is both banded and massive. Banded structures were particularly pronounced in the upper levels, the associated minerals including siderite, quartz, fine cube galena, zinc blende, and pyrite. A little tourmaline was noted in places in the quartz.

FOURTH OF JULY CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 264.

The Fourth of July Crown-granted claim, property of the Columbia Mining Company, % Pemberton and Son, Victoria, B.C., is situated near the head of Robb creek to the south of and adjoining the Texas-Cowboy group. It is accessible by trail up Robb creek from Blaylock.

The workings lie at an elevation of about 5,750 feet. They comprise a shaft, a crosscut adit, and a winze, giving a total depth of about 100 feet. The workings develop a mineralized fissure zone conforming closely with the bedding of limy sediments of the Slocan series, intruded nearby by a large, dyke-like body of granodiorite porphyry. The fissure strikes north 40 degrees west and dips at an angle of about 70 degrees northeast. At the surface the lode is several feet wide, is oxidized, and consists of quartz and siderite with some galena and pyrite. The crosscut starts in granodiorite and runs south-southwest for 150 feet. At about midway of the length, the granodiorite contact is crossed. From the end of the crosscut drifts run east and west along the lode. The east drift is a few feet long, the west drift about 200 feet long. In the drifts the lode averages about 4 feet in width and is composed of crushed rock containing disseminated ore and gangue minerals. Some galena ore carrying considerable pyrite and a little brownish zinc blende was obtained from a winze below this level. Quartz and spathic iron are both fairly abundant.

GIBSON (DAYBREAK) GROUP

References: Ann. Repts., Minister of Mines, B.C., 1917, p. 186; 1926, pp. 260-261; 1927, p. 286; and other years.

The Gibson group, including Butte and Wintrip Crown-granted claims, is owned by the Daybreak Mining Company of Portland, Oregon. It is on the eastern side of the valley of Klawala creek, an eastern tributary of Keen creek. The workings lie between elevations of 5,100 and 5,500 feet. The property is accessible by road for 6½ miles from Zwicky and then by trail up Klawala creek. A tramway, 5,081 feet long, connects the mine workings with the road up Keen creek.

The property is in a belt of Slocan sediments about 2,000 feet wide and striking northeasterly. The belt of sediments is intruded on both

sides by granitic rocks of Nelson batholith. In the vicinity of the mine workings abundant limestones and other calcareous rocks are interbedded with more argillaceous and quartzitic beds, some of which are quite carbonaceous. The average dip is about 75 degrees to the northwest.

The first shipment from the Gibson group is recorded in 1895 when 14 tons averaged 73 ounces in silver to the ton and 78 per cent lead. Shipments were also made in 1897, but no records of the amount or character of the ore are available. A further small shipment of silver-lead ore was made in 1926. From 1926 to 1928 mining was carried on more energetically, mostly on No. 1 level, and comparatively large shipments of silver-lead-zinc ore, amounting altogether to 538 tons, were made.

Six or seven adits have explored two nearly parallel lodes, known as "A" and "B" lodes. They are about 300 feet apart and conform very nearly with the strike and dip of the enclosing rocks. The "A" lode is a mineralized, sheared, and brecciated zone several feet wide, filled chiefly with broken rock but carrying in places disseminated blende, galena, and pyrite associated with spathic iron and a little quartz. Locally the ore minerals are sufficiently concentrated to provide pay ore.

The lode is encountered at 160 feet from the portal of the lowest, No. 1, crosscut adit and is drifted on northeasterly for 500 feet. Near the crosscut the lode is conspicuously mineralized with zinc blende, spathic iron, pyrite, and a little disseminated galena and would probably provide ore of milling grade. The drift is not thought to be extended far enough to get under a second shoot of similar ore encountered in No. 3 level 185 feet above.

The B lode was intersected at 469 feet from the portal of No. 1 crosscut adit and has been drifted on for 1,300 feet to the northeast of the crosscut. Its average width in this drift is less than that of A lode. Considerable mineralization has been found in places along this drift and a little stoping done. The ore contains more galena than that in A lode and consists in part of solid cube and banded galena and in part of mixed galena and zinc blende with pyrite and a little chalcopyrite in a gangue of spathic iron and partly replaced wall-rock. The walls show much slickensiding and carbonaceous matter. The B lode is drifted on in No. 6 adit, 400 feet above No. 1, and there it is 4 to 5 feet wide and composed of crushed rock and gouge with streaks and disseminations of vein matter.

A third or "C" lode, not yet explored, outcrops between 800 and 900 feet above the lowest adit. It is parallel to the others and outcrops about 250 feet southeast of the B lode.

The mineralization seems to be largely a replacement of the wall-rocks and is more pronounced where the rocks are most calcareous. The boundaries of the ore-bodies are for this reason not well defined but are limited rather by the grade of vein materials which will pay to mine.

In view of the limy character of much of the sediments, the width and persistence of the shear zones developed in them, the abundant evidence of mineralization, and the favourable geological relations of the sediments with the nearby batholithic intrusives, the belt of sediments within which this property is located seems particularly worthy of exploration.

GLUEPOT CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1922, pp. 191-192.

The Gluepot Crown-granted claim is on the southwestern slope of the valley of Long creek, a northwestern tributary of Keen creek. It is accessible from Zwicky by road up Keen creek for 7 miles to a point opposite the mouth of Long creek, from which point a trail 2½ miles long leads to the property. The claim is owned by Mary McAndrew, J. Strachan, and J. D. Moore, Kaslo, B.C.

The workings lie at an elevation of about 5,800 feet. An adit 180 feet long has been driven along a shear zone in coarse-grained Nelson diorite. The zone is about 4 feet wide. It strikes north 55 degrees east, dips 70 degrees northwest, and contains a quartz vein averaging less than 6 inches in width. The quartz carries pyrite and a little disseminated silver-bearing mineral, probably grey copper. A lamprophyre dyke a few inches wide follows the hanging-wall of the shear zone, and above it is a fine-grained, acid dyke. A number of small open-cuts demonstrate the continuity of the lode for at least several hundred feet.

GOLD CURE GROUP

The Gold Cure group, comprising Gold Cure, Gold Cure fraction, Crown Point, and Full Rig Crown-granted claims and a fraction, is situated on the divide between Briggs and Klawala creeks, southeastern tributaries of Keen creek. The property is owned by Marsh Mines Development Company, % O. W. Hoffman, Sunnyside, Wash. It is accessible from Zwicky by road up Keen creek to within a mile of Briggs creek, from which point a trail about 2 miles long leads to the workings, 3,000 feet above.

The property lies between the Gibson (Daybreak) and Bismark groups, within the same belt of Slocan sediments and possibly also on the same lode system as on these other properties.

The only shipments credited to this group were made in 1909 and amounted to 20 tons of silver-lead ore averaging about 100 ounces in silver to the ton and 50 per cent lead.

GRANITE KING GROUP

The Granite King and Gray Eagle Crown-granted claims are owned by Geo. B. MacDonald *et al.*, % MacDonald, Craig, Tarr Armstrong, and E. Hughes, 283 Portage Avenue, Winnipeg. They are situated southwest of the headwaters of Dago creek and lie southwest of and adjoin the Flint property. The property is underlain by coarse-grained porphyritic Nelson granite.

Some work has been done on both claims, including one, perhaps two, adits on the Gray Eagle and one on the Granite King. The adits are about 1,350 feet apart horizontally and explore a fault-fissure lode striking north 40 to 50 degrees east and dipping about 60 degrees northwest. The adit on the Gray Eagle claim is about 400 feet long and follows on the lode which varies from a few inches to 2 feet in width and is composed

mainly of gouge and broken rock. A little quartz and a sparse dissemination of ore minerals were noted. Some specimens from the dump contain galena, zinc blende, and pyrite in a gangue of siderite and quartz. The pyrite and siderite are partly oxidized. Native silver in wire and flaky form is reported to occur in small amounts. A crosscut from the lower Flint adit has been driven part way to this lode and should intersect it at a distance of about 325 feet west of the Flint vein and about 300 feet below the lower Gray Eagle adit.

Another lode on the Gray Eagle claim strikes north 41 degrees east and is vertical. It is a mineralized fault fissure in the granitic rocks, is 13 inches wide, and lies 15 feet east of the main lode.

On the Granite King claim, about 450 feet above and 1,350 feet southwest of the lower Gray Eagle tunnel, an adit has been driven for 75 feet along the main lode which strikes south 40 degrees west and dips about 55 degrees northwest. At the face of the adit the zone is about 2½ feet wide and carries small streaks and lenses of ore minerals along both foot- and hanging-wall. The lode as a whole is filled with broken rock and gouge, partly cemented by vein minerals, chiefly quartz. The ore minerals include blende, pyrite, and galena. Open-cuts above this adit show more encouraging mineralization. At one exposure the lode has a width of 20 inches, including one paystreak of galena 4 inches wide along the hanging-wall, another streak 2 inches wide on the foot-wall, and considerable vein quartz carrying disseminated galena. Blende and pyrite are common associated ore minerals.

GRINGO CLAIM

The Gringo Crown-granted claim owned by W. J. Twiss, 402 Pender Street West, Vancouver, B.C., lies high on the hillside southeast of Bear lake. It includes a part of the southeastern extension of the thick limestone bed at the Lucky Jim mine. A little work, including a shaft and open-cuts, was done years ago on a narrow vein or on veins composed of quartz and galena and occurring in slaty rocks underlying this limestone bed. Further exploration should endeavour to trace the vein-bearing fissures to where they intersect the limestone.

HARP GROUP

References: Bancroft, M. F.: Geol. Surv., Canada, Sum. Rept. 1917, pt. B, p. 30.
Ann. Rept., Minister of Mines, B.C., 1918, p. 161.

The Harp group of three claims, held by location, is the property of W. J. Murphy of Kaslo. It lies less than a mile east of, and about 350 feet above, Zwicky. Some work has been done on a series of quartz veins striking northwest to north and dipping steeply to the west. The veins occur in sedimentary rocks or along contacts of sediments with greenstone schist and consist of vitreous to smoky quartz containing considerable sericite and mineralized with pyrrhotite, pyrite, and chalcopyrite. One vein exposed at an elevation of 2,630 feet is 3 to 4 feet wide and has been explored by an open-cut and a short adit for about 35 feet. It consists of vitreous, smoky quartz carrying pyrrhotite, pyrite, and chalcopyrite. The hanging-wall rock is banded quartzitic argillite, very similar to that occurring on the Manganese No. 4 claim of the Manganese group (*See*

report). A thin section of this rock, studied microscopically, revealed a mosaic chiefly of quartz and a manganiferous garnet, the latter partly altered to oxide of manganese. The foot-wall rock is mostly a greenish schist forming a band about 2 feet wide underlain by sediments. Immediately beneath the quartz vein, however, is a close succession of narrow lenses of pink, rhodonite-bearing rock which, at one time, may have formed a nearly continuous band varying from an inch or 2 to 18 inches wide. Under the microscope the rhodonite-bearing rock much resembles a siliceous limestone and is composed of quartz, calcite, a little garnet, considerable pyrolusite, and abundant rhodonite. The latter occurs in masses, streaks, and disseminations through the rock, in places reaching a width of several inches. A considerable amount of float of similar rhodonite-bearing rock has been found at a number of points along the slope of the hill to the north of this property. Mr. A. J. Curle of Kaslo, B.C., reports that an analysis of a specimen of this rhodonite gave 27·43 per cent manganese, whereas theoretically pure rhodonite would carry 42 per cent. A specimen examined by E. Poitevin of the Geological Survey was reported by him as "calciferous rhodonite, that is, impure rhodonite, due to the presence of calcium and iron carbonate." These blocks of float are commonly partly coated with manganese oxide and some specimens carry a little pyrolusite smeared along fracture planes in the rock. Aside from the abundant rhodonite, the float boulders and the specimens from the Harp group much resemble a siliceous limestone forming part of a thick band of limestone near the base of the Milford group and conspicuously exposed in bluffs above the railway and highway about 2 miles southeast of Zwicky. The same limestone band is believed to extend through the Harp group a short distance above the workings, where outcrops of limestone were noticed, and may also form part of the tongue of Milford rocks exposed on Manganese No. 4 claim of the Manganese group. In places this limestone carries considerable graphite and a few, scattered, small, pinkish, fine-grained masses of a mineral, either rhodonite or rhodochrosite. The inference from such associations and resemblances is that the rhodonite on the Harp group is secondary after some primary manganese mineral, probably rhodochrosite, deposited as a carbonate during the formation of these siliceous limestones and subsequently, by metamorphism, converted to rhodonite and, to a lesser degree, manganese-bearing garnet.

HECLA AND SUMMIT CLAIMS

The Hecla and Summit Crown-granted claims are near the summit of the high ridge at the head of Beaver creek and southwest of mount Jardine. They have reverted to the Crown.

The claims are underlain by greenstones and tuffaceous sediments of the Kaslo series. About 500 feet below the top of mount Jardine, a narrow, vein-bearing fissure intersects tuffaceous sediments on a strike of about north 28 degrees east and a vertical dip and was traced for 100 feet or so vertically, up the hill. The fissure is occupied by a vein composed of crystalline quartz, associated with a little ferruginous carbonate partly altered to limonite, and cube galena. The vein varies from an inch or two to several inches wide, the galena occurring in short, nearly pure streaks as much as 4 inches in width.

HELEN GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1919, pp. 121-122.

This property consists of the Helen and Highland claims, held by location, and owned by W. English and J. English of Kaslo. It lies southeast of, and about 2,600 feet above, Blaylock, from which it may be reached by a trail, about 3 miles long. The workings comprise two adits, 100 feet apart vertically, and a shaft, and are in a body of porphyritic granite that forms a stock-like apophysis of the Nelson batholith and intersects Slocan sediments. The upper adit encounters a mineralized shear zone about 3 feet wide striking north 70 degrees west and dipping 45 degrees southwest. A little stoping has been done on this lode and a raise projected to the surface. Very little ore mineralization was observed, but specimens of clean gneissic galena were noted on the dump and probably came from small pockets within the lode which is otherwise mostly composed of crushed wall-rock. The lower adit intersects the same lode at 35 feet from the portal, where it is composed of from 3 to 4 feet of crushed rock with 6 inches of gouge on the hanging-wall. A drift to the northwest is badly caved. The shaft, 15 feet south of the portal of the upper adit, is inaccessible.

In 1915 a shipment of 6 tons of ore is recorded to have averaged 178 ounces in silver to the ton and 61 per cent lead.

HILLSIDE GROUP

The Hillside group, consisting of the Hillside, Galt, and Last Chance Crown-granted claims, is situated southwest of and a few hundred feet above the railway at Retallack and is accessible by the road up Jackson creek. It has reverted to the Crown.

The property is underlain by slaty and calcareous Slocan sediments penetrated by a small granodiorite stock and by a few dykes of quartz porphyry.

Three short adits aggregating about 600 feet in length explore a vein-lode striking northeasterly and dipping southeast. Shipments amounting to about 2½ tons were made in 1900. The ore is stated to have carried 191 ounces in silver to the ton, 29·7 per cent lead, and 21·5 per cent zinc. So far as is known no work has been done since 1900.

INDEX AND METROPOLITAN

References: Ann. Rept., Minister of Mines, B.C., 1919, p. 121; and other years.

The Index mine property, held by location, is owned by (?) Frank Helme, Kaslo, B.C. It is in the valley of Keen creek and is accessible by road, 14½ miles from Kaslo. The property was bonded in 1919 to the Index Mining Company of Spokane. The southeastern contact of a belt of Slocan sediments with coarse-grained granitic intrusives of the Nelson batholith passes through the property. The sediments consist of limy and quartzitic argillites, most of which are considerably fractured and sheared, and are cut by several dykes and sills of feldspar porphyry. They strike from north to north 40 degrees east and dip about 70 degrees southwest.

The Index workings lie on both sides of the road up Keen creek and comprise three adits aggregating about 1,300 feet of lineal work. The upper two explore a mineralized crush zone striking about north 55 degrees west and dipping steeply, in part irregularly, to the southwest and in part to the northeast. The lode is composed chiefly of crushed rock, but carries pockets and narrow veins consisting mainly of quartz, although containing some siderite and calcite and variable proportions of galena, blende, and pyrite. Pockets of ore have been extracted, production to date amounting to 4 tons of silver-lead ore carrying an average of 85 ounces in silver to the ton and 70 per cent lead.

The Metropolitan workings probably lie on the Index property. They are about 1,000 feet above the road and include two adits of unknown length. Neither was examined.

JACKSON GROUP

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1,055; 1896, p. 63; 1898, p. 1,083; 1923, p. 226 (Dublin Queen); 1927, p. 288; 1928, p. 304.
Rept. of Zinc Commission, 1906, pp. 177-181.

The Jackson group is owned by Jackson Mines, Limited, % Jas. Anderson, Stock Exchange Building, Vancouver. The group consists of the Northern Belle, Ophir, Kootenay Star, Congress, Dublin Queen, and Labour Day fraction Crown-granted claims. The property is in the valley of Jackson creek and is accessible by a good wagon road 5½ miles from Retallack station. The camp is 2,450 feet above the railway at Retallack.

The Jackson lode was staked on the Northern Belle in 1892 and was worked in its early years by the Northern Belle Mining Company of Seattle. In 1893 shipments aggregating 600 tons of ore carried an average of 100 ounces in silver to the ton and 80 per cent lead. Later, in the nineties, the property was acquired by Jackson Mines, Limited. In 1898 a 40-ton mill equipped to produce lead concentrates only was erected on the property. The mill was remodelled in 1904 to save the zinc blende and in 1905 produced 1,200 tons of zinc concentrates averaging 10 ounces in silver to the ton, 38 per cent zinc, 2 per cent lead, and 15 per cent iron (in siderite). Up to 1906 the property is recorded to have produced, in addition to the above, about 2,000 tons of lead ore, half of which was in the form of concentrates averaging 58 ounces in silver to the ton, 60 per cent lead, and 12 per cent zinc. No production is recorded since 1905, but in 1906 considerable underground work was done including the extension of Nos. 3 and 5 levels for an additional 550 and 350 feet respectively. Since 1906 small shipments have been made by lessees working on veins exposed elsewhere on the property. In 1928 a production of 40 tons of silver-lead ore was credited to them.

The underlying rocks are Slocan sediments cut by dykes and sills. Black, slaty strata interbedded with finely banded argillites and a few narrow limestone beds are underlain towards the northeast by massive and fractured argillites and quartzitic rocks. The strata have a general northwesterly strike and dip mostly towards the southwest. The intrusives comprise dykes and sills of quartz porphyry that are commonly closely alined with the sedimentary formations, and highly altered greenish dykes

of more basic composition that cut across the sediments more nearly parallel with the vein-bearing lodes. Underground, the association of these green dykes with the ore-bearing portions of the Jackson lode is a noteworthy feature.

The Jackson mine workings are on the lower, west slope of Jackson Creek valley and consist of five adit levels and an incline shaft. The adits are driven westerly along the Jackson lode. The portal of the lowermost, No. 5, adit is a few feet above and west of Jackson creek. This adit is about 800 feet long and at 200 feet from the portal meets the incline shaft (45 degrees) sunk on the lode from the surface for about 175 feet, vertically, or 110 feet below No. 5 level. The portal of No. 4 adit is 127 feet, vertically, above and about 300 feet west of the portal of No. 5 adit. No. 4 adit is 400 feet long and is connected by a raise with No. 3 adit 64 feet vertically above. No. 3 adit is, in turn, connected by raises and stopes with the two adit levels, Nos. 2 and 1, 62 feet and 124 feet, respectively, above. The portal of the uppermost, No. 1 adit, is 320 feet, horizontally, northwest of the portal of No. 4 adit. The latter is not connected with No. 5 adit level. Nos. 3, 2, and 1 adits are, respectively, about 900, 400, and 150 feet long. The uppermost outcrop of the Jackson lode, as explored at the mine, is about 100 feet northwest of and 40 feet, vertically, above the portal of No. 1 adit.

The Jackson lode is a mineralized, fault-fissure zone which was most productive between the uppermost outcrop and level No. 2 within a maximum length of about 150 feet. Within this productive section the lode swings from south 75 to 85 degrees west to about north 20 degrees west, in which latter direction it conforms or nearly conforms with the bedding of the enclosing rocks. The lode dips south at an angle of 40 degrees to 45 degrees. Towards the west end of No. 5 level the dip lowers to about 30 degrees. On the whole the lode is well defined, a feature particularly true of the hanging-wall. The width varies from 2 to 6 feet along the more productive sections, but is relatively narrow and has been non-productive in the lower, more westerly workings. The lode filling in the stoped areas was said to have carried bunches and irregular streaks of galena next the hanging-wall across an average width of about 10 inches with a mixture of blende, siderite, quartz, and crushed rock beneath. Commonly a nearly solid band of zinc blende from a few inches to 3 feet thick followed closely along the foot-wall. The more productive parts of this lode are followed for considerable distance by narrow, greenish dykes. These dykes are sheared and completely altered and consist chiefly of carbonate, quartz, and a greenish micaceous mineral resembling mariposite. Such a dyke 2 feet wide appears at the portal of No. 5 adit. It is overlain by 1½ feet of ore, largely fine-grained galena, and underlain by nearly 4 feet of mixed blende, quartz, spathic iron, and crushed argillite. The dyke is slightly mineralized by galena. A specimen of the fine-grained lead ore was assayed by the Mines Branch, Department of Mines, Ottawa, and gave 56·5 ounces in silver and 0·50 ounce in gold to the ton, 76·54 per cent lead, and 3·30 per cent zinc. The association of these greenish dykes with the lode and, in particular, with the more productive parts of it, may have some genetic as well as structural significance. Here, as else-

where in the district, such dykes have been found in close association with fissure vein deposits and though in no case have they seemed to be directly responsible for the mineralization yet their association has, in several instances, suggested that their period of intrusion closely preceded the incursion of mineral-bearing solutions; that their source has been one with that of these solutions; and that the fissures they have followed have been along lines or zones of weakness which, if not completely healed by the dykes or if reopened by further fracturing and fissuring involving the dykes themselves, have permitted access to the later ore-bearing solutions.

Mineralization at the Jackson mine has been mostly confined to two important and quite distinct sections. Most of the ore was produced from between the surface and No. 3 level and within 100 feet or so east of the point where the lode on its westerly course swung abruptly to a north 20 degrees west direction. On No. 3 level the lode followed for nearly 250 feet in this latter direction to where it resumes the more normal course and from where it was drifted along to the west for over 350 feet without encountering important mineralization, except possibly at one point, about 70 feet from the turn, where a little stoping has been done on some fine-grained zinc ore lying along the well-defined hanging-wall here dipping 60 degrees south.

The ore-body on and above No. 3 level apparently raked steeply to the east and has been explored along the direction of rake between Nos. 3 and 4 levels. No. 4 level was inaccessible in 1927. On No. 5 level, 125 feet below No. 4, the lode is well defined, but carries little value along that part of its course in line with the ore shoot above. East along this level the lode is mineralized on both sides of the incline shaft and a 10-inch streak of galena is stated to continue with few interruptions to the bottom of the shaft, 110 feet below on the dip of the lode. This statement could not be verified as the shaft was full of water below No. 5 level at the time visited.

The ore minerals, including galena (steel and cube), zinc blende, and copper and iron pyrites, occur in a gangue of siderite, and quartz associated with crushed rock. The latter is commonly the greenish dyke rock already referred to. The ore is essentially a type requiring concentrating. Possibly ore remains in the block of ground between levels 3 and 5 below the old ore shoots, and in the vicinity of the incline shaft. It might be profitable to attempt to locate the eastern continuation of the lode on the other side of Jackson creek.

Above the mine workings there are a number of exposures of vein matter on the Dublin Queen claim and on adjoining claims of the Corrigan group lying north of the Jackson group. On the Dublin Queen claim a lode has been traced on the surface for several hundred feet. At an elevation of about 6,700 feet it crosses the small creek leading into Jackson creek above the Jackson camp and has been explored in this vicinity by a short drift adit, by a crosscut to the lode about 25 or 30 feet above the drift adit, and by a series of open-cuts. The crosscut reached the lode 50 feet from the portal and the lode has been drifted on for 90 feet to the northeast and 20 feet to the southwest, but without discovering vein matter that could be mined profitably. From an open-cut on the Dublin Queen

60 sacks of ore was mined which was stated to have yielded 349 ounces of silver to the ton and 73 per cent lead. The lode strikes about north 65 degrees east and dips steeply to the southeast. On its dip it would run into the adjoining Albatross claim. To the southwest it lines up with vein outcrops near the southern boundary of the Winona fraction.

JENNIE CLAIM

This Crown-granted claim, property of the Consolidated Mining and Smelting Company, is on the west side of Kaslo Creek valley about 8 miles from Kaslo. No work has been done on it for years, but early operations are reported to have disclosed vein quartz carrying some jamesonite and galena. Other outcrops of vein quartz carrying jamesonite have been found on this slope in a gulch lying west of the Manganese property, 7 miles from Kaslo.

JOKER AND MANSFIELD

Reference: Ann. Rept., Minister of Mines, B.C., 1899, p. 705.

These prospects are in the basin of Joker lakes at the head of Keen creek. They include Joker, Mona fraction, Derby, and probably other claims, those mentioned being Crown-granted and owned by Western Canadian Collieries, Limited, Blairmore, Alta. The claims are accessible from Kaslo by about 20 miles of road up Kaslo and Keen creeks and a trail 3 miles up Joker creek to Joker lakes.

Workings include four or more adits and one or more shafts. An adit at the southeast end of lower Joker lake, at an elevation of 6,550 feet, has been driven for 300 feet along a small quartz vein following a line of jointing in Nelson granitic rocks. The vein strikes north 55 degrees east and dips 85 degrees southeast. The quartz and wall-rock are both stained with secondary copper minerals and carry a little galena and a silver-bearing mineral, probably grey copper.

About midway along the east side of upper Joker lake an adit, inaccessible in 1927, was driven in similar rocks. About 500 feet above and 1,000 feet southeast of this, a third adit, 50 feet long, follows a quartz vein striking north 15 degrees east and dipping 60 degrees southeast. This vein carries disseminated pyrite as well as some galena, zinc blende, and chalcopyrite. A winze at the face was full of water at the time visited.

At the south end of upper Joker lake another adit 200 feet long has been driven along a quartz vein a few inches wide in coarse-grained granite. This vein occupies part of a shear zone striking north 35 degrees east and dipping 80 degrees to the southeast. Pyrite was the only ore mineral observed.

So far as is known no shipments have been made from these properties. Assays of samples are reported to have disclosed important values in gold.

KENO

The Keno property, comprising one or more claims held by location, is about 3,500 feet above and 4 miles by trail southeast of Blaylock. The workings include three adits, of which the lower two were inaccessible in 1925. The upper follows a well-defined shear zone cutting grey limestone

and dark calcareous argillites of the Slocan series. The general strike of the zone is nearly south and the dip 50 degrees east. It varies from 1 to 4 feet wide and is mainly composed of broken, slickensided rock and gouge. At 42 feet from the portal a raise extends to the surface. At 54 feet the zone splits, one branch leading to the east and standing nearly vertically and the other continuing to the south. The east split was followed for 50 feet to where it pinched out. At 30 feet it cuts a porphyry dyke and at this point a little brecciated vein matter is visible on the north wall. The south split has been drifted on for 46 feet past the split and at the face shows 2 feet of crushed rock. Very little vein mineralization was seen underground, but on the dump were specimens of clean galena and others of vein quartz carrying galena associated with zinc blende and grey copper.

KING AND QUEEN CLAIMS

These claims are staked on the old Empress property on the slope north of Bear lake and below Silver Glance mine. They belong to H. Giegerich of Kaslo. The workings include several adits, are inaccessible, and lie about 2,000 feet above the railway.

The country rocks are mainly black, carbonaceous slates and thin, interbedded quartzites and argillites of the Slocan series. They are folded and faulted and are penetrated by numerous dykes and sills of quartz porphyry and one small granite stock.

The workings have explored a zone of fracture and shearing striking westerly. In this zone are quartz veins and lenses varying from an inch to over a foot in thickness and mostly rather flat lying. They carry grey copper, argentite, pyrite, a litte galena and zinc blende, either sparsely disseminated through the quartz or occurring in streaks and bunches, providing exceptionally high-grade ore.

Most of the work on this property was done in the years 1903-1909, inclusive, during which time 117 tons of ore carrying an average of 245 ounces in silver to the ton is reported to have been produced.

LIBERTY GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1899, p. 703.

The Liberty group consists of the Liberty, Stars and Stripes, Sixteen to One, Mastodon, and Last Chance Crown-granted claims on the north side of Keen Creek valley about a mile northeast of the Cork-Province mine and about 1,000 feet above Keen creek. It is accessible by road from Zwicky to the foot of a short trail that leads across Keen creek and up the mountain slope to the workings. The Last Chance claim belongs to Matilda O. Augustine, Kaslo, B.C., the other claims have reverted to the Crown.

Exploratory work was conducted on this group in the late nineties and since that time operations on a small scale have been recorded at intervals. Records indicate a meagre production in 1899 and again in 1923 and 1925. During 1925, 2 tons of ore were extracted and contained an average of 48 ounces in silver to the ton and 48 per cent lead.

The property extends across the contact of the Nelson batholith with the Slocan series. The sediments consist of interbedded slate, argillite, andalusite schist, and limestone. They strike northeasterly to northerly nearly parallel with the batholithic contact and are intruded by dykes and sills of quartz porphyry and spurs from the batholith. Near the contact the batholithic rocks are coarse-grained hornblende diorite and quartz diorite.

The workings include eight or more short adits and shafts in sediments and minor porphyritic intrusives and explore two or more fissure-vein lodes striking northeasterly and conforming in part with the structure of the enclosing sediments. One lode is opened by two or more adits, of which the lower or lowest is about 400 feet above Keen creek. This adit is a crosscut running north 35 degrees west for 85 feet through porphyry. At 70 feet the crosscut meets the lode which strikes north 55 degrees east and dips 60 degrees southeast. The lode is several feet wide and carries mineralized streaks and small bunches of sulphide, chiefly pyrite. Less than 100 feet above, a crosscut adit intersects porphyry and quartzite for 50 feet from the portal and at this distance meets a fissure lode striking northeasterly and dipping 60 degrees southeast. This fissure has been followed for 15 feet. At the face it is 2 feet wide and carries vein matter consisting of pyrite and galena in a gangue of quartz, siderite, and broken rock. Copper stains indicate the presence of some copper-bearing mineral.

About 370 feet above the last-mentioned adit and near a cabin, an adit has been driven for 175 feet in a direction of north 40 degrees west through quartz porphyry to a point where it encounters a mineralized shear zone striking north 55 degrees east and dipping 75 degrees southeast. This lode has been followed for about 10 feet on either side of the crosscut and some mineralization was encountered in the form of streaks and pockets of galena, pyrite, quartz, and siderite.

Less than 250 feet higher, another adit, now inaccessible, was driven along a 4-foot dyke of feldspar porphyry intersecting micaceous quartzite. Fifty feet above this adit a shaft has been sunk on the same porphyry.

About 100 feet above and 100 feet southwest of the shaft an adit has been driven for 150 feet along a crushed zone in sediments. The zone is about 4 feet wide, strikes north 28 degrees east, dips 60 degrees northwest, and is filled with gouge and crushed rock carrying some pyrite and stained with iron oxide. About 50 feet higher an adit, now caved, apparently investigates the same crushed zone, and a few feet higher a third adit, 60 feet long, is driven on the same zone. The contact of the Slocan series with the Nelson batholith lies only a few feet above this upper adit.

LINCOLN GROUP

References: Ann. Repts., Minister of Mines, B.C., 1894, p. 737; 1920, p. 122.

The Lincoln group, comprising the Lincoln, Deaths Head, and Celebration Crown-granted claims, is on the east side of Robb (Spring) Creek valley and is accessible by trail 2 miles long, from Blaylock station. The property is owned by the Columbia Mining Company, % Pemberton and Son, Victoria, B.C.

The workings lie about 1,500 feet above Blaylock and include two adits which were inaccessible in 1927. Last recorded mining work was done about 1921.

The underlying rocks are chiefly Slocan sediments and, in the vicinity of the workings, include a limestone bed about 50 feet thick. Fissures intersecting this limestone have permitted access of mineralizing solutions. These, in turn, have replaced the wall-rock and formed a mineral deposit from which some 55 tons of silver-lead ore carrying, on the average, 48 ounces in silver to the ton and 52 per cent lead, have been produced.

LUCKY BOY CLAIM

The Lucky Boy Crown-granted claim, property of A. T. Garland, of Kaslo, is on the southern flank of Goat mountain at the head of Jackson creek. It adjoins and lies north of the U. S. claim and is accessible by road and trail up Jackson creek from Retallack station (*See* Figure 13).

The property has long lain idle and the workings, including two, perhaps more, adits, are quite inaccessible. Work commenced in 1894 when 20 tons of high-grade ore were extracted. Other small shipments are reported to have been made from 1903 to 1910. Of these one of two tons carried an average of 125 ounces in silver to the ton and 70 per cent lead. When visited in 1927 a small pile of oxidized vein matter carrying considerable galena lay at the portal of the upper adit.

The underlying rocks are Slocan sediments comprising well-banded argillites interbedded with limestone. They strike north 25 degrees west and dip 42 degrees northeast.

The workings explore a vein-lode which is reported to swing from north 70 degrees east to north 30 degrees east and then back to the more easterly direction. An ore shoot was found along the north 30 degrees east portion of the lode, which conforms with a series of closely spaced joint fractures in the enclosing rocks. The ore was chiefly argentiferous galena in a quartz gangue. The lode outcrop is stained with iron oxide.

MAGGIE BROWN CLAIM

The Maggie Brown claim, held by location, is south of, and about 3,000 feet above, Bear lake and is accessible by trail from Zincton. It is owned by A. Schueler, Zincton post office. It lies on the southeastern extension of the thick limestone bed at Lucky Jim mine. An adit 60 feet long has been driven from the southwest towards the belt. It intersects argillaceous sediments of the Slocan series and has encountered three stringers, two near the face from 1 to 2 inches wide, carrying galena in a calcite gangue. Though unimportant in themselves, the occurrence of this mineralization close to the limestone bed suggests that the latter should be prospected for mineralized fractures on the chance that, as at Lucky Jim mine, more substantial deposits might be found in connexion with them.

MANGANESE GROUP

References: Bancroft, M. F.; Geol. Surv., Canada, Sum. Rept. 1917, pt. B. pp. 30-33. Ann. Repts., Minister of Mines, B.C., 1917, pp. 156 and 185; 1918, pp. 160-161; 1919, facing p. 120 (two illustrations "Curle's Manganese Deposit, Kaslo"). Nash, A. D.: Private report.

The Manganese group, comprising Manganese and Manganese No. 1 Crown-granted claims, and the Manganese Nos. 2, 3, and 4 and Cantan claims held by location, is situated low down on the eastern side of Kaslo Creek valley about 2 miles above Zwicky or 7 miles by rail from Kaslo. The property was staked in July, 1917, and is owned by A. J. Curle, Kaslo, B.C. It is traversed by the Kaslo-Nakusp branch of the Canadian Pacific railway and by the new highway between Kootenay and Slocan lakes.

Records of production are incomplete, but are stated by Mr. Curle to include about 1,000 tons, of which between 850 and 900 tons were produced by Col. F. B. Millard of Spokane who had a lease and bond on the property in 1918. This ore is stated to have carried between 45 and 50 per cent metallic manganese. Later in 1918 Curle shipped about 100 tons. A sample lot of 30 tons extracted in 1917 from an area of 684 square feet and amounting to 1,780 cubic feet of material averaged 43 per cent metallic manganese.

The property extends from Kaslo creek easterly over a series of benches and up the valley side to an elevation of about 1,600 feet above Kaslo creek.

The valley side for 2 miles below and above maintains a nearly north course and possesses markedly regular contours. The slope is fairly regular to within 800 feet of the bottom, below this it is less regular and, in the vicinity of the Manganese property, it reaches stream level by a succession of benches of irregular width. Along this 4-mile stretch the valley wall is indented by a great number of tributary valleys, each carrying a small stream. In the valley bottom and for a maximum height of about 400 feet above, the underlying rocks are platy to slaty black, rusty weathering argillites of the Slocan series striking northwesterly and dipping at about 65 degrees southwest. East of these rocks are greenstones of the Kaslo series that occupy the slope to an additional height of between 500 and 600 feet where they are interrupted by a tongue of sedimentary rocks of the Milford group about 1,500 feet in width. Farther east, at the upper limits of the property, the Kaslo series again outcrops and continues to the summit of Blue ridge. Overlying the solid formations and concentrated particularly on the lower slopes is an irregular but mostly heavy accumulation of drift, from which the succession of terraces have been carved. The lower valley contours, though in detail possessing many irregularities, have in general a smoothed out appearance as a result of the filling of unconsolidated materials, among which the manganese deposits constitute a minor part.

The manganese deposits occur chiefly on Manganese and Manganese No. 1 claims and mostly on a single bench about 375 feet above the railway. Other occurrences have been noted at lower and somewhat higher elevations. The deposits consist of wad or bog manganese interstratified with and gen-

erally fairly sharply separated from deposits of hydrous iron oxides, calcareous tufa or sinter, and layers of clayey sub-soil. The principal manganese deposits occupy two irregular areas, one on the Manganese claim covering about 5½ acres and one on the Manganese No. 1 claim over 2½ acres. Production to date has come entirely from the more extensive deposit and has exhausted most of the higher grade material. Within these areas the bog manganese formed deposits of variable composition and ranging from less than an inch to 3 feet in thickness.

The various types of wad in these deposits have been classified by Bancroft as follows:

"Unconsolidated wad forming the surface soil, in places covered by a thin layer of wood ash due to forest fires.

"Layers of partly consolidated wad associated with other deposits derived by chemical precipitation from mineral-bearing solutions.

"Hummock-like deposits, formed near mineral springs, having abrupt lateral limits.

"Concentrating or lumpy ore consisting of nodules and concretions of wad in beds of unconsolidated detrital material. The manganese content in the form of nodules is due to admixture consequent upon mechanical disintegration, transportation, and deposition of debris through surface erosion. In this surface waste, manganese oxide, chemically precipitated, acts as a cement, binds together portions of the detrital material, coats pebbles, forms concretions about organic remains, and exhibits all degrees of dissemination."

Of these types, the layers of partly consolidated wad form the highest grade material, but occur in relatively small proportion to the unconsolidated wad type, which consequently is the material of principal economic interest. Analyses of both types are given below. The partly consolidated wad has a porous, clinkery appearance much like that of coke. The concentrating or lumpy ore is largely of foreign matter. A large specimen of it from a stratum 6 inches thick at a depth of several feet in partly consolidated bench materials was assayed by the Mines Branch, Ottawa, and found to carry 10·06 per cent metallic manganese.

The deposit on Manganese No. 1 occupies 2·58 acres. A great number of holes were sunk by Mr. Curle to the bottom of the deposit and one hundred and seventy-seven of these were sampled and the samples combined to form two large composite samples, one of the soft, unconsolidated wad and the other of the so-called high-grade or partly consolidated material. The one hundred and seventy-seven holes, though irregularly spaced, afforded materials representing a fair average of the deposit. In these holes the thickness of unconsolidated wad varies from less than an inch to 33 inches and averages 13 inches. Partly consolidated wad was found in fifty-three holes and was roughly estimated to form one-tenth of the total amount of the unconsolidated wad. On the basis that 1,780 cubic feet of the wad weighed 29·5 long tons it is calculated that the unconsolidated material within the surveyed area amounted, in 1927 when the estimate was made, to about 2,270 short tons, and that the high-grade present would bring this tonnage up to nearly 2,500 tons. Wad has also been found at a number of places close to, but outside of, the surveyed area, but had not been

sufficiently investigated to permit of any estimate of tonnage. On the other hand the estimate of 2,500 tons within the area surveyed is probably excessive in so far as available tonnage is concerned, for the reason that it includes material too thin to be profitably excavated and because there would also be a very considerable waste in actual operations.

The deposit on the Manganese claim, which has supplied production to date, has not been entirely exhausted though most of the better grade material has been removed. The owner is of the opinion that between 700 and 800 tons remain and would probably average about 30 per cent manganese.

Another showing of wad on the Manganese claim is on the slope of the lowest terrace above the railway, where some high-grade consolidated wad overlies boulder clay and is capped by several feet of calcareous tufa.

The following analyses by A. Sadler of the Mines Branch are of the composite samples of unconsolidated (A) and consolidated (B) wad mentioned in a previous paragraph:

—	A	B	—	A	B
Mn	(31·57)	50·10	CoO	0·013	.....
MnO	.....	.....	CaO	3·40	.....
MnO_2	49·94	(79·25)	MgO	0·72	.....
SiO_2	12·03	.....	S	0·045	.....
Fe_2O_3	3·73	0·76	CO_2	6·44	.....
P_2O_5	0·21	.....	$H_2O + 105°$	10·80	.....
NiO	0·22	.....	Insoluble	.....	2·57

On the Manganese No. 4 claim, at an elevation of about 1,600 feet above the railway and near the upper contact of a belt of sediments of the Milford group with greenstones of the Kaslo series, an open-cut 60 feet long in altered, banded, quartzitic and argillaceous sediments exposes an irregular zone striking northwesterly with that of the sediments and in which are lenses of barren-looking quartz. The enclosing sediments across a width of several feet are weathered brown and black as a result of the decomposition of contained iron and manganese minerals. Under the microscope the sediments are seen to be chiefly quartzitic types carrying varying proportions of black and reddish oxides and, locally, abundant grains of a manganiferous garnet (spessartite?) which are commonly surrounded by rims of black manganese oxide. Most specimens show abundant tiny crystals, commonly diamond shaped and possessing high relief, of another manganese mineral, probably either braunite or hausmannite. A general sample of this manganiferous deposit was taken by Mr. Curle who reports that the assay returns gave 14·08 per cent manganese, 15·3 per cent iron, and 38·64 per cent silica.

The bog deposits were formed by mineral springs carrying in solution manganese, lime, and iron. On reaching the surface the contained manganese and iron carbonates were precipitated and almost immediately oxidized. The contained lime carbonate was deposited in the form of calcareous tufa. Due to differences in the relative solubilities of these different substances and to variations in local conditions, the tendency has been for each to form more or less separately from the others.

The source of the materials carried in solution by the spring waters may be referred with some confidence to the rock formations traversed by the streams draining the slopes of Blue ridge east of the property. These slopes are underlain chiefly by greenstones of the Kaslo series and this series has been regarded as the source of the iron, calcium, and manganese. In the writer's opinion, however, this interpretation can hardly be more than partly correct because a belt of sediments of the Milford group outcrops on the valley side and manganiferous horizons occur in them. Doubtless further careful prospecting would reveal other occurrences of manganese-bearing rocks in this belt of sediments.

MARTIN GROUP

References: Ann. Rept., Minister of Mines, B.C., 1923, p. 212; and other years.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 197-198.

The Martin group of seven claims, held by location, is owned by J. A. Carter and J. W. Powers of Kaslo, B.C. It is in the upper basin of Dago creek and is accessible by the Flint mine trail which leaves the road up Keen creek about half a mile below the Cork-Province mine or 4 miles from Zwicky.

The property was located in 1902 and work has been done on it each year since. The first shipments of ore were made in 1915 when 24 tons yielded an average of 78 ounces in silver to the ton and 59 per cent lead. Total shipments amount to 59 tons which have averaged about 55 ounces in silver to the ton and 53 per cent lead.

The property is underlain by coarse-grained, porphyritic, Nelson granite or granodiorite. In the mine workings and on the surface a narrow band of highly altered, dark micaceous rock is associated with the main lode and is probably a basic dyke.

The main workings of the mine are two adits 136 feet apart, vertically, and intermediate levels at 65 and 90 feet above the lower adit. Nos. 1 (the lower) and 2 adits are 600 and 145 feet long, respectively, and about 360 feet of lineal work has been done on the intermediate levels. The workings are connected by raises. Several hundred feet of crosscutting to, and drifting on, other lodes than the main has been done on No. 1 and the intermediate levels.

The ore deposits occur in a faulted zone that has a general trend of north 55 degrees east and is marked on the surface by a narrow, steep ravine in the rocky hillside. The course of the ravine is also coincident with that of a narrow, irregular band of rock, presumably a greatly altered dyke. The faulted zone or lode dips west at from 65 to 70 degrees. Two other vein-bearing fissures converging eastward intersect the main lode near the face of No. 1 level. On one of these, known as "No. 2 vein," a 70-foot drift has been run on the 65-foot intermediate level.

The lode filling is composed of sphalerite, galena, and subordinate amounts of pyrite and chalcopyrite, in a quartzose gangue with a little siderite and calcite and abundant crushed and altered rock. The ore where best developed is from several inches to 2 feet wide and is composed in part of nearly solid galena. The largest shoot was found on the intermediate levels and had a length of 100 feet and appeared to rake southwest at about 45 degrees. The galena carries most of the silver.

METALS RECOVERY COMPANY, LIMITED

Reference: Ann. Repts., Minister of Mines, B.C., 1925 to 1929.

This company, under the management of the late M. S. Davys, Kaslo, erected a mill in the valley of Kaslo creek, about ¼ mile below the mouth of Lyle creek, to treat tailings from the old Whitewater mine mill. These tailings have accumulated over a considerable area along the bed of Kaslo creek and carry silver-lead, zinc, and gold. The mill was built in 1925 and has a capacity of 60 tons a day. Altogether, up to about the end of 1928, between 35,000 and 36,000 tons of material were handled. In 1926 the production was over 16,000 tons and averaged about 2·3 ounces in silver to the ton, a fraction of a per cent lead, and 2 per cent zinc. The milled products gave a zinc concentrate carrying about 40 per cent zinc, 7 per cent lead, and 40 ounces in silver to the ton; and a lead-iron concentrate averaging 20 per cent lead, and 80 ounces in silver and $5.60 in gold to the ton.

METLAKAHTLA CLAIM

The Metlakahtla claim, property of M. J. Mahoney, Zincton, is at the mouth of Whitewater creek. It lies south and east of, and adjoins, the Whitewater Deep group of claims.

The underlying rocks are chiefly Slocan sediments comprising slates and one or more narrow limestone beds. The strata are crumpled and faulted and are cut by a green, lamprophyre dyke exposed above the left bank of Whitewater creek on this claim. The dyke strikes northerly, crosses Whitewater creek about 300 feet north of the Metlakahtla claim, and is exposed about 1,400 feet farther north 500 feet from the portal of No. 10 adit, Whitewater mine, where it is 40 feet wide. At one point on the Metlakahtla claim a narrow, siliceous band or vein 3 feet above the base of the dyke contains disseminated pyrite and galena.

Principal work on this claim has been done on a mineralized zone or lode about 22 feet wide striking easterly up the east bank of Whitewater creek. The lode conforms, or nearly conforms, with the enclosing sediments which dip southerly at angles varying from about 40 to 60 degrees. It has been explored underground by two short adits, 25 feet apart vertically. The lower adit drifts on the foot-wall and the upper adit on the hanging-wall section of the lode. When visited these workings were largely inaccessible. The lode is exposed at 50 feet above the upper adit and, again, at about 100 feet. Mineralization is mainly confined to widths of about 1½ to 3 feet along or close to the walls and consists of quartz and partly replaced wall-rock, mainly limestone, carrying streaks and disseminations of sphalerite, pyrite, and a little galena. The exposures are heavily stained with iron oxide.

MOHAWK GROUP

References: Ann. Repts., Minister of Mines, B.C., 1921, p. 133; 1926, p. 266.

The Mohawk group, consisting of the Mohawk, Mohegan, and Ten Day Man claims held by location, is in the valley of Twelvemile creek about a mile southeast of Utica mine and to the south of and adjoining the Rainbow group. It is owned by J. H. Chisholm and R. J. Hughes, Kaslo, B.C.

Records show an initial production of 4 tons in 1918. This ore carried 165 ounces in silver to the ton and 57 per cent lead. In the following year 16 tons credited to the Ten Day Man claim yielded 162 ounces in silver to the ton and 68 per cent lead. A final shipment of 2 tons in 1921 assayed 138 ounces in silver and 66 per cent lead.

The underlying rocks are chiefly massive andalusite argillite and quartzite of the Slocan series, striking north 30 to 35 degrees east and dipping steeply southeast. These sediments are intersected by fine-grained, feldspar-porphyry dykes and, at a short distance to the south of the workings, by granitic rocks of the Nelson batholith.

The workings consist of five adits and considerable surface stripping, and explore two lodes, both of which have the same strike as the enclosing rocks, but one of which dips steeply southeast and the other as steeply northwest. The southeast dipping lode is opened near the Mohawk-Rainbow line by two adits 60 feet apart, vertically. The upper is 40 feet long and follows the lode which has andalusite schist on the hanging-wall and a quartzite foot-wall. The lode strikes north 35 degrees east, dips 70 degrees southeast, is marked by about 6 inches of gouge, and carries some spathic iron, and a little galena. The lower adit is driven on the same lode and in similar rocks for about 125 feet. At this level the lode is from 5 to 6 feet wide and contains galena in bunches and narrow stringers. It dips about 60 degrees southeast.

The other lode was exposed by an open-cut for 150 feet and from these surface workings, it is reported, $7,000 worth of ore was taken out. The ore formed in small bunches in the lode down to 30 feet below the surface. An upper adit at an elevation of about 6,300 feet was driven for 125 feet on a mineralized shear zone which strikes north 30 degrees east, dips 70 degrees northwest, and is from 5 to 6 feet wide. In this drift some silver-lead ore was encountered in bunches associated with pyrite and calcite. From the face of the adit a raise extends to the surface 50 feet above. Fifty feet below this level is another adit 50 feet long on the lode. This adit encountered a little ore in a small underhand stope. About 60 feet farther down the hill (vertically) an adit has been driven, apparently on the same lode, for 330 feet. The rocks in this adit strike with the lode, but dip 70 degrees southeast. The zone is from 5 to 6 feet wide, possesses a well-defined hanging-wall and is filled with crushed wall-rock, streaks of gouge, and small bunches of galena associated with calcite gangue. In a raise to the surface about half-way along this adit an ore shoot was encountered in the upper 12 feet and about 8 tons of ore reported to have been extracted.

The ore on this property is chiefly argentiferous galena occurring mostly in coarse cube form and carrying silver-rich minerals such as grey copper and ruby silver.

MONTE CHRISTO CLAIM

The Monte Christo Crown-granted claim is owned by the estate of the late John A. Finch, % Geo. Aylard, 211 Belmont House, Victoria, B.C. The claim lies across Rossiter creek on the lower northern side of Kaslo Creek valley a short distance above the railway at Blaylock.

Quite a little exploratory work has been done on this claim, chiefly as the result of the discovery of galena float in a small depression on the steep western bank of Rossiter creek. One block of this float is stated to have provided 100 sacks of lead ore. Seven tons of silver-lead ore, shipped in 1907, averaged 52 ounces in silver to the ton and 54 per cent lead. A further shipment of 21 tons of silver-lead-zinc ore was made in 1927.

The underlying rocks are chiefly slaty sediments of the Slocan series, interstratified with three or more narrow limestone beds. These sediments strike about north 55 degrees west, stand nearly vertically, and are faulted and deformed.

Workings include eight short adits spaced at intervals over a vertical range of 400 feet above the bottom of the steep canyon of Rossiter creek. They have failed to show the source of the galena float which from its position and concentration would appear to have come from some nearby vein outcrop. Such mineralization as has been encountered in place is due, partly, to limestone replacement at the intersections of small fissures and, partly, to the occurrence of small quartz veins carrying disseminated galena and blende.

MONTEZUMA GROUP

References: Geol. Surv., Canada, Ann. Rept. 1895, pt. A, p. 33.
Ann. Repts., Minister of Mines, B.C., 1898, p. 1085; 1899, p. 701; 1904, p. 158; 1906, p. 143; 1908, p. 93; 1928, p. 286.
Rept. of Zinc Commission, 1906, p. 169.

The Montezuma group of three Crown-granted claims lies in the basin of Montezuma creek, a northern tributary of Keen creek, and is accessible by road and trail from Zwicky. The property is owned by H. Giegerich, Kaslo, B.C.

The Montezuma and Mexico Crown-granted claims of this group were located in 1891 and have extralateral rights. Most of the work has been done on the Montezuma claim, at elevations ranging from about 5,600 to 5,900 feet above sea-level. The property was explored in the early years by the Kaslo-Montezuma Mining and Milling Company of Seattle. Financial difficulties in the late nineties culminated in closing the mine which remained idle until about 1906 when it was acquired by the present owners and operations were resumed.

Records of early production are incomplete, but Customs Export sheets indicate that approximately 750 tons of ore, yielding 60 per cent lead and 75 ounces in silver to the ton, were shipped in 1898. In the following year a production of 2,805 tons of mill feed carried an average of 9 ounces in silver to the ton and 11 per cent lead. Shipments in 1907 and 1908 comprised 350 tons of ore, yielding 55 ounces in silver to the ton and 67 per cent lead. In 1918, 204 tons, and in 1928, 357 tons, of the old mill tailings were shipped to Trail. The 1928 shipments carried, on the average, 22 per cent zinc, 4·5 per cent lead, and 8½ ounces in silver to the ton.

The prevailing rocks are metamorphosed argillaceous sediments and limestones of the Slocan series. These have a general north to northwesterly strike and dip to the east or northeast at an average angle of about 60 degrees. They are penetrated by acid dyke rocks and are moderately metamorphosed by granitic intrusives of the Nelson batholith

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which outcrop to the east of the property and probably underlie it at no great depth.

The discovery at Montezuma mine was a large capping of oxidized ledge matter carrying galena, zinc blende, and pyrite. This was explored at the surface by trenches and open-cuts over a length of 70 feet or more and disclosed a mineralized zone, 15 to 30 feet wide, striking northeasterly and dipping at about 70 degrees southeast. An adit (No. 1) driven 20 feet below this showing indicated pronounced mineralization along foot- and hanging-wall sections of the zone and across widths of from 5 to 10 feet. No. 2 adit, 80 feet below No. 1, crosscuts to the same lode. A third adit, nearly 300 feet below No. 2 level, reached the lode by a long cross-cut and was connected by a raise with the upper workings.

The results of this work have not been encouraging, particularly in view of the large surface showing. A considerable tonnage of ore was stoped from the upper levels over a maximum length of about 150 feet, but below No. 2 level the vein matter became lean and formed a more or less chimney-shaped mass extending much if not all, of the way down to No. 3 level. Below No. 2 level, however, it did not average over 20 or 30 feet in length along the lode, whereas on this level ore of concentrating calibre, associated with pockets of high-grade material, persisted for over 100 feet and maintained an average width of 10 feet. This ore was stoped out without, apparently, discovering further deposits.

The ore consisted of massive galena and zinc blende, with a conspicuous amount of pyrite, in a gangue of crushed rock, siderite, and quartz. It is stated to have been concentrated in the ratio of 5½ to 1, the lead product assaying about 60 per cent lead and 50 ounces in silver to the ton.

Most of the workings are now inaccessible, so that it is difficult to form conclusions as to why the ore occurred only in the one comparatively restricted area. The locality, in its geological relations, appears to have attractive possibilities and to be worthy of more exploratory work.

NIL DESPERANDUM CLAIM

The Nil Desperandum Crown-granted claim lies south of Fish lake and is reached by a short trail from Giegerich station. It is owned by Wm. Matheson, Zincton, B.C.

On this claim a couple of short adits, 150 feet apart vertically, have investigated outcrops of vein quartz occurring as irregular lensy masses in slaty rocks of the Slocan series intersected by dykes and sills of quartz porphyry. The quartz is in places stained with copper carbonates and is sparingly mineralized with pyrite, galena, zinc blende, and, probably, a little grey copper. No work has been done for many years.

NOME

The Nome property is on the northeast side of Klawala (Cariboo) Creek valley and is reached by the road up Keen creek and by a trail up Klawala creek for a distance of between 3 and 4 miles. The workings lie 2,400 feet above the Keen Creek road. The property is underlain by

coarse-grained, porphyritic, Nelson granite intersected by small, basic dykes.

Workings include two adits about 200 feet apart (vertically). The lower follows a shear zone about 4 feet wide. The zone strikes north 35 degrees east, dips steeply to the northwest, and shows little mineralization other than pyrite which is partly oxidized near the surface. The upper adit lies 1,300 feet to the southeast of the other and was inaccessible at the time visited (June, 1927), but appears, from material on the dump, to have encountered somewhat similar conditions to those in the lower adit and is probably driven on a parallel shear.

OHIO CLAIM

The Ohio claim lies on the west side of the valley of Lyle creek, a northern tributary of Kaslo creek, and is accessible by trail from Retallack. It is owned by Horwood Williams of Toronto and the estate of the late W. R. Winstead of Spokane. Records of production are incomplete. One shipment in 1909, amounting to 10½ tons, is stated to have averaged 160 ounces in silver, 2 per cent copper, and $4.55 in gold.

The underlying rocks are chiefly slaty sediments of the Slocan series, interbedded with some limestone.

The workings lie about 1,200 feet above the railway at Retallack. They include four adits spaced at intervals over a total vertical range of about 150 feet. The middle two are connected by a raise and by stopes. The second lowest (No. 3) is about 300 feet long and is the longest of the four.

These workings explore a lode striking from north 65 degrees west to due west and dipping steeply to the south. The lode conforms closely with the trend of enclosing slaty sediments and varies in thickness from a narrow streak to 10 feet. It is composed of crushed slate associated with bands and lenses of, chiefly, quartz and siderite. The siderite is vuggy in part, the vugs containing fine crystals of carbonate and clusters of slender quartz prisms. Some of the lenses lie diagonally in the lode and pass out into the hanging-wall along tributary fissures. They carry pockets, disseminations, and streaks of ore minerals comprising grey copper, pyrite, galena, and conspicuous amounts of chalcopyrite. The appreciable percentage of copper and considerable gold values are of particular interest.

ONTARIO NO. 2 (JESSIE-BLUEBIRD) GROUP

References: Ann. Rept., Minister of Mines, B.C., 1921, pp. 131-132; and other years.

This property, comprising Ontario No. 2 Crown-granted claim, and Jessie, Bluebird, and Neptune claims held by location, lies in the basin of Woodbury creek on the ridge between the main branch of this creek and the tributary valley of Silver Spray creek. It is accessible by road and trail up Woodbury creek from Kootenay lake, a distance of about 10½ miles. The property is owned by Eric Johnson, Kaslo, B.C.

Production commenced in 1907 when shipments totalling 64 tons averaged 466 ounces in silver to the ton and 10 per cent lead. Further ship-

ments aggregating 108 tons have been made since that time, the last, amounting to 21 tons, being recorded in 1921. The average content of the entire output of 172 tons has been about 335 ounces in silver to the ton and 10 per cent lead.

The workings include two adits, only the lowest of which was open at the time visited (June, 1927). Altogether these workings are reported to comprise about 1,500 feet of development. The two crosscut adits are 100 feet apart vertically, and reach the lode at 80 and 200 feet, respectively, from the portals. A raise connects the levels at a point 395 feet southwest of the face of the lower, or 200-foot, crosscut and a short intermediate level was run from this raise about midway between the two main levels. Considerable stoping has been done above the lower level.

These and other, small workings explore a sheared, shattered, and mineralized zone from 5 to 30 feet wide in porphyritic granite of the Nelson batholith. The lode strikes about north 75 degrees east and dips from 55 to 75 degrees northwest. Where the lode could be seen its filling consists of gouge, crushed wall-rock, quartz, and ore minerals. The quartz occurs in bands and lenses of varying width, following an irregular course through the lode, and also cements and partly replaces the shattered fragments of wall-rock incorporated in the lode matter. The ore minerals include, chiefly, galena and pyrite with some grey copper (?) and, probably, other silver-bearing sulphides. They occur in both massive and disseminated forms and are partly oxidized.

The vein matter was carefully sorted before shipment and the higher grade material packed to Kootenay lake at a cost of $30 a ton. This sorting required an intimate knowledge of the character of the ore as good values may be obtained from ledge matter that appears quite unattractive.

PEORIA GROUP

The Peoria group of six Crown-granted claims and fractions lies along the summit and eastern slopes of Dardanelles mountain to the north of and adjoining the Dardanelles group. It is owned in part by Peoria Mines, Limited, % D. E. Kerr, Duncan, B.C. Nothing has been done on this property for many years and the workings are mostly caved and inaccessible. According to early reports, the workings include a shaft 54 feet deep, on the Snowflake claim; two short adits on the Harriet claim to the south; a shaft and adit on the Cody fraction southwest of the Harriet claim; and numerous open-cuts and shallow trenches on these and the other claims. These workings exposed some vein matter in small fissures trending northeasterly and intersecting limestone and slaty sediments of the Slocan series. The slaty wall-rocks seem, on the whole, too incompetent for the development of ore-bodies of appreciable size. The small quantity of vein matter hitherto discovered was composed chiefly of quartz and galena, the latter carrying good values in silver. A heavy limestone bed on the Snowflake claim is probably the same bed as that on the adjoining Maggie Brown property and, farther northwest, is intimately associated with the ore-bodies at the Lucky Jim mine. The discovery of ore-bearing fissures intersecting this limestone would encourage further exploratory work.

PHOENIX GROUP

References: Bancroft, M. F.: Geol. Surv., Canada, Sum. Rept. 1917, pt. A, p. 33. Ann. Rept., Minister of Mines, B.C., 1928, p. 304.

The Phoenix group, comprising the Phoenix and Fletcher Crown-granted claims and the Columbia fraction, is in the upper basin of Lyle creek and is accessible by trail from Retallack station via the Ohio property. It is owned by M. J. Mahoney, Zincton, B.C.

The underlying rocks are members of the Kaslo series, the workings being situated near the northeastern contact of a broad belt of serpentine with other greenstone types.

The showings lie at an elevation of about 5,600 feet in a gulch tributary to Lyle creek and at the extreme northern edge of the Sandon map-area. They occur in a mineralized shear zone and are explored by a short adit, two open-cuts, and other surface work.[1] The shear zone strikes northwesterly, more or less in line with the gulch, and varies up to 10 feet in width. Along it occur lenses and stringers of quartz carrying disseminated pyrite, chalcopyrite, and a little free gold. The disseminations are more concentrated in some places than in others and appear to carry gold values in proportion to the extent of this concentration. A sample of quartz carrying bright cubes of pyrite was obtained by Bancroft for assay and subsequently determined by the Mines Branch, Ottawa, to carry gold in the proportion of 2·6 ounces to the ton. A sample of similar looking quartz, carrying both pyrite and chalcopyrite, was obtained by the writer and assayed 0·63 ounce gold to the ton. A polished surface of this quartz was studied under the microscope and one minute speck of free gold observed in it. No free gold could be seen with the unaided eye. In places the quartz has a cellular appearance as a result of the weathering of iron-bearing sulphides.

PONTIAC AND TECUMSIE CLAIMS

References: Ann. Repts., Minister of Mines, B.C., 1899, p. 701; 1904, pp. 156-157.

The Pontiac and Tecumsie Crown-granted claims lie east of Pontiac creek, a southern tributary of Woodbury creek, and are accessible from Kootenay lake by road and trail up Woodbury creek. The claims are owned by Alice G. Caldwell and the estate of W. C. Chaplin, % J. D. Chaplin, Welland Vale Manufacturing Company, St. Catharines, Ont.

The first recorded production was in 1898 when 20 tons averaged 50 ounces in silver and $15 in gold to the ton and 30 per cent lead. Total production has amounted to 1,368 tons and has averaged over 15 ounces in silver and nearly $4.50 in gold to the ton and 6 per cent lead.

The property is the most northeasterly of a series, including Scranton and Sunset groups, situated in an area of porphyritic Nelson granite in which a few inclusions of older sedimentary rocks are found. When visited, in June, 1927, the workings were mostly inaccessible, partly from caving and partly from snow which covered much of this higher country at that time of the year.

[1] Since visited by the writer it is reported that further work has been done on this property by the Consolidated Mining and Smelting Company.

Workings on the Pontiac and Tecumsie claims include three adits and explore, to a vertical depth of 200 feet or so below the outcrop, a sheared and fractured zone in the granitic rocks. The zone strikes north 25 degrees east to northeast and contains a number of quartz veins and stringers, most of which carry more or less sulphide minerals including galena, zinc blende, pyrite, and high-grade silver minerals. One vein has received most attention. It carries disseminated sulphides as well as pockets or small shoots of higher grade material. The appreciable gold forms an attractive feature.

According to early reports only the better grade vein matter could be expected to yield a profit in view of high transportation costs.

RAINBOW AND CENTRAL CLAIMS

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 265.

This property, owned by Wm. Anderson, Kaslo, lies on the nose of the ridge between the main branch and the west fork of Twelvemile creek, about $4\frac{3}{4}$ miles by road up this creek from Keen (Adamant) station. The workings are about 600 feet above the forks of the creek. The property adjoins and lies to the north of the Mohawk group.

The underlying rocks are metamorphosed argillites (andalusite schists) and quartzitic beds striking northeasterly and dipping steeply to the southeast. They are intersected by a few acid dykes and lie within the contact metamorphic zone of the Nelson batholith which outcrops to the southeast of, and probably underlies, the area at no very great depth.

Recorded production includes one ton of silver-lead ore and five tons of zinc ore shipped in 1924 and 1926 respectively. The silver-lead ore carried 128 ounces in silver, 65 per cent lead, and 1 ounce in gold; and the zinc ore, 1 ounce in silver to the ton, 4·2 per cent lead, and 52 per cent zinc. When visited in July, 1926, lessees calculated they had about 20 tons ready for shipment.

The workings include a shaft and two adits. The latter are about 230 feet apart vertically and the collar of the shaft about 100 feet above and 130 feet southwest of the portal of the lower adit. In addition some surface work has been done.

These workings explore three parallel or nearly parallel vein lodes, each of which marks the course of strong shearing and fissuring in a direction nearly coincident with the bedding of the enclosing sedimentary rocks. All three lodes are encountered in the lower adit level. This adit driven as a crosscut for 125 feet to the most easterly lode continues as a drift southwest on the lode for about 140 feet, the face of the drift reaching into slide material on the south side of the ridge. A crosscut to the southeast from near the face of this drift and 20 feet long encounters three or four flat stringers of ore in crushed rock and gouge. At 35 feet from the face of the drift a crosscut was driven for 180 feet to the northwest, cutting a second lode at 85 feet and a third lode, referred to as the "McInnis vein," at 165 feet. These lodes dip to the southeast at 75 degrees and 70 degrees respectively. The second lode is about 4 feet wide with gouge on both walls and is composed of crushed rock containing a little calcite and

siderite. The McInnis lode at this level is about 10 feet wide but shows little mineralization. Higher up, however, this lode is intersected at 30 feet from the portal by the upper, crosscut adit and has been followed southwest by a drift for 60 feet. In this drift a few lenses of vein matter were encountered and yielded 39 sacks of ore. At the face the lode was about 18 inches wide.

The easterly or main lode, as exposed in the lower adit, has a well-defined foot-wall striking north 35 to 40 degrees east and dipping 75 degrees southeast. The lode has a maximum width of at least 20 feet and is largely composed of gouge and crushed wall-rock. Ore mineralization has favoured the foot-wall where it forms a paystreak from 4 to 18 inches wide composed of gangue minerals with galena, blende, pyrite, and oxidized vein matter. The galena carries high-grade silver minerals and assays, consequently, run high in this metal. Ore also forms small lenses, stringers, and disseminations, at irregular intervals through the lode filling. The size of the lode and its favourable geological situation encourage its further exploration.

REVENUE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1920, p. 122; 1928, p. 306.

This property, comprising the Revenue, Revenue fraction, Birthday, and Tamarac Crown-granted claims, lies on the north slope of Sturgis creek, an eastern tributary of Keen creek. It is accessible by the road up Keen creek from Zwicky and thence by trail for 2½ miles up the valley of Sturgis creek. The property has been recently acquired from the original owners by the Sturgis Creek Mines, Limited, with head office at 303 MacLean Block, Calgary, Alberta.

Production in 1913, 1914, and 1916, amounted to 67 tons of silver-lead ore carrying an average of nearly 77 ounces in silver to the ton and 54 per cent lead. In 1928 a further production of about 40 tons was reported.

The workings consist of four adits and some surface cuts. These explore a lode intersecting coarse-grained, porphyritic Nelson granite on a strike of north 15 degrees east and a dip varying from a high angle to the west to vertical. In June, 1927, the underground workings aggregated over 600 feet of tunnelling.

The lode is a well-defined fault fissure about 3 feet wide and composed of broken and crushed wall-rock, vein quartz, and ore minerals. The latter include galena and zinc blende, and are either disseminated or concentrated in the form of a paystreak of solid or nearly solid ore several inches wide. The higher grade material has been largely stoped out of the upper levels where it appeared to rake into the hill at about 30 degrees. In addition to the main lode a second, nearly parallel lode lying about 100 yards to the west has received a little attention, but has afforded no production.

SCRANTON CLAIM

References: Ann. Rept., Minister of Mines, B.C., 1904, p. 157.
Richmond, A. M.: Dept. of Mines, B.C., Bull. No. 1, 1932, pp. 118-119.

The Scranton Crown-granted claim adjoins and lies northwest of the Pontiac claim of the Pontiac and Tecumsie group near the head of Wood-

bury creek. It is owned by R. F. Taylor, Thos. Doyle, C. Henry, % Royal Trust Company, Victoria, B.C. Both properties are underlain by coarse-grained, porphyritic, Nelson granite and in both occurs the same lode or lode system.

A quartz vein investigated on the Scranton claim is reported to have been well mineralized in places with pyrite and to have carried some clean galena. Selected ore is stated to have assayed 70 per cent lead and 70 ounces in silver and $10 in gold to the ton. The gold is thought to be associated with the iron sulphide.

Comparatively little development has been done and the workings were mostly obscured at the time visited (June, 1927). No production is recorded.

According to Mr. Richmond a promising showing

"has recently been exposed by open-cutting near the Scranton camp. . . . Several open-cuts, a shallow winze, and a short crosscut tunnel have opened up a length of 150 feet of well-mineralized vein which varies from a few inches to as much as 6½ feet in width. One section of the vein, 65 feet long and averaging 4·68 feet wide, is well mineralized with pyrite, galena, and zinc blende, with which are contained gold and silver values. The results of assays on five channel samples cut in this section were found to average: gold, 0·72 ounce to the ton; silver, 8·1 ounces to the ton; lead, 7·4 per cent; zinc, 1·4 per cent. The gold content in the five samples varied from $2.80 to $28.40 a ton, with the above stated average of $14.20 a ton."

SILVER BEAR GROUP

References: Ann. Repts., Minister of Mines, B.C., 1919, pp. 120-121; 1923, pp. 211-212; 1924, p. 189.

The Silver Bear group, comprising the Silver Bear and Broughton Crown-granted claims, lies on the lower southeast side of Keen Creek valley about 9½ miles from Zwicky and is accessible by road from this station. The property is owned by F. Helme, Kaslo, B.C., and, in recent years, was operated under terms of a lease and bond by the late M. S. Davys, of Kaslo.

An initial production of 24 tons of high-grade silver ore is recorded in 1919. This ore averaged 165 ounces in silver to the ton and 6·4 per cent lead. Further production in 1920 and 1923 brought the total to 108 tons averaging 160 ounces in silver to the ton and about 7·5 per cent lead.

The property is developed by six adits, three or more intermediate levels, and several open-cuts aggregating, altogether, over 3,000 feet of lineal work. The principal workings are three crosscut adits that explore the main lode over a vertical range of 340 feet below the outcrop. The lowest or No. 3 crosscut adit reaches this lode at 730 feet from the portal. This is the main working level and opens out beside the road up Keen creek.

These workings develop a sheared and fissured, mineralized zone situated towards the middle of a belt of Slocan sediments having a width, on this property, of between 1,500 and 2,000 feet. The belt has a general northeasterly trend and the strata composing it have the same general strike. The sediments comprise interbedded limy and quartzitic argillites, limy quartzites, and some beds of nearly pure limestone. The belt of sediments is flanked by granitic intrusives of the Nelson batholith, chiefly coarse-grained porphyritic granite which, near the sedimentary con-

tacts, is, in general, less porphyritic and somewhat more basic than elsewhere. The sediments tend to dip away from the granitic contacts, so that the general structure of the belt is synclinal. This structure is, however, complicated by much faulting and shearing.

The lode system on the property has a general northeasterly strike, dips southeast at about 65 degrees, and has been traced by underground and surface workings over a length of about 1,000 feet. As indicated by the principal workings there are two principal lodes that are nearly parallel and are separated by an interval of 80 feet or so of comparatively massive rock. The lodes are zones of strong shearing and fissuring. Each varies from less than a foot to several feet in width and is composed of broken and crushed rock and, more locally, ore and gangue minerals. Most of the work has been done on the more westerly or "foot-wall" lode along, or near, which a raise extends from the lowest or No. 3 level for a vertical distance of 180 feet and connects with a winze sunk for 65 feet from No. 2 level. Above No. 2 level stopes extend to the surface and it is from these upper workings that most if not all of the production has come. The main shoot had a maximum length on No. 2 level, and from there to an intermediate level, 30 feet above, of about 90 feet, but it apparently narrowed rapidly higher up. Below No. 2 level the lode was being investigated in 1927 by a series of intermediate levels, the lowest of which lies about 160 feet below No. 2 or 90 feet above No. 3 level. The ore in the upper workings lay against a heavy seam of gouge on the hanging-wall side of the lode and consisted of broken bodies of quartz with some calcite, siderite, and ore minerals. The latter included galena, zinc blende, pyrite, and one or more silver-bearing minerals. A small dyke of fine-grained granite lying about 10 feet below the foot-wall of this lode carries considerable pyrite and small cubes of galena.

The more easterly or "hanging-wall" lode is similar in type to the other, but has not, so far as known, revealed any substantial mineralization.

In addition to these principal lodes, a third is reported to have been intersected by an old adit 20 feet above No. 1 crosscut adit. This lode outcrops 20 feet higher (vertically) up the hill than the "hanging-wall" lode, but has only been slightly prospected.

SILVER BELL GROUP

References: Ann. Repts., Minister of Mines, B.C., 1899, p. 704; 1919, pp. 120-121.

This group, comprising Silver Bell, Hub, and Little Bell fraction Crown-granted claims, is situated to the east of and adjoins the Silver Bear group in Keen Creek valley. It is owned by R. F. Green *et al.*, Kaslo, B.C.

The first recorded production was in 1898 when 50 tons of ore yielded about 100 ounces in silver to the ton and 15 per cent lead. Further shipments were made in 1899, 1909, 1919, 1920, and 1921. The aggregate output has amounted to 472 tons, containing, on an average, 151 ounces in silver to the ton and 18 per cent lead.

The property lies along the southeasterly contact of a belt of Slocan sediments with granitic intrusives of the Nelson batholith.

The workings, including several short and two main adits, were mostly inaccessible when visited in June, 1927, and but little information could be obtained. The ore mineralization occurs in a wide, crushed zone in the sedimentary rocks. This zone apparently strikes about east and dips at a low angle to the south. It is reported that lode matter carrying much silver was extracted from and near the surface over a length of about 200 to 300 feet. The ore occurred in broken bands and lenses and was composed of quartz, with some calcite and ore minerals. The latter included high-grade silver minerals, galena, zinc blende, pyrite, and considerable oxidized material or "carbonate" ore containing abundant iron oxides.

SILVER GLANCE GROUP

References: Ann. Repts., Minister of Mines, B.C., 1893, p. 1061; 1901, p. 1025; 1902, p. 153; 1917, p. 186.

The Silver Glance group, comprising the Silver Glance and Summit Queen Crown-granted claims and the Silver Glance fraction, lies on the southeastern side of London ridge and is accessible by trail from Giegerich station. The property is owned by J. W. Power and T. E. Tollefound, of Kaslo, B.C.

The property was located in July 1892, and since that time has been owned and operated by different persons and groups of persons. Records of production are incomplete. It is reported that up to 1903 about 150 tons had been shipped and that production from 1904 to 1909 amounted to 134 tons. In 1920, 6 tons are recorded as having yielded about 32 ounces in silver a ton. Average values of shipments prior to 1909 are recorded at 162 ounces silver a ton. Some of the ore carried exceptionally high silver values and is said to have averaged about $2 a ton in gold.

The underlying rocks include one stock-shaped mass about 1,000 feet in diameter of medium-grained granite. This stock intersects Slocan sediments intruded by many conspicuous dykes of quartz porphyry. The sediments comprise interbedded argillaceous and quartzitic beds and have a general northwesterly strike with dips to the northeast or southwest in most places, at rather low angles.

The underground workings, comprising six or more adits, are extensive but are mostly inaccessible and afford little information regarding either the ore-bodies that have been worked out or the mineralization yet remaining.

The workings explore two nearly parallel lodes, several hundred feet apart. Most of the work has been done on the "Old" or "Silver Glance" lode. It is investigated by five or six adits, of which the lowest is at an elevation of about 6,150 feet, and the uppermost more than 200 feet higher. When visited in August, 1927, all but No. 3 adit were caved. As developed in these workings the lode cuts across the granite stock, mentioned above, and much of the work seems to have been done within the stock. The lode is a sheared, mineralized fissure zone striking north 25 degrees to 45 degrees east and dipping southeast at an angle of about 40 degrees. Its average width is probably about 2 feet. The lode is composed chiefly of crushed rock, but, locally, carries considerable vein quartz and some ore minerals. The quartz occurs as a series of lenses, bands, streaks, and

irregular masses. It is white, massive, granular, or vuggy, and contains a little galena and grey copper in nests, streaks, and patches. Brittle silver (stephanite) and silver glance (argentite) are also stated to occur and picked specimens have assayed as high as $15,000 a ton, chiefly in silver.

The "New" lode is a comparatively recent discovery and in 1928 had been explored by a couple of open-cuts and a 40-foot adit. The lode is a fairly well-defined fissure cutting sediments and quartz-porphyry dykes on strike of north 45 degrees east and a dip of 45 degrees northwest. It carries lenses and bands of vein quartz varying from a few inches to 3½ feet thick and mineralized, principally, with disseminated grey copper. The mineralization seemed most pronounced where the lode crosses the porphyry dykes.

SMUGGLER CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1928, pp. 306-307.

The Smuggler Crown-granted claim is owned by H. Bernard Morrison, Nelson, B.C. It is at the headwaters of Keen and Enterprise creeks on the westerly edge of Kokanee glacier at an elevation of about 7,700 feet. Access may be obtained by road and trail up either of these creeks, the commonly used route following up Keen creek from Zwicky.

Production has amounted to 14 tons of silver-lead ore reported to have yielded 276 ounces in silver to the ton and 65 per cent lead.

The underlying rock is typical coarse-grained, porphyritic, Nelson granite which, in this vicinity, forms the high Kokanee massif.

Workings comprise three adits and several open-cuts and in July 1927 were inaccessible because of snow and caving. They explore a lode 3½ to 6 feet wide, striking northwesterly and dipping steeply to the southwest. It is claimed that the lode has been traced southeasterly to the summit of the divide at the head of Kokanee creek and that in this direction it is believed to link up with the lode system at the Molly Gibson mine.

The mineralization, judging from the lode material on the dumps, occurs as varying widths of vein quartz, in part vuggy and in part chalcedonic, carrying lenses, bands, and streaks of galena, zinc blende, pyrite, grey copper, and traces of ruby silver. The dense, chalcedonic, and banded appearance of some of the quartz is characteristic of showings on a number of properties in this section of the district. The lode matter is partly oxidized.

A second lode, or "No. 2 vein", lies 500 feet southwest of and about parallel with the main lode and has been prospected by shallow surface workings at an elevation of about 7,400 feet. It is, principally, a quartz vein, 1½ to 2 feet wide, in which little sulphide mineralization can be seen.

SNOWSTORM (SLOCAN CHIEF) CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1928, p. 307.

The Snowstorm is a surveyed claim owned by C. W. Tipping, Slocan. This claim, originally named the Slocan Chief, formed one of a group at the headwaters of Keen creek close to Kokanee glacier, adjoining and to the northwest of the Smuggler group. The claim is accessible by road and trail up either Enterprise or Keen creeks.

Small shipments were made in 1900, 1923, and 1924. Four tons produced in the last two of these years yielded 144 ounces in silver to the ton and 13 per cent lead.

The underlying rock is chiefly the coarse-grained porphyritic granite of the Nelson batholith.

The workings were covered with snow at the time visited, July, 1927. The following account is from the Resident Engineer's report for 1928.

"On the Slocan Chief some old workings develop two small veins striking southeasterly and dipping to the southwest. At about 6,600 feet a drift-tunnel extends about 200 feet along a narrow vein without developing any appreciable amount of ore. From a deep open-cut above this tunnel some high-grade ore is reported to have been extracted. About 40 feet in the tunnel from the portal a second vein is intercepted in a short crosscut. This vein is from 4 to 6 inches wide and contains galena, zinc blende, and possibly silver sulphides. . . . . This little vein is clean cut with gouge on either wall. Due to the caved condition of some of the workings the results are somewhat indefinite."

SUNSET CLAIM

References: Ann. Rept., Minister of Mines, B.C., 1901, p. 1029; and other years.

The Sunset Crown-granted claim lies east of and adjoins the Wellington claim of the Wellington group (*See* Figure 14) at an elevation of about 1,800 feet above, and 2 miles by trail north of, Retallack station. It is owned by the estate of A. H. Buchanan, % the Bank of Montreal, Rossland, B.C.

No work has been done on the property since it became involved in certain legal entanglements over twenty-five years ago. The claim was staked in the early nineties and considerable work done on a lode regarded as an easterly extension of the Wellington vein lode. In 1901 shipments of 52 tons of silver-lead ore carried 160 ounces in silver to the ton and 26·5 per cent lead.

The underlying rocks belong to the Slocan series and are like those on the adjoining Wellington and Charleston properties. The principal members are slates and slaty argillites striking from west to about northwest and dipping northerly in the vicinity of the mine workings. One narrow bed of quartzite was observed at the junction of the lower crosscut adit with the lode.

A shaft was first sunk on an outcrop of vein matter in the lode and, it is said, some drifting was done from the shaft. At an elevation 80 feet below that of the collar a crosscut adit was run from the surface for 250 feet to where it intersected the lode. Drifts were run east and west along the lode and stopes extended to the surface. In these workings the lode strikes nearly east, dips to the north at about 55 degrees, and angles across the enclosing strata, which strike about north 60 degrees west and dip 50 degrees northeast. Much of this work was done in 1900. In the following year the Goldfields Syndicate of Rossland took a lease on the property and, it is stated, worked it from the lower level of the Wellington mine and shipped a considerable tonnage of silver-lead ore.

Very little vein mineralization was observed in the now accessible portions of the workings, but judging from material on the dumps it consisted of an intimate mixture of zinc blende, galena, grey copper, and

pyrite in a gangue composed chiefly of quartz but containing some siderite. Zinc blende appears to have been the predominant sulphide and in part has a dense, cherty appearance.

SUNSET GROUP (WOODBURY CREEK)

References: Ann. Repts., Minister of Mines, B.C., 1899, pp. 700-701; 1904, p. 157. Richmond, A.M.: Dept. of Mines, B.C., Bull, No. 1, 1932, pp. 118-119.

The Sunset group, comprising Sunrise, Grand View, and Granite Crown-granted claims, lies south of Sunset lake at the head of the first west fork of Pontiac creek, a tributary of Woodbury creek. The property is owned by Alice J. Caldwell and the estate of W. C. Chaplin, % Welland Vale Manufacturing Company, St. Catharines, Ontario, and is accessible by road and trail up Woodbury creek from Kootenay lake, a total distance of about 12 miles.

The Sunset property is credited with a production of about 60 tons, but values are not given.

The workings include seven or more adits, two or more shafts, and open-cuts. The adits range from 6,450 to about 6,800 feet in elevation. These workings were caved or otherwise inaccessible at the time visited, June, 1927. From what could be seen, as well as from earlier reports, it appears that this property, together with the Scranton claim and Pontiac-Tecumsie group to the northeast, are traversed by the same lode system in which a series of quartz veins with a general northeasterly course cut across coarse-grained, porphyritic, Nelson granite. The quartz veins are locally well mineralized, carrying shoots of clean and mixed ore containing galena, pyrite, zinc blende, and high-grade silver minerals. Values have been largely in silver, lead, and gold, the latter associated, it is thought, with the pyrite. Operations have been handicapped by difficulties in transportation necessitating shipments of only the higher grade material, whereas much of the ore developed is of a concentrating character. To what extent any particular quartz vein is continuous is not known, but it would appear that certain veins at least have been traced for half a mile or more and may be much longer. They occur in shattered and sheared mineralized zones 30 feet or more in width, each zone carrying, probably, several quartz veins and more irregular quartz deposits. The quartz is, principally, a massive milky type, but shows honeycombed and vuggy textures and is associated with a little siderite. Surface outcrops of vein matter are oxidized.

T. C. F. GROUP

The T. C. F. group comprises six claims held by location and is north of Kaslo close to the west shore of Kootenay lake. It is owned by E. F. Timms, *et al.*, of Kaslo.

The property was staked in 1896 and most of the work on it was done many years ago.

The group is underlain by metamorphosed sediments of the Lardeau series and many granitic intrusives. The metamorphic rocks include a variety of schists interbedded with much crystalline limestone and other limy strata. These rocks strike a few degrees west of north and dip mainly to the west at from 35 to 40 degrees.

The workings are partly inaccessible. They comprise two adits and a shaft. The adits represent about 450 feet of work and are 200 feet apart vertically. The lower is about 600 feet above Kootenay lake.

The workings have investigated three quartz veins. The Main vein trends nearly north, dips steeply to the east, and varies from a few feet to 40 feet in width. The Shaft vein is smaller and apparently lies at an angle of about 20 degrees to the Main vein. The Third vein strikes nearly east and dips 45 degrees to 50 degrees north. The upper adit is about 330 feet long and is in part a drift 180 feet long on the Main vein. The lower adit intersects both the Shaft and Third veins, on the former of which a shallow shaft has been sunk.

The veins locally carry disseminations and pockets of pyrite, pyrrhotite, chalcopyrite, and (?) galena. Values are in gold, assays of the better mineralized vein matter being reported as $10 in gold to the ton. Mostly, however, the values do not exceed $1 or $1.50. Further exploration of these veins has been contemplated with the view, particularly, of investigating their intersections, places that have not yet received attention.

TEXAS-COWBOY GROUP

References: Ann. Rept., Minister of Mines, B.C., 1926, p. 263; and other years.

The Texas-Cowboy group, comprising the Cowboy, Texas, Garland fraction, Minnie, and Carbonet No. 2[1] Crown-granted claims is in the upper basin of Robb (Spring) creek and is accessible by trail, 3 miles long, from Blaylock station. It is owned principally by A. T. Garland, Kaslo, B.C.

Records of production are incomplete but it is reported that a carload of ore was shipped from this property in 1895. Subsequent operations, under lease, provided shipments of 12 tons in 1897 and 7 tons in 1898. The 1897 output yielded an average of 90 ounces in silver to the ton and 64 per cent lead. All three shipments were made from the Texas claim. A few tons were also produced from small workings on the Cowboy claim.

The underlying rocks are Slocan sediments intersected by minor intrusives. The sediments are largely slaty argillites and andalusite schists interbedded with limestone strata varying from a few feet to over 100 feet in thickness. The general strike is northwesterly and the dips are mostly to the southwest at about 55 degrees. The intrusives include acid dyke rocks and irregular bodies of medium-grained, biotite granodiorite as much as several hundred feet wide.

The principal workings are on the Texas claim and comprise a shaft and three adits driven at intervals over a vertical range of 145 feet below the shaft. They are partly inaccessible. Old mine plans indicate that the shaft, sunk from the surface on the Texas vein lode, communicated at a depth of 20 feet with a short intermediate drift which in turn was connected by a winze with the uppermost adit 40 feet, vertically, below the intermediate level. This adit is over 160 feet long and from near the face a second winze is indicated as having been sunk on the lode for about 90 feet. Of these upper workings, only the adit is accessible and is so badly caved towards the face that it does not permit entry to the other workings with which it is connected.

[1] *See* separate report on this claim.

References to discoveries in these upper workings indicate that the Texas lode had a strike of north 60 degrees west, dipped southwest at 69 degrees, and had a maximum thickness of 4 feet. It carried vuggy and massive quartz and siderite bands or lenses with a little zinc blende. A lens of pyrite occurred in the intermediate drift and was about 25 feet long and up to 4 feet thick. It carried a little zinc blende and a few specks of galena. Clean galena ore formed irregular, small pockets.

About 85 feet below the upper adit are two other adits known as the Old and New Lower adits, respectively. The Old Lower adit was driven 70 feet northwesterly and towards the face encountered a wide shear zone striking nearly east and dipping south at about 60 degrees. This shear zone was investigated by short crosscuts and by a drift extending easterly for 50 feet. The zone is about 10 feet wide and angles across the blocky argillites and limestone intersected by a tongue of granodiorite and other smaller dykes. Towards the east face of the drift a little vein mineralization, including some galena, was observed along the hanging-wall of the shear zone which at this place intersects limestone.

The New Lower adit is a crosscut from a point 145 feet to the north of the Old Lower adit. It runs southwesterly for 150 feet at which point it encounters what is apparently the shear zone investigated in the other adit. Here, however, the shear zone is narrower, and carries little or no mineralization. The foot-wall is of granodiorite and hanging-wall of limestone. A crosscut carried south for more than 100 feet encounters granodiorite within a few feet and continues in this rock to the face.

The relation between the lode encountered in the old upper workings and the shear zone found in the two lower adits is not clear. It is possible they are parts of the one lode and that this lode follows the edge of the granodiorite body encountered in the new lower adit. The granodiorite body is probably that outcropping along the trail immediately north of the Texas cabin. Further surface prospecting in the vicinity of the shaft and along the north contact of the intrusive in the vicinity of the cabin might throw light on the structural relation of the vein deposits to this intrusive.

U.S. CLAIM

The U.S. Crown-granted claim, owned by Laura Giegerich, % H. G. Giegerich, Kaslo, B.C., is in the upper basin of Jackson creek to the northeast of and adjoining the Almeda claim of the Echo-Almeda group (*See* Figure 13).

Shipments from the U.S. claim have been valued entirely for their zinc content. The only productive years, 1913 and 1914, witnessed an output of 180 tons carrying an average of 52 per cent zinc. No work has been done on the property since that time.

The underlying rocks are chiefly slaty Slocan sediments interbedded in the vicinity of the lower main adit with more massive, argillaceous beds. All the strata are more or less heavily pyritized. They have a general northerly strike and dip east at about 55 degrees. Local irregularities are common and there is evidence of much faulting and fracturing. The sediments are intruded by acid and basic dykes, of which the former tend to follow the strike of the bedded rocks, whereas the basic dykes cut irregularly across them.

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The workings comprise two long and two short adits lying between elevations of 6,550 and 6,800 feet. Examination of some of the underground workings was prevented by the accumulation of water.

The principal lode is conformable with the enclosing sediments, striking north and dipping 55 degrees to the east. The lowest adit intersects this lode by a crosscut 225 feet long driven easterly through fairly massive, black, siliceous argillites. The lode is a mineralized fault-fissure marked by several inches of gouge and crushed rock. It has been drifted on for 90 feet south of the crosscut and a little stoping has been done on it at intervals. At the face of the drift the lode shows 2 inches of pyrite associated with several inches of lode matter carrying sparsely disseminated sulphides. The lode has evidently been drifted on for some distance north of the crosscut and in this direction is developed by stopes and raises connecting with upper workings. Entry to this drift was prevented by water. The upper adit, 100 feet above, angles for some distance northeasterly across black, carbonaceous, slaty argillites. Whether it reaches the lode is not known.

A short adit, 210 feet above and 700 feet northeast of the portal of the lowest main adit, runs for 50 feet across broken, black, slaty argillites and follows a mineralized shear striking north 70 degrees east and dipping 50 degrees to the southeast. The course of the shear is marked by a width of from 2 to 6 inches of gouge and crushed rock carrying much disseminated pyrite. Specimens on the dump contained narrow veinlets of galena and zinc blende apparently following joint fractures in the sediments. Another short adit 350 feet south and about 100 feet above the portal of the lowest main adit is a crosscut driven south for 35 feet across broken, pyritic argillites intersected by one, narrow, basic dyke, to reach a broken, quartzose lode exposed a short distance above the portal. This lode strikes north 50 degrees east and dips southeast. Aside from pyrite little mineralization was noted and nothing of interest was observed in the crosscut itself.

UTICA GROUP

References: Ann. Repts., Minister of Mines, B.C., 1910, p. 97; 1911, p. 131; 1913, p. 124; 1922, pp. 190-191; 1923, p. 210; 1924, p. 189; 1928, p. 304; and other years.

The Utica group comprises seventeen claims including Utica, Rock Bolder, Andrew Jay, Colorado, Pay Ore fraction, and Alice No. 5 fraction Crown-granted, and several surveyed but not Crown-granted, claims. It is at the head of Twelvemile creek and on both sides of the high divide between the basins of Kaslo and Carpenter creeks. The property is accessible from Keen (Adamant) station by a road 5 miles long leading up the valley of Twelvemile creek. It is owned by Utica Mines, Limited (N.P.L.) with head office at 213 Bank of Nova Scotia Building, Vancouver, B.C.

The property has been operated by a number of persons and organizations. The principal lode or lodes were discovered and staked in July, 1892.

The first recorded production was in 1909 when 34 tons of silver-lead ore yielded, on the average, 84 ounces in silver to the ton and 24 per cent lead. Production to the end of 1912 is recorded as being 1,110 tons, yielding 142 ounces in silver a ton and about 15 per cent lead. In 1911, 267 tons of

silver-lead ore was mined and yielded 37,756 ounces of silver and 61,518 pounds of lead. Shipments of zinc ore commenced in 1913 and continued in the following three years. During this period the recorded output was 2,782 tons, with an average content of 130 ounces in silver to the ton, 15·5 per cent lead, and 4·5 per cent zinc. In 1913, 40 tons of zinc ore was shipped. One car lot of zinc blende ran 122 ounces in silver to the ton and 38 per cent zinc. In 1913, 660 tons of silver-lead and silver-zinc ore was produced. Up to 1914 most of the production had been won from what has been called the "Small" or "East vein." In the first quarter of 1916 shipments included 230 tons of lead concentrates and 20 tons of zinc concentrates. Production during the years 1917 to 1922 inclusive amounted to 1,672 tons and carried an average of 117 ounces in silver to the ton and 14 per cent lead. No shipments have been made since 1922.

The rocks on this property are Slocan sediments and later intrusives. The former include a variety of interbedded types of which limestone and andalusite schists are most conspicuous. Heavy beds of limestone are prominently exposed on the steep, northeastern slopes of Paddy peak and are remarkable for the intensity of deformation they exhibit. The more argillaceous rocks are characterized by abundant, acicular crystals of andalusite which, though commonly small, are in places an inch or more long. The lamination planes of these more highly metamorphosed rocks are commonly lustrous from the abundant colourless mica, and on such surfaces the casts of long, irregularly orientated, crystals of andalusite form depressions resembling bird tracks.

The intrusive rocks include a number of dykes, chiefly of acid rocks, and three prominent, stock-shaped bodies of medium-grained, biotite granite. The largest stock outcrops to the north and northwest of Paddy peak, and occupies an area about half a square mile in extent. The two other stocks are much smaller. About 2,000 feet southwest of the mine workings the Slocan sediments are in contact with the main body of porphyritic granite of the Nelson batholith with which the stocks are presumably related and to which the metamorphism of the sediments is mostly due.

The structure of the sedimentary rocks is complex. Their general trend at a distance from the intrusives is northwesterly, but in the vicinity of the intrusives cross-folds strike nearly northeast. Cross-folding is notable in the upper main workings of Utica mine and along the northeastern slopes of Paddy peak between these workings and the batholithic contact. Faulting and shearing are conspicuous and individual outcrops show extreme distortion of the beds. Northwest of the mine workings, however, the structure becomes more regular and takes on the general form of a syncline overturned slightly towards the southwest, so that the prevailing dips are at rather high angles to the northeast.

Five principal adits and a shaft explore the main lode. In addition a number of short adits were run years ago, to prospect a mineralized cross-fissure subsequently abandoned in favour of the main lodes. The workings on the main lode commence 100 feet or so below Paddy peak and may be referred to from uppermost down as Nos. 1, 2, 3, 4, and 5 adits, respectively. Assuming the elevation of No. 5 to be 6,150 feet above sea-level, the elevations of Nos. 4, 3, 2, and 1 adits would be about 6,500, 6,720,

7,570, and 7,670 feet, respectively. In addition, what appears to be a short, prospect drift-adit about 25 feet long is situated about 170 feet above No. 3 adit.

The principal development has been done and the bulk of production has come from between Nos. 4 and 3 adits. Each of these levels explores two nearly parallel lodes referred to as the "East" or "Small" lode and the "West" or "Big" lode. These lodes have a fairly uniform strike of south 40 degrees west, varying, in places, from south 30 degrees west to south 50 degrees west, and dip southeast at angles varying between 65 degrees and 70 degrees. They are about 90 feet apart on No. 3, and 115 feet apart on No. 4, level. The intervening ground carries numerous, small, mostly irregular, stringers of vein matter, chiefly calcite. The upper workings, Nos. 1 and 2 adits, were inaccessible at the time visited (July, 1926) because of ice and caving, but so far as could be seen did not appear to explore more than one lode, thus leading to the conclusion that either the two lodes of the lower levels had united or that one was discontinuous. That they joined appears the more likely view since they are closer together on No. 3 than on No. 4 level, and the block of ground between the two lodes on Nos. 3 and 4 levels carries vein matter related to that of the lodes.

No. 4 adit reaches the East lode by a 130-foot crosscut from the southeast and continues to the West lode, a farther distance of 130 feet. According to mine plans drifts were run on the East lode for over 1,200 feet southwest and 100 feet northeast. These drifts were caved at short distances from the crosscut, at the time visited. Drifts on the West lode have been run for over 1,200 feet southwest and 100 feet northeast and were accessible to the northeast face and for 750 feet to the southwest. No. 3 level, 220 feet above No. 4, is a drift adit on the East lode for about 600 feet. At 150 feet from the portal a crosscut, 90 feet long, connects with the West lode which has been drifted on for 680 feet southwest and 70 feet northeast. Most of these workings are accessible.

The wall-rocks of the lodes and the rocks between the lodes are andalusite schists with narrow interbeds of limestone and limy argillites. The rocks have very nearly the same strike and dip as the lodes. Two well-defined limestone beds, each several feet thick, occur, one along or near the hanging-wall of the East lode, and the other between the two lodes.

Little mineralization could be seen in the drifts along the East lode, as the productive portion has been stoped out. The lode varies in thickness from a few inches to 7 feet and is composed chiefly of crushed rock lying between a well-defined foot-wall and a fairly well-defined hanging-wall, both marked by narrow seams and streaks of carbonaceous, slickensided gouge. In the productive section on No. 4 level the lode contained an important vein deposit which has been stoped over a length of about 700 feet commencing 150 feet from the crosscut. This ore-body proved continuous in a raise to No. 3 level over a height on the dip of 264 feet and has been stoped out between these levels. The ore formed a paystreak along the foot-wall on No. 4 level, varying in width from a mere streak to 32 inches and averaging about $2\frac{1}{2}$ inches over the length of the stope. This paystreak consisted of argentiferous galena and zinc blende interbanded with calcite, siderite, and a little quartz. The zinc blende carried much more silver than the galena owing to its more intimate association

with grey copper and to the presence, as reported, of horn silver. A little native silver was also present.

The West lode varies from 3 to 20 feet in thickness, and is largely composed of crushed and sheared rock, but possesses well-defined walls marked by heavy seams of carbonaceous, slickensided gouge. The productive section was encountered about 200 feet southwest of the crosscut on No. 4 level and extended along the level for over 600 feet. The vein matter has been largely stoped out above this section to and for some distance above No. 3 level. The ore along and above No. 4 level occurred as a succession of shoots angling across the lode from wall to wall with comparatively barren intervals between. The location of the shoots appeared to be influenced by cross-fissures and no continuous paystreak, as in the East lode, was present. The ore as mined was chiefly of milling grade, carrying argentiferous zinc blende as the abundant ore-mineral and including pockets or small shoots of fairly clean zinc blende. In one raise a crosscut 8 or 10 feet into the foot-wall is reported to have struck granite with a little quartz and iron pyrites along the contact. The principal gangue mineral in the West lode is calcite which forms bands or lenses 2 or 3 feet thick. A little siderite and quartz are also present. Specimens of the ore indicate that movements occurred since its deposition, the zinc blende being greatly fractured and the galena commonly gneissic or banded and flowing around fragments of zinc blende or filling interstices in it.

In following the course of the lode system up the steep flank of Paddy peak much the same rocks were noted in about the same relative positions. The larger stock of granite lies close to and northwest of the lode and is probably the granite encountered in the raise mentioned above. The upper adits open onto a steep, rocky ravine that can be climbed only with difficulty. At the portal of No. 2 adit a band of limestone lies on the hanging-wall side and another on the foot-wall side of the lode which here follows a band of andalusite schist about 7 feet thick. Above the portal of this adit the limestone beds seem to come together and still higher up may pinch out or be faulted off. The character and extent of the mineralization in these upper workings were not ascertained. Some oxidation has occurred and marks the course of the lode at these higher elevations.

Work in recent years has been mostly centred on exploring the ground at depth and has included the running of No. 5 crosscut adit to pick up the lode system at a depth of 350 feet below No. 4 adit. The crosscut was started from a point close to creek bottom about 2,800 feet north 75 degrees east of the portal of No. 4 adit. It was driven for 2,012 feet north 86 degrees west, or at an angle of about 55 degrees to the lodes as developed on levels 3 and 4. If the East lode had continued with the strike and dip displayed on Nos. 3 and 4 levels, it should have been encountered by No. 5 adit, because the face of this crosscut, according to a rough survey, lies about vertically beneath, and 1,500 feet northeast of, this lode at the level of No. 3 adit, nearly 600 feet above. So far as could be seen no fault such as might be expected to offset the lode system was encountered in this crosscut. It appears as if a lode system having the strength indicated at No. 4 level should persist to at least the level of the No. 5 crosscut and that the East lode must have changed either its strike or dip, or both, in the interval between No. 4 and No. 5 levels and, therefore, the lode might have

been encountered by continuing the No. 5 crosscut along its original course. Instead, the crosscut was continued along a southerly course to get under the lode system where explored in the upper workings. At the time visited (July, 1927) the crosscut had been extended 450 feet and from the end two crosscuts had been run, one to south 70 degrees west for about 200 feet and the other south 40 degrees east for about the same distance. None of these workings had encountered anything resembling the East lode, although two or three small slips carrying a little mineralization but striking and dipping contrary to the lode had been intersected. It was observed, however, that in these inner workings the strata strike nearly north, whereas on Nos. 3 and 4 levels their strike is about north 40 degrees east. The dips in both the upper and lower workings appear to be mainly to the southeast or east, although one or two westerly dips were observed in No. 5 level. It seems not at all unlikely that the lode has swung with the strata and if it has the distance from the portal of No. 5 adit to the lode would be increased.

Some work was done in early years on a fissure-vein lode striking north 27 degrees west and dipping 50 degrees to the northeast. This lode outcrops about 800 feet north 27 degrees west of the portal of No. 3 adit and at about the same level. It was investigated by a 200-foot drift adit at this point and by three short adits higher up. All these workings are caved and little could be learned of the character of the lode matter encountered.

VERA CLAIM

Reference: Ann. Rept., Minister of Mines, B.C., 1926, p. 263.

The Vera claim, held by location, is about 1,800 feet above and 1½ miles southwest of Blaylock station and about opposite the mouth of Lyle creek. It is owned by G. H. Murhardt, of Three Forks, B.C.

The underlying rocks are mostly slaty argillites and interbedded limestone of the Slocan series. They strike about north, are nearly horizontal or dip at low angles, up to 30 degrees, to the west, and are intersected by quartz-porphyry dykes.

The workings comprise two adits about 50 feet vertically apart. The lower is 260 feet long. For most of its length it follows one or more fractures striking about south 30 degrees west and dipping steeply to the northwest. These are as much as an inch or more wide and for distances of several yards are filled with coarse cube galena. The fractures are productive where they intersect a thick bed of grey limestone, but, as investigated by a couple of raises, are lost where they reach overlying slaty beds.

The upper adit is driven southwesterly along a shear zone following the bedding of flat-lying slaty argillites. The zone is 5 or 6 feet wide and is filled with crushed rock and gouge. Some crosscutting has been done, but so far as could be seen no ore mineralization is present.

VIOLET GROUP

Reference: Ann. Rept., Minister of Mines, B.C., 1921, p. 133.

The Violet group, comprising Violet and Lookout claims, held by location, belongs to D. McLellan, Dr. Henry Ainsworth, and W. MacLanders of Kaslo, B.C. It is at the head of Silver Spray creek, a northern tributary

of Woodbury creek. The property is accessible by a trail 3½ miles long branching from the Woodbury Creek trail at a point 9 miles from Kootenay lake. The workings lie at elevations of between 8,300 and 8,400 feet above sea-level on the western slope of Sunrise mountain within a few hundred feet of the summit.

Records of production indicate that 4 tons of silver-lead ore shipped in 1921 contained an average of 262 ounces in silver to the ton and 13 per cent lead.

The underlying rock is the coarse-grained, porphyritic granite of Nelson batholith.

The workings were covered with snow at the time visited (June, 1927). They were examined in 1921 by B. T. O'Grady who reports as follows.

"The ore, consisting principally of grey copper and silver sulphides, with small amounts of galena and pyrite, is found in siliceous stringers and bunches on the foot-wall side of a sheared zone in granite which strikes northeasterly along the summit of the divide. The hanging-wall is not clearly defined, but the lead appears to have a width of from 6 to 15 feet and almost vertical dip. Within the lead the granite is much altered in appearance, with highly siliceous phases.

"Just below the summit a 50-foot tunnel has been driven on the lead. Sixty feet vertically below this level a tunnel has been driven 110 feet, partly as a crosscut and partly along the hanging-wall side of the lead. Fifty-four feet in from the portal of this tunnel a 10-foot crosscut has been made to the foot-wall of the lead, which was then drifted on for 15 feet to the northeast and 26 feet to the southwest. Near the extremity of the lower tunnel a raise connects with the upper tunnel.

" The ore is carefully sorted for shipment, as packing charges from the workings to Kootenay lake are about $35 a ton. Grab samples of sorted ore gave: Upper tunnel: gold, 0·02 ounce; silver, 935·5 ounces; lead 31·2 per cent; zinc, 3·9 per cent. Lower tunnel: gold 2·03 ounces; silver, 90·1 ounces; lead, 33·5 per cent; zinc, 1 per cent.

Mr. McLellan, one of the owners, reports that the lode has been traced on the surface by open-cuts for 300 feet and that a few tons of very rich silver ore were extracted by surface operations. The rich ore was stated to occur as a persistent paystreak from 3 to 6 inches wide, with free walls. Picked specimens have assayed over 2,000 ounces in silver to the ton.

VOYAGEURE CLAIM

The Voyageure Crown-granted claim lies at the head of the first creek west of Tenmile creek, to the north of and about 3,700 feet above Keen (Adamant) station. It is accessible by the " Blue Ridge " trail which leads from the Sandon-Kaslo highway a few hundred feet west of the crossing of Tenmile creek. The claim is owned by B. Bainbridge, Kaslo, B.C.

The property lies within the area of the Kaslo series. The workings, comprising three adits, are in a body of greenish rock probably of volcanic origin and now largely composed of ankeritic carbonate, quartz, and a greenish mica resembling mariposite. This rock is penetrated by numerous stringers and lenses of quartz associated here and there with bunches of

ore minerals including zinc blende, galena, pyrite, and chalcopyrite. The zinc blende has a highly resinous appearance, a feature rather characteristic of the zinc blende on other properties within the Kaslo series.

WELLINGTON GROUP

References: Geol. Surv., Canada, Ann. Rept., 1895, pt. A, p. 32.
Ann. Repts., Minister of Mines, B.C., 1896, p. 65; 1928; and other years.

The Wellington group (Figure 14) comprising Wellington, Blutcher, I.C., Ivanhoe, Ottawa, Metis, Tiger No. 2, A.Y., and Hazel Crown-granted mineral claims, the Porcupine (Homestake) surveyed claims, and two claims held by location, is owned by Wellington Mines, Limited, with head office at 605 Empire State Building, Spokane, Wash. It is a consolidation, made in 1927, of the Wellington and Homestake groups, the former comprising the first six of the Crown-granted claims mentioned above. The property is on the north side of Kaslo Creek valley near Retallack station. It adjoins and lies west of the Whitewater, Whitewater Deep, and Charleston groups and the Sunset claim.

The Wellington, the original claim of the group, was discovered in 1892, and was shortly afterwards purchased along with the neighbouring claims by Kootenay and Columbia Prospecting and Mining Company of Ottawa, Ontario. This company opened up the Wellington lode on the Wellington claim under the impression that it was the continuation of the Whitewater lode. Between 1892 and 1897 nearly 600 tons of silver-lead ore valued at over $55,000 was shipped from this claim.

In March, 1897, the company reorganized as the Wellington Silver Mining Company, Limited. A few tons of ore were shipped by this company from the old workings in 1902 and operations by lessees in 1908, 1909, and 1910 resulted in shipments of 90 more tons of silver-lead ore. Altogether the mine is reported to have produced between $90,000 and $100,000 worth of ore.

In 1923 the property was purchased by the Slocan Consolidated Silver Mines, Limited, and in 1927 the property, together with the claims of the Homestake group, was acquired by the present owners.

The rocks on the Wellington group are lower members of the Slocan series and are essentially similar to those on the adjoining properties to the east. Towards the base of the section they are principally slates and thinly laminated argillaceous beds with which are interstratified beds of grey quartzite, up to several feet thick, and a little impure limestone. These lower members are overlain by a heavier series of argillaceous and calcareous beds including considerable limestone. The strata have a general westerly strike varying to nearly northwest. They are folded into a series of anticlines and synclines (*See* structure section CD, Figure 3, Memoir 173, in pocket) in which the predominant dip is to the south or southwest. Locally they are much sheared and crushed. They are penetrated by a few dykes, most of them small and basic resembling those found underground at the Whitewater mine.

At least three prominent lodes occur on the Wellington group (*See* Figure 14). Only on the Wellington lode, however, has any considerable work been done. It outcrops on the Wellington claim and has been

explored by four shafts, two crosscut adits at depths of 40 and 200 feet respectively below the lode outcrop, and by intermediate levels at 80 and 140 feet below the surface. The structure of this lode is difficult to define as the underground workings are largely inaccessible and outcrops are few.

Old mine plans indicate that work has been done on either two lodes or on hanging and foot-wall splits of one. The hanging-wall split or south lode strikes about north 50 degrees east and dips 60 degrees southeast. On the 200-foot level it was intersected 555 feet from the portal of No. 2 crosscut adit, and has been partly stoped from this level. To the east the drift on this lode extends at least several hundred feet and in this direction probably continues into the adjoining Sunset claim. The foot-wall split or north lode was intersected on the 140-foot level, but developed mostly from the 80-foot intermediate level. It strikes about east and dips north, at about 70 degrees. At the surface it appears as a wide, crushed zone and has been traced easterly onto the Sunset claim where it is continuous with the Sunset lode. On the Wellington claim the highest grade ore was obtained from this north lode, as much as 5 feet of solid galena being found in the winze between the 40 and 80-foot levels. This lode has produced about 75 per cent of the ore from the Wellington mine.

About 1,000 feet south of the outcrop of the Wellington lode a strong, sheared, fissure zone, presumably the westerly continuation of the Whitewater lode, cuts through the I.C. and Metis claims. One old shaft and another freshly timbered shaft have been sunk on this lode on the I.C. claim. The lode here strikes north 80 degrees west and dips steeply south. Some mineralization was noted in material on the dumps at the mouths of these shafts, but the nature of its occurrence and the extent of the workings from these shafts were not ascertained. On the Blutcher claim, to the north of the Wellington, is another lode regarded as the westerly extension of the Charleston lode. It has been intersected on the Blutcher claim by a short crosscut but is not otherwise prospected.

The Wellington, Whitewater, and Blutcher lodes are all strongly sheared, mineralized fissure zones cutting at a small angle across, mainly, slaty, argillaceous sediments. The ore shoots that have been discovered rake to the east and are of lenses of zinc blende, galena, and grey copper, quartz, crushed and slickensided wall-rock, and siderite. The proportion of quartz gangue is generally high. The ore, in general, as obtained from workings on the Wellington claim, carries a high silver value in proportion to the amount of lead. It assayed from 125 to 328 ounces in silver to the ton and 10 to 55 per cent lead in carload lots, an average for 400 tons being 175 ounces silver a ton and 30 per cent lead. The zinc of these ores has hitherto received no attention, but should prove important in future developments.

Work on the Porcupine (Homestake) mine has been chiefly on a lode presumed to be the westerly extension of the Whitewater lode from the adjoining I.C. claim. The lode is a strongly sheared zone conforming with or angling slightly across slaty, argillaceous rocks and interbedded limestone on a general east strike and a dip to the south of about 70 degrees. The principal workings comprise two adits at the same elevation and con-

nected underground. They aggregate about 1,250 feet of lineal work and are situated about 400 feet below and 1,000 feet to the south of the portal of the main crosscut adit (No. 2) of Wellington mine. The face of these workings reaches to within a few feet of the I.C. claim boundary.

Below these workings a number of short adits have been driven to explore outcrops of vein matter in which some silver-lead mineralization had been noted. The lowest of these workings is on the Hazel claim and is about at the elevation of No. 10 adit of the Whitewater mine. In 1927 it was in about 250 feet.

More recent developments on this property are described in the Resident Engineer's report for 1928, as follows:

"Work was first confined to exploration of the upper horizon of the Whitewater vein in order to gain definite information regarding its continuity, dip, and strike, with a view to determining where the intersections of the Whitewater shear zone with important limestone beds would occur at depth. During the course of this work a little ore and favourable indications are reported to have been encountered, while sufficient information was obtained to allow a decision to be arrived at regarding the procedure for development at depth.

"Following this decision, plans were made to advance the old Hazel tunnel, which had been driven by former operators for a distance of 250 feet. This tunnel will gain a depth of about 800 feet below the old upper workings and, according to survey, will have to be advanced for 800 feet to reach the foot-wall zone of the Whitewater vein. At the end of the year this tunnel was reported to have been advanced 100 feet and at a distance of 270 feet from the portal, to have unexpectedly intersected a vein showing a width of 6 feet of commercial ore at a depth of 600 feet below the surface. It is understood that while the crosscut is being continued this vein will be explored."

WHITEWATER AND WHITEWATER DEEP GROUPS

References: Ann. Repts., Minister of Mines, B.C., 1892, p. 532; 1896, p. 64; 1898, p. 1082; 1907, p. 97; 1908, p. 94; 1910, p. 97; 1911, p. 132, and pp. 136-138; 1923, p. 210; 1925, p. 234; 1926, pp. 261-262; 1927, pp. 286-287; 1928, p. 303; and other years.
Rept. of Zinc Commission, 1906, pp. 174-177.
Geol. Surv., Canada, Sum. Rept. 1925, pt. A, pp. 210-212.

The above groups consist of twenty-four Crown-granted claims and fractions, covering 507·73 acres and embracing the amalgamated Whitewater[1] and Whitewater Deep[2] groups of claims (*See* Figure 14). They are owned by Whitewater Mines, Limited, Kaslo, B.C. The property is on the north slope of Kaslo Creek valley on either side, but mostly to the west of the valley of Whitewater creek. The portal of the lowest adit is alongside a railway spur 2,000 feet east of Retallack station.

The outcrop of the Whitewater lode was discovered in 1892, and the Whitewater and Irene claims were staked. During this first year 7 tons

[1] Whitewater, Irene, Myrtle R, Tennie C., Elkhorn, Little Ralph, Breslau, Hustler and Alpha No. 2 fraction.

[2] Paupers Dream, Nancy Hanks, Maude S., Fresno, Hazel C., Last Link, Easter, Vancouver, Wedge fraction, Whitewater Deep fraction, Yosemite fraction, Oregon, Bryan fraction, Silver Tip fraction, and Sloper fraction.

of ore, averaging 200 ounces in silver and 50 per cent lead, were shipped. Within the next few years much mining was done and some heavy shipments were made. In the late " nineties " the property was acquired by the Erl Syndicate. In 1898, 120 men were employed and the property was regarded as the best paying mine in the district. Early operations on the Whitewater property also included the commencement of the long No. 14 crosscut, 375 feet below No. 10 adit.

In the next few years quite a heavy production, chiefly from the Whitewater workings, was obtained in part by the owners of the property and in part by lessees. In 1904 a first shipment of zinc ore was made and carried good values in silver. Towards the close of 1905 the total production of Whitewater mine was estimated at 12,548 tons of lead concentrates and 8,435 tons of hand-sorted lead ore averaging 84·4 ounces silver to the ton, 33·9 per cent lead, and 18·5 per cent zinc.

In 1910 the entire mine plant was destroyed by fire. The Whitewater and Whitewater Deep properties at this time and for a number of years later were operated together. The production of this period was mostly by lessees whose small-scale operations in the vicinity of the old stopes of the upper mine afforded unusually handsome profits.

In 1923 the present organization, Whitewater Mines, Limited, was formed. This company acquired the Whitewater and the Whitewater Deep mines. During the nine years preceding this amalgamation the production, amounting to 6,793 tons, was the work of lessees. The total production of the mine up to this date was estimated to be 51,863 tons.

Since 1923 the company has been mostly engaged in developing the Whitewater Deep property. Production in 1924 and 1925 amounted to 763 tons averaging 65 ounces in silver to the ton, over 15 per cent lead, and about 15 per cent zinc. This was shipped in part as silver-lead and in part as silver-zinc ore. In 1926 the production amounted to 9,839 tons, chiefly mill feed which averaged from 3 to 4 ounces in silver to the ton, 4 to 6 per cent lead, and 16 to 20 per cent zinc. In the following year shipments by the company amounted to 5,558 tons, to which leasing operations in the upper workings supplied an additional 661 tons. The output was much heavier in 1928 when the company was able to take advantage of its own milling facilities; it is recorded at 24,553 tons.

At Whitewater mine the rocks are mostly carbonaceous slate, slaty argillites, and impure limestone beds lying towards the base of the " limestone " zone of the Slocan series, a zone containing an abundance of slaty argillaceous rocks but particularly characterized by a number of thick limestone strata. Interbedded with the slate and limestone in the vicinity of the Whitewater and adjoining properties are a few beds of quartzite whose outcrops are commonly distinguished by their grey colour, massive structures, and by a network of quartz veins and lenses. The sediments strike from nearly east to nearly southeast. The general dip is to the south or southeast, but the structure is complicated by minor folds and faulting so that northerly dips are observable both underground and at the surface. One basic dyke, 40 feet wide, was encountered in the first crosscut to the north not far from the portal of No. 10 adit. It also appears towards the east face of No. 11 level. The dyke is very much like, if not identical with, one observed on the Metlakahtla claim on the east slope

of Whitewater valley and which strikes about north 10 degrees west and dips steeply to the east. A similar basic dyke was observed towards the west end of levels 12 and 13 on the north side of these drifts. Several other basic dykes of peculiar greenish hue were also observed on 10 level. The greenish colour is due to numerous, small, flaky masses of a bright green mineral, probably mariposite (a chrome-bearing mica). Otherwise these rocks are composed chiefly of carbonates.

The great width of limestone is noteworthy of the Whitewater Deep mine. It is a rock more susceptible to replacement than the slaty, argillaceous types encountered in the upper workings and explains the occurrence and great width of some of the ore-bodies in these lower levels.

No. 14 crosscut, the main working adit, has exposed a cross-section of the formations encountered underground. This crosscut adit intersects the formations nearly at right angles and has a length of over 2,200 feet. For 1,400 feet from the portal the rocks are mostly platy argillites or slates, interbedded with some more blocky quartzitic bands and, at 150 feet from the portal, with one limestone bed several feet thick. In this distance a great number of fissures were observed, some of which show a little mineralization. These fissures strike about parallel with or at a small angle to the main lode, but may dip either to the north or south at angles varying from 45 degrees to perpendicular. Some are filled with vein quartz which forms lenses as much as several feet in thickness. Between 1,400 and 1,800 feet from the portal the crosscut passes through a thick belt of limestone and limy sediments that appear to be continuous with a thick limestone belt outcropping northwest of the wagon road west of the portal of No. 10 level. The large ore-bodies recently discovered in operation on and between adit levels Nos. 10 and 14 formed where this limestone belt is intersected by tributary fissures running out from the main lode. The limestone is consequently regarded as exceedingly important in the development of Whitewater Deep ground.

In No. 14 adit, the northern edge of the limestone band, a strongly sheared and mineralized fissure cuts across the adit with a dip of 30 degrees or less, to the south. This fissure is probably the downward continuation of the main Whitewater lode. At 175 feet past this lode is the foot of the main raise to No. 10 level. At a point 103 feet up this raise some vein matter was intersected and may be the Whitewater lode. The same lode is stated to have been picked up 30 feet below No. 13 level in a raise driven from No. 14 level at a point 150 feet past the main raise. Beyond this inner raise the crosscut continues for another hundred feet in rather slaty rocks and without encountering significant mineralization. The main raise to No. 10 level is in the hanging-wall of a massive bed of quartzite several feet thick with slaty rocks on either side. A similar, perhaps the same, quartzite forms the foot-wall of the Retallack raise above No. 10 level. The quartzite bed or beds indicate the dip to be about 50 degrees to the south.

The ore deposits at the Whitewater mine are associated with a strong zone of fissuring and shearing referred to as the Whitewater lode. This lode varies from a foot or more to 50 or 60 feet in thickness and, in the upper levels (above No. 7), where it has been most consistently followed, probably averages 5 feet wide. It has been traced on the surface for

several hundred feet vertically in the vicinity of the portals of tunnels 1 to 9 and, with considerable certainty, northwesterly up the west slope of Whitewater creek to the shaft on the Myrtle R claim. West of this shaft it is believed to continue into the adjoining property of Wellington mines. In the opposite direction, east of Whitewater creek, its course is more hypothetical, but it may be represented by a strong shear zone picked up by small workings on the American claim on Lyle creek. The total explored length, assuming such extensions, is about 3 miles.

The general course of the lode is very nearly west, or a few degrees to the north of west. Above No. 10 level the average dip is 47 degrees to the south, but at greater depth is considerably steeper. This change in dip is coincident with the passage of the lode from a zone of slaty rocks into more competent strata. In places the lode conforms with the attitude of the enclosing strata, but, in general, it has a somewhat steeper dip and angles slightly across them.

The Whitewater lode has been explored by eleven adits, Nos. 1 to 9 inclusive on the Whitewater group, and Nos. 10 and 14 on the Whitewater Deep group. Nos. 11, 12, and 13 are blind levels connected with those below and above by raises and stopes. No. 14 adit is about 1,500 feet below the highest outcrop of the lode, or 2,000 feet below it on the dip of the lode. The productive zone above No. 8 level was one large composite ore-shoot and has been mostly exhausted. Subsequent mining operations have been partly designed to explore the continuation of this shoot at depth and partly to develop the ore-bodies more recently discovered in the lower levels.

The ore-bodies of the upper and lower workings are of quite different types. In the upper levels the mineralization is concentrated along the Whitewater lode which occurs mainly in slaty, argillaceous sediments. The lode filling is composed of crushed rock, siderite, quartz, and ore minerals and shows evidence of considerable movement and shearing with development of much carbonaceous gouge and slickensided ground. The ore-bodies of the productive zone in this lode rake 30 degrees to 35 degrees east, a direction and dip corresponding to those of striæ along the walls of the lode. Towards the centre of the productive zone, between levels 3 and 7, a leaner portion of this zone has been mostly worked by lessees. It included ore of a character referred to as "black ore" which elsewhere above No. 3 level furnished a large tonnage. The ore minerals in the productive zone are galena, zinc blende, grey copper, and oxidized products, with some copper and iron pyrites. The associated gangue is chiefly siderite, but some quartz is present. The ore as stoped from these upper workings occurred in streaks and lens-like masses, the former averaging about 8 inches wide and the latter reaching, below No. 7 level, a maximum width of nearly 40 feet.

In the deeper workings the Whitewater lode at different places appears to have split into parts of about equal size that follow courses at a small angle to one another. Such a condition has made crosscutting and exploratory drifting imperative and although more such work remains to be done, explorations to date appear to indicate that, in most instances, the principal lode has been followed. One important split branches off at a small angle to the south of the main lode below No. 6 level and for some time was thought to be the sheared fissure crossing No. 14 crosscut level to the south

of the main raise. Investigations have, however, failed to pick up this split in the workings above and have indicated that the fissure on No. 14 level is more likely the main lode and, if so, that the angle of dip has greatly decreased between 13 and 14 levels.

Developments and conditions of mineralization in the Deep workings need only be briefly summarized. The principal working adit is No. 14, about 2,000 feet long to the foot of the main raise connecting with No. 10 adit 375 feet vertically above or 520 feet up on the dip of the lode. No. 10 adit is driven from the west bank of Whitewater creek and in August, 1927, had a total length of about 2,400 feet. It is a crosscut for about 1,000 feet to the Whitewater lode, beyond which it continues as a drift. Encouraging mineralization has been encountered in the vicinity of this level and particularly between levels 9 and 10, at intervals over a length of about 500 feet west of the intersection of the crosscut and the lode. Several raises connect this section of No. 10 level with No. 9 above and short drifts have been run from these raises where mineralization is pronounced. At 270 feet west of No. 10 crosscut a shaft connects with No. 11, 120 feet below. At 1,600 feet from the portal, No. 10 level meets the main raise from No. 14 level. West of this raise comparatively little mineralization has been encountered on No. 10 except near the face where the lode filling carries some ore minerals in the vicinity of one or more of the carbonate-mariposite dykes referred to on a preceding page.

No. 11 level is for most of its length a drift along the main lode and in August, 1927, had been extended 240 feet west and 1,120 feet east of the main raise. In the west drift the lode carries abundant siderite, but very little visible ore minerals. Near the face of the drift it splits and shows a width of several feet of siderite, most of which appears to be following the south split which seems particularly worthy of further investigation. In the opposite direction the drift has been driven under the main ore-bearing zone of the Whitewater mine and it is reported that a crosscut from the easterly face has revealed a 4-foot vein of ore on the hanging-wall side of the lode.

Work on and between levels 12 and 13 has afforded very important results. These workings have explored a great width of limestone and limy sediments representing, apparently, the upward extension of the wide belt in No. 14 crosscut. No. 12 level exposed in the limestone belt a system of fissures running from the hanging-wall of the Whitewater lode at an angle of about 30 degrees with it. Exploration of these fissures resulted in opening up the main ore-body and other smaller bodies, from which most of the production since 1925 has come. The fissures are irregularly spaced, vary from mere cracks to well-marked fissures a few inches wide, and dip mostly at 50 degrees or more to the northeast. These fissures were the channels by means of which the mineralizing solutions gained access to the limestone belt which has been widely replaced by ore and gangue minerals. Though more pronounced in the vicinity of the fissures, the replacement has tended to follow the bedding structures of the limestone belt. These structures are more complex than is suggested by the comparatively regular southerly dip of the associated rocks in the vicinity of the main raise. On 12 level and extending down to 13 level the limestone dips at an average angle of 30 degrees to the

north. Below 13 level its structure is less certain, but its appearance on 14 level, 180 feet south of the main raise, suggests either an intervening sharp roll or a fault. On and near 13 level there are indications of folding and on 14 level the limestone, where first encountered south of the main raise, dips at a low angle to the south. Farther south along this level it first flattens and then assumes a northerly dip; still farther south its structure is not definitely known, but apparently it again rolls to the south.

The main ore-body on and below No. 12 level was composed of a series of overlapping lens-shaped bodies varying in thickness up to 30 feet or more. Each lens was a mixture of ore and gangue materials in varying proportions. The characteristic ore consisted of interbanded siderite and zinc blende with partly replaced limy rock. More or less galena was generally present in either banded or disseminated form and also as pockets of cubes. Solid or nearly solid masses of zinc blende 9 or 10 feet thick were encountered. Banded structures were commonly well shown and conformed with the bedding.

The main ore-body as known in 1927 had a length of over 300 feet west of the main raise. Its average width was about 8 feet. In 1928, an underlying, nearly parallel shoot was reported to have been drifted on for 80 feet and to have a width of from 6 to 15 feet. Exploratory work east of the raise encountered encouraging mineralization in the limestone belt, but neither the extent nor relation of this to the main ore-body or bodies had been determined at the time visited.

No. 12 level has been extended west of the main ore-body to explore the continuation of the main Whitewater lode below the western portion of No. 10 level. In this direction the lode angles into the main limestone belt and mineralization was encountered at a number of places, though in no considerable quantity. It is reported that more recently an extensive ore-body has been opened in this section of the mine. According to information received from the company and reported by the Resident Engineer, this ore shoot has been followed to the west face of No. 12 level over a length of 450 feet with an average width of at least 8 feet, the face of the level being still in ore. The same ore-body was picked up and drifted on for 100 feet on No. 13 level. "This ore-body," says Langley "lies at a depth of about 1,800 feet on the dip of the vein below its projected outcrop, while recent work on the fourteenth level indicates its probable downward continuation to this horizon."

INDEX