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MINES AND GEOLOGY BRANCH

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GEOLOGICAL SURVEY

PRELIMINARY REPORT

NELSON MAP-AREA, BRITISH COLUMBIA

BY

H. M. A. Rice

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EAST HALF OF NELSON MAP-AREA, BRITISH COLUMBIA

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INTRODUCTION

The area covered by this report lies in the Purcell range of mountains in southeastern British Columbia. Except for the northeast corner it includes the entire area lying between latitude 50 degrees and the International Boundary from longitude 116 degrees to the divide between East and West Kootenay; in all about 1,050 square miles.

The main highway through Kingsgate, Yahk, Cranbrook, and Kimberly runs along the eastern side of the Purcell range and from it occasional branch roads run into the foothills of the range. Access to most of the area is, however, by horse trail. With the exception of the main trail across the range from St. Mary lake to Crawford bay most of these trails are in poor repair.

The area as a whole is extremely mountainous. In the northwestern part the elevation of the ridges is between 7,000 and 8,000 feet above sea-level with individual peaks rising to nearly 10,000 feet. The mountain units are separated by deeply cut valleys whose elevation ranges between 3,500 and 4,500 feet for most of their length. The resultant topography is extremely rugged with steep-sided mountains and ridges rising abruptly from the valleys. South, towards the boundary, the height of land slopes gradually to a maximum elevation of a little over 6,000 feet.

Most of the area is heavily forested with firs and pines of various kinds. Larch (tamarack) up to 2 feet in diameter at the butt grows to an elevation of 8,000 feet. Many parts of the area have been logged off, but a considerable amount of valuable timber still remains.

The entire area, with the possible exception of the highest peaks, has been covered by a continental ice-sheet that moved in a

general southerly direction towards the Rocky Mountain trench and the valley of Kootenay lake. All the valleys in the mountainous parts of the area have been deeply eroded by valley glaciers and are broad, sweeping, U-shaped troughs with tributary streams cascading down from hanging valleys. Small lakes occupying cirque basins at the heads of the tributary streams are dotted all over the area. Although glacial erosion has been very severe over most of the area, in the lower reaches of St. Mary river, Perry creek, and Moyie river the ice has done very little scouring and, in places, the pre-glacial gravels are very little disturbed.

GENERAL GEOLOGY

Introduction

Most of the area is underlain by a thick series of late Precambrian sediments. Rocks of this series occur over many thousands of square miles of southeastern British Columbia and extend across the International Boundary into Montana and Idaho. In Canada these Precambrian sediments have been divided into the Lower and Upper Purcell series and the Windermere series.

The Lower and Upper Purcell series consist of a very uniform succession of fine-grained sediments, apparently deposited without a break in the progress of sedimentation. The Windermere series is, on the whole, composed of coarser grained and distinctly different rocks from those of the Purcell series and the base of the Windermere is marked by a conglomerate that overlies the Purcell series unconformably.

Lower Cambrian formations outcrop over a small area in the centre of the district. They overlie the Lower Purcell series unconformably, the Upper Purcell and Windermere series being absent in this locality.

Two principal groups of igneous rocks occur as: (1) a number of dykes and sills, mainly of dioritic composition and probably

of post-Purcell age, known as the Purcell intrusives; and, (2) small batholiths, stocks, and dykes of granitic composition and late Mesozoic or early Tertiary age.

The valleys and lower slopes of the mountains are largely covered with a thick mantle of unconsolidated glacial drift which has been reworked by streams to make small, local flood-plains in some of the valley bottoms.

Table of Formations

Formations in the Northwest Part of the Area		
Recent		Glacial drift and alluvium
Late Mesozoic or Early Tertiary		Granitic rocks
Precambrian	Windermere	Hamil Horsethief Toby conglomerate
	Post Upper Purcell?	Purcell intrusives
	Upper Purcell	Mount Nelson Dutch Creek
	C o n f o r m i t y	
	Lower Purcell	Kitchener-Siyeh Creston Aldridge
	B a s e u n e x p o s e d	
Formations in the Southeast Part of the Area		
Recent		Glacial drift and alluvium
Late Mesozoic or Early Tertiary		Granitic rocks
Palaeozoic		Eager Cranbrook
	Post Upper Purcell?	Purcell intrusives
Precambrian	Lower Purcell	Kitchener-Siyeh Creston Aldridge
	B a s e u n e x p o s e d	

Lower Purcell Series

The Lower Purcell series comprises not less than 36,000 feet of sediments, very uniform in composition and apparently representing continuous sedimentation. These sediments consist essentially of argillaceous quartzite, argillite, and impure dolomitic limestone. Although the same rock types occur throughout the series the upper formations contain a greater number of limestone beds than the lower. The presence of ripple-marks and mud-cracks throughout the series shows that the basin in which it was deposited was, at all times, shallow.

In the adjoining Cranbrook area a succession of lavas were outpoured during the close of the Siyeh epoch and these lavas are taken to mark the boundary between the Lower and Upper Purcell. Although the Purcell lava does not occur in the area the boundary has been drawn on lithological grounds at approximately the same horizon.

Aldridge Formation

The Aldridge formation is the lowest member of the Lower Purcell exposed in the area. It consists essentially of dark to light grey, argillaceous quartzites and slaty argillites, that, in general, weather a characteristic rust-red colour. No section suitable for measurement was found in the area, but a section measured in the Rocky mountains is about 15,000 feet thick.

The zone of transition between the Aldridge and the Creston consists of several hundreds of feet of thin-bedded, grey and green striped argillites with abundant mud-cracks. The actual boundary has been arbitrarily fixed at the horizon where the typical red weathering of the Aldridge gives place to grey-green weathering.

Where intruded by a Purcell sill the argillaceous quartzite in the immediate vicinity is commonly metamorphosed to a green and siliceous quartzite much resembling the normal type of Creston. Where Aldridge sediments are intruded by granitic rocks they are as a rule

transformed into quartz-mica schists, usually containing abundant garnets.

Creston Formation

The Creston formation consists of some 6,000 feet of argillaceous quartzite and argillite. The argillaceous quartzite forms the bulk of the formation and is generally a massive, green and purple rock in beds from 2 to 3 feet thick. White and light grey varieties occur in places. The argillite is predominantly dark green or purple in colour, but grey argillite is not uncommon. At the head of Whitefish creek and elsewhere a considerable thickness of extremely thin-bedded, dark grey and white or grey and green argillite occurs in the Creston. This is an unusual type in the Creston and is similar to the argillite occurring at the top of the Kitchener-Siyeh formation. Limy beds occur occasionally throughout the formation and are especially numerous near the top. Mud-cracks and ripple-marks are common in all parts.

Kitchener-Siyeh Formation

In Cranbrook area the Siyeh formation is defined as a succession of non-limy, highly coloured argillites, 1,000 to 2,000 feet thick, which overlie the Kitchener formation. In the area being considered these argillites can seldom be recognized or, where they do occur, they are so thin that they cannot be considered of sufficient importance to justify a separate formational name. The two formations have, therefore, been mapped together as the Kitchener-Siyeh formation.

This formation consists of 6,000 to 7,000 feet of argillite, argillaceous, magnesian limestone, and occasional beds of argillaceous quartzite. The argillite is green, purple, or dark grey in colour and the limestone usually light cream with occasional light green and purple varieties. All types characteristically weather buff.

Most of the rocks of this formation are soft and consequently more generally sheared and contorted than either of the two older formations.

Upper Purcell Series

The basal formation of the Upper Purcell series in Cranbrook area has been called by Schofield[1] the Gateway formation. The remainder

[1] Schofield, S.J.: Geol. Surv., Canada, Mem. 76, pp. 36-38 (1917).

of the series is divided by him into the Phillips and Roosville formations[2]. In Windermere area to the north, Walker[3] subdivided the

[2] Idem., p. 42.

[3] Walker, J.F.: Geol. Surv., Canada, Mem. 148, pp. 7-11 (1926).

Upper Purcell into the Dutch Creek and Mount Nelson formations. In the area being considered the writer was unable to recognize Schofield's subdivisions, whereas Walker's were distinct and his units easy to map. The latter's subdivisions have, therefore, been used.

Dutch Creek Formation

The Dutch Creek formation, the lowest member of the Upper Purcell, consists of about 4,300 feet of slaty argillite, quartzite, and magnesian limestone. The base of the section along the divide between East Kootenay and West Kootenay south of Rose pass consists of 750 feet of massive, buff-weathering, magnesian limestone interbedded with siliceous, light-coloured quartzite and blue-grey limestone. This is overlain by 3,550 feet of green, grey, and black, banded, slaty argillite with occasional beds of argillaceous quartzite and magnesian limestone.

The transition zone between the slaty rocks at the top of the Kitchener-Siyeh formation and the massive quartzite and limestone

at the base of the Dutch Creek is probably not over 100 feet thick and the change in lithology is very marked. There is, however, no suggestion of an unconformity.

Mount Nelson Formation

The Mount Nelson formation overlies the Dutch Creek conformably and is the highest known component of the Upper Purcell series. The base of the formation consists of 700 to 800 feet of light-coloured, siliceous quartzite. These quartzites are overlain by about 3,500 feet of green and grey argillite and light-coloured, magnesian limestone. The formation is rather similar to the Dutch Creek, but contains a greater proportion of limestone and limy argillite. The massive, light-coloured quartzite at the base of the formation is an excellent horizon marker and forms a convenient boundary for the two formations.

Windermere Series

Toby Conglomerate

The Toby conglomerate was observed only in the vicinity of Rose pass. There it consists of 250 feet of coarse conglomerate interbedded with quartzite and argillite. It varies in a short space from a rock composed of well-rounded, 2- to 3-inch quartz pebbles in a siliceous cement, to one consisting of angular blocks of sandy, dolomitic limestone in a cement of the same composition. In one place the siliceous type contains large, angular blocks of argillite.

The Toby conglomerate overlies the Mount Nelson formation unconformably. The unconformity is well marked, but exposures were too limited to permit measurement of the angular discordance. Walker[1], however, observed a difference of up to 45 degrees in the direction

[1] Walker, J.F.: Geol. Surv., Canada, Sum.Rept. 1928, pt.A, p.125.

of the bedding in the two formations at their contact.

Horsethief Formation

The Horsethief formation overlies the Toby conglomerate conformably. The formation, measured along the divide between East Kootenay and West Kootenay, northwest of Rose pass, is 12,130 feet thick and consists of grey and green argillite, blue-grey limestone, and limestone conglomerate. Beds of coarse quartzite and fine pebble conglomerate occur all through the formation.

The Horsethief formation is easily distinguished from the older formations as the blue-grey limestone is rare in other formations in the area and pebble conglomerates are not known in the Purcell series at all.

Hamil Formation

The Hamil formation overlies the Horsethief conformably. Only the base of the formation occurs in the area and it consists of very massive, thick-bedded, siliceous quartzite, white, green, and reddish in colour. The rugged peaks of the ridge west of the West Fork of St. Mary river consist of this formation.

Age of the Beltian (Purcell and Windermere Series)

In Windermere map area Walker[1] observed the Windermere

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[1] Walker, J.F.: Geol. Surv., Canada, Mem.148, pp. 17-19 (1926)

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series unconformably overlain by Lower Cambrian strata and concluded that it was Precambrian in age. The Windermere series overlies the Purcell series unconformably, consequently Purcell series must be older than the Windermere series and also Precambrian in age. In the area described in this report the Lower Purcell series is overlain unconformably by Lower Cambrian strata, a fact that bears out the above conclusion. From the absence of intense metamorphism, as well as from the comparatively simple structures developed in it, the

Beltian is believed to be late Precambrian in age.

Lower Cambrian Formations

The Lower Cambrian formations occur at only two localities in the centre of the area.

(1) A triangular-shaped area to the west of Hellroaring fault and on the east by the contact with the Kitchener-Siyeh formation.

(2) A small exposure in a tightly folded syncline near the head of Hellroaring creek.

The Lower Cambrian has been divided into two formations, the Cranbrook at the base and the Eager overlying it.

Cranbrook Formation

The Cranbrook formation consists of some 600 feet of massive, siliceous quartzite, white, greenish, and reddish in colour, interbedded with highly coloured, slaty rocks. In many places the formation includes a bed of rock magnesite having a maximum thickness of about 50 feet. The formation is distinctive and not easily confused with the older formations, except possibly with the base of the Dutch creek. No fossils have been found in it.

The contact with the older formations is puzzling. In several places in Cranbrook area to the east a well-marked unconformity exists, but in Nelson area no evidence of an unconformity was observed, and, in places, the contact has the appearance of a gradational boundary. There is little doubt in the writer's mind from the exact lithological similarity between the formations in the two areas that the Cranbrook formation of this report is indeed the counterpart of the type Cranbrook formation and is, therefore, Lower Cambrian in age.

Eager Formation

The Eager formation overlies the Cranbrook formation, but the nature of the contact, whether gradational or disconformable,

could not be determined.

It consists of several thousand feet of soft, slaty argillite, grey, green, and brick red in colour, interbedded with soft, argillaceous quartzite and limy beds. At two localities fossils were found and by means of them the formation was determined to be upper Lower Cambrian in age and correlated with the Eager formation at St. Eugene Mission in Cranbrook map-area.

Purcell Intrusives

The Purcell intrusive rocks occur throughout the area as sills and dykes. The former are up to 800 feet thick and some are traceable for several miles. They are dark green, medium- to coarse-grained rocks with the average composition of quartz diorites. Occasional more basic phases occur approximating in composition an acid gabbro.

The sills are largest and most abundant in the Aldridge formation, but Purcell sills and dykes occur in all members of the Lower and Upper Purcell.

Age of the Purcell Intrusives

In Cranbrook area a succession of andesitic flows, the Purcell lavas, were extruded during the close of the Siyeh epoch. The Purcell intrusives resemble the flows lithologically and in the past have been considered to be of the same age. Certain dioritic intrusives however in the Upper Purcell contain an unusual type of amphibole which is exactly similar to that occurring in the typical Purcell sills. For this reason and on account of their general similarity with the Purcell intrusives they are considered to be genetically related to them and of approximately the same age. The Purcell intrusives therefore are probably at least as young as post Upper Purcell.

Walker[1] reports greenstone dykes which he correlates with

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[1] Walker, J.F.: Geol. Surv., Canada, Mem. 148, p. 21.

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the Purcell intrusives in the Windermere series in Windermere map-area,

and in that place the intrusives may be as young as post Windermere.

All these facts suggest that the Purcell intrusives are younger than heretofore supposed, in part at least post Upper Purcell and probably post Windermere. Altered greenstone dykes very similar in appearance to the smaller members of the Purcell intrusives have been seen in the Eager formation in Cranbrook area. It is possible that the Purcell intrusives are Palaeozoic or even Triassic in age. They are, however, definitely older than the granites.

Granitic Rocks

Several large granite stocks or small batholiths occur in the northern part of the area. These bodies, together with a number of small stocks and pegmatite dykes scattered through the area, comprise the granitic suite. The bulk of these intrusives consist of medium to coarse-grained, light grey to pinkish grey rocks varying in composition from granite to granodiorite, the latter being a comparatively rare variety. Many of these rocks are strikingly porphyritic, the orthoclase phenocrysts in some cases being several inches long.

The metamorphic effect on the intruded sediments varies widely: in some places the sediments are comparatively unaltered whereas in others Aldridge argillaceous quartzite is completely altered to a garnetiferous, quartz-mica schist. This type of rock is particularly well developed in the canyon near the mouth of Matthew creek.

The age of the granite is not definitely known. The intrusives are almost certainly related to the Nelson batholith which they closely resemble in rock type. Both were probably intruded some time between the late Jurassic and early Tertiary, possibly during the Cretaceous.

A small stock of ultrabasic rock outcrops near the North Fork of St. Mary river. The composition of this intrusive varies from a pyroxenite to a peridotite, the end members being composed of almost pure pyroxene and olivine. It is dark green to bluish grey in colour and buffish brown on the weathered surface. Its age is not known except that it is definitely older than the granite.

STRUCTURAL GEOLOGY

The generalized structures of the area fall naturally into two divisions, a northern and a southern, separated by the important, northeasterly trending Hellroaring fault which has been traced from the eastern boundary of the area near St. Mary river to the head of Goat river. This fault apparently dips steeply, but whether it is a thrust or a normal fault is not known. The southeast block has moved down with respect to the northwest block.

The structure of the northern part consists of a broad, open anticline plunging gently to the north and complicated by many minor irregularities. To the west the limb of this anticline passes into a belt of tight folding in which the formations of the Lower Purcell are repeated several times. Still farther to the west, on the border of the area, the formations are overturned and dip steeply to the east. Faulting is common throughout this northern section, but none of the faults appears to be very continuous or to have much displacement with the possible exception of the Kimberly fault. This fault was traced into the northeast corner of the area, but its southwesterly continuation could not be recognized. One other fault, the Alki Creek fault, deserves mention as its trend is contrary to that of most of the faults in the area, which is northeasterly. It runs from the head of Alki creek at about north 40 degrees west across the East Fork of St. Mary river and dips about 60 degrees southwest. It is a thrust fault with a strong

crushed zone and probably considerable displacement.

In the southern part of the area the sediments have a general northeasterly strike and dip northwest. The succession is interrupted and in places repeated by three major faults named from south to north the Moyie fault, the Perry Creek fault, and the Sawmill Creek fault.

The Moyie fault has been traced north-northeast across Idaho into British Columbia at Kingsgate. It strikes north where it enters the area, but within a short distance swings into a northeasterly direction and has been traced for some 14 miles to the northeast beyond the eastern boundary of the area. It is believed to be a thrust fault with a displacement of 10,000 to 15,000 feet and to dip steeply west and northwest.

The Perry Creek fault follows the course of Perry creek southwest from the edge of the area. It has been traced south from the head of that creek for 2 or 3 miles, but appears to be dying out in that direction. It is a normal fault with a maximum displacement at the north end of about 9,000 feet.

The Sawmill Creek fault extends from the eastern boundary of the area near St. Mary river in a southwesterly direction to the head of Hellroaring creek. It is a strong normal fault with a displacement of several thousands of feet. At the northeast end the Hellroaring fault and the Sawmill Creek fault run very close together. Outcrops are scarce here and it is not known exactly what has happened but probably the two faults join as represented on the map.

Minor faults, both thrust and normal, which parallel the trend of the major ones, are common.

The principal period of deformation in the area is believed to have extended from the late Jurassic to the early Tertiary.

ECONOMIC GEOLOGY

Placer Deposits

Although in the past there has been a considerable amount of placer mining done in the area, at the present time activity is confined to small operations on Perry creek and Moyie river. Here, as elsewhere in the district, the gold occurs in glacial material either as originally deposited or reworked by recent streams. The ground is nowhere rich, but some operators are making wages.

It is unlikely that deposits of value exist anywhere in the area except possibly in the lower reaches of Perry creek and Moyie river where Tertiary gravels may underlie the morainic material. Several attempts have been made to explore these gravels, but none has as yet been successful. The conditions at Perry creek have been fully discussed by Cairnes.[1]

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[1] Cairnes, C.E.: "Some Mineral Occurrences in the Vicinity of Cranbrook, B.C."; Geol. Surv., Canada, Sum. Rept. 1932, pt. A, pp. 76-80.

In the past a considerable amount of gold has been obtained on Weaver creek and much undoubtedly remains, although it is questionable if any quantity can be extracted commercially.

Lode Deposits

The lode deposits of the area may be divided into three types:

(1) Gold-quartz veins.

(2) Quartz-sulphide veins in sediments.

(3) Copper deposits in diorite.

Gold-quartz Veins

The gold-quartz veins mainly occur in the drainage basin of Perry creek. They have received little attention since described in detail by Cairnes[1] and will not be discussed by the writer.

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[1] Idem., pp. 85-94.

Quartz-sulphide Veins in Sediments

Deposits of this type are common in the area. None is being operated at present, but several promising prospects are being held. Individually they vary in size and mineral content, but they all appear to have the same general nature and origin.

Most of the deposits consist of steep-dipping fissure veins occupying fracture zones in sediments. With few exceptions they either occupy or are in the neighbourhood of major faults. The gangue mineral is quartz, but small amounts of siderite occur in most veins. The usual sulphides are galena and sphalerite, but chalcopyrite and pyrite commonly occur and, in some cases, are more abundant than the first two minerals named. In one deposit, the Rose Pass prospect, stannite, an ore of tin, was identified and is abundant. Erythrite (cobalt bloom) occurs at the Great Dane prospect, but the primary mineral to which it owes its origin was not seen.

The source of the mineralization is believed to be the magma from which the granitic intrusives were formed, and the veins to have been deposited during the last stages of the period of mountain building when the folding and faulting took place: probably at the close of the Mesozoic or in the early Tertiary.

The reason for this belief is that, almost without exception, the fracture zones of the major faults have been mineralized. The mineralization is, therefore, later than the opening of the faults. Furthermore, in some cases, the veins so developed have themselves been shattered by renewed movement along the fractures. The veins were, therefore, formed before the close of the period of structural activity with its attendant folding and faulting. It was at about this time that the granitic rocks of the area are believed to have been intruded and the conclusion seems reasonable that the mineralization and the granitic rocks have a genetic relationship. Of more

practical importance, however, is the evident relationship between the faulting and the mineralization. It is clear that the most likely place for the development of ore-bodies is in the neighbourhood of major faults.

Copper Deposits in Diorite

These deposits are strictly confined to the Purcell sills. Only two important properties were examined, but numerous small veins occur in diorite sills in all parts of the area.

Two types of these deposits occur, which are associated with and grade into each other:

(1) The "differentiate" type, which consists of irregular masses of chalcopyrite and pyrrhotite or pyrite with occasional specks of galena and sphalerite disseminated through a gangue composed predominantly of amphibole similar to that occurring in the sill itself.

(2) Quartz-calcite veins carrying the same sulphides as the "differentiate" type of ore.

The quartz-calcite veins usually cut across the sills at a fairly steep angle and never persist very far into the sediments. The sulphides in these veins appear to be concentrated close to the margin of the sill.

Schofield[1] believed that the disseminated type of deposit

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[1] Schofield, S.J.: "Cranbrook Map-area, B.C."; Geol. Surv., Canada, Mem.76, pp. 140-144 (1917).

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was formed by the differentiation of the sulphides from the magma of the sill after intrusion. Such may be the case, but, in the writer's opinion, the evidence is not conclusive. The close association between the two types of ore and the way in which they grade into each other shows a close genetic relationship. The quartz-calcite veins are clearly of hydrothermal origin, that is they were deposited from aqueous solutions migrating through fractures in the diorite, and

it seems possible that the "differentiate" bodies may also have been deposited or at least enriched by the action of hydrothermal solutions. It is at least fairly certain that the source of both types of ore is the magma from which the sills were formed, but whether before or after this magma was intruded as sills is not clear in the case of the differentiate ore.

Non-metallics

In 1932 a large body of rock magnesite was found in the Cranbrook formation near Marysville. This deposit consists of a bed of high-grade magnesite from 50 to 100 feet thick, which has been traced almost continuously for 4½ miles. It has been described fully by Cairnes[1]. A body of similar magnesite, owned by the Consolidated Mining and Smelting Company, occurs in a small syncline on the divide at the head of Hellroaring creek. During the past season another body was found in the Cranbrook formation on the west side of Hellroaring creek. There is little information regarding this locality, but the magnesite bed seems to persist for a considerable distance and the specimens obtained appear to be of good grade. Its distance from transportation renders this discovery of little economic significance at the present time.

[1] Cairnes, C.E.: Some mineral deposits in the vicinity of Cranbrook, B.C., Geol. Surv., Canada, Sum.Rept., 1932, pt. A, pp. pp. 101-104.

DESCRIPTION OF PRINCIPAL PROPERTIES

Gold-Quartz Veins

Rome and Valley Prospect (5)[1]

The Rome and Valley prospect consists of twenty-three claims held by location, controlled by J.M. Baird of Cranbrook, B.C., and associates. It is located near the head of Rome creek, a tributary of Perry creek, about a mile by trail from the Perry Creek road near Sawmill creek.

[1] This number appears on the map and shows the location of the property described.

The deposit consists of two or more large and persistent quartz veins. In most of the quartz no sulphides can be seen, but in places small amounts of pyrite and galena occur. In one open-cut beautiful crystals of pyromorphite (lead phosphate) are plentiful. The only commercial values are in gold and assays from samples taken by the owners are reported to range from $1.10 to $19.95 a ton (gold at $35 an ounce).

The main workings consist of thirteen open-cuts, ten of which expose a vein striking north 15 degrees east and dipping 35 degrees to 50 degrees northeast. This vein has been traced for 1,550 feet and probably continues for at least another thousand feet to the north. It varies in width from 2 feet to 25 feet and averages about 6 feet. The remaining two open-cuts are located on a parallel vein of the same type and apparently comparable in size with the one first described.

The economic possibilities of this property hinge on the average value of the primary ore. The vein is well exposed in the open-cuts and no question remains that there is a large tonnage in sight if the average value of the ore is sufficiently high to permit its profitable extraction.

The Running Wolf Prospect (4)

References: Ann. Rept., Minister of Mines B.C., 1930, p.243; Schofield, S.J.: Geol. Surv., Canada, Mem. 76, pp. 139-140.

The Running Wolf prospect is located on French creek, a tributary of Perry creek, and is reached by a trail about a mile long from the Perry Creek road.

The deposit consists of a number of quartz veins occupying fissures in badly altered Creston argillaceous quartzite. The workings consist of five tunnels, three of which are now caved. The main tunnel exposes three veins each about 30 feet wide. Two of these veins occupy fault zones parallel to that on the Rome and Valley

prospect and approximately on strike with it. The third vein is in a cross fracture. A few hundred feet down the hill another tunnel has been driven along a vein that parallels the two main veins above. The veins are composed of massive quartz with occasional specks of pyrite and are reported to carry gold. They have been fractured by post-mineral movements along the original faults.

It is interesting to note that the Rome and Valley and the Running Wolf prospects are apparently on the same zone of fracturing or faulting and that this zone probably continues to the south to cut across the ridge between Perry creek and Moyie river at Old Baldy mountain. Exposed on the ridge at this point is a strong fracture zone that is occupied by a large quartz vein.

Homestake Prospect (3)

References: Ann. Repts., Minister of Mines, B.C., 1915, p. 108; 1925, p. 230; 1926, p. 243; 1929, p. 297 Cairnes, C.E.: Geol. Surv., Canada, Sum. Rept. 1932, pt. A, pp. 88-92.

The Homestake mine, on which more work has been done than on any other property on Perry creek, is located on Manchester creek on the opposite side of the valley from the two prospects previously mentioned. It has been fully described by Cairnes in 1932, since when it has not been worked.

Kimberly Gold Fields, Limited (Quartz Mountain) (8)

References: Ann. Repts., Minister of Mines, B.C., 1932, p. 201; 1933, p. 201; 1934, p. 30.

The property of the Kimberly Gold Fields, Limited, owned by Elmer Rice and associates, consists of thirty-five claims located near the head of Sawmill creek and is reached by a branch automobile road about 3 miles long from the main Perry Creek road. The deposit consists of a quartz vein, striking north 55 degrees east and dipping about 35 degrees southeast, that occupies a

fracture zone in Creston argillaceous quartzite not far to the southeast of the Sawmill Creek fault. The vein consists of white, vuggy quartz with occasional patches of pyrite and is reported to carry considerable gold in places. A number of assays taken by the Resident Engineer in 1932 averaged 0.25 ounce a ton in gold.

The vein has been traced on the surface by a line of deep open-cuts, now mostly filled in, running in a southerly direction down the slope of the hill. A short distance below the last open-cut a tunnel has been driven which passes more or less directly under the open-cuts. This tunnel shows no ore and it is evident, considering the low southeasterly dip of the vein, that it is in the foot-wall. From the face of the tunnel short cross-cuts have been driven to the right and left without encountering the vein. Near the collar of the tunnel another short crosscut has been driven to the right and in the face of this a vein some 3 feet wide has been cut. There is little doubt that this is the same vein as that occurring in the open-cuts. If the right branch of the crosscut from the face of the tunnel be extended there is a good chance that the main vein will be picked up in a short distance.

A small crew of men are at present employed on development work.

Two or three hundred yards west of the main showings, the Sawmill Creek fault is exposed in an open-cut. The vein consists of strongly brecciated Creston, the greater part of which carries a considerable amount of pyrite. The whole zone has been silicified and the eastern part is occupied by a large quartz vein.

Argillaceous quartzite outcropping in bluffs to the west of the fault zone has been completely silicified in places, so that it resembles vein quartz. One or two open-cuts have been made in these silicified zones, but it is doubtful if the latter have any economic possibilities.

The Prospector's Dream (1)

References: Ann.Rept., Minister of Mines, B.C., 1898, p. 1013.

The Prospector's Dream lies on the Moyie River slope of Mount Baldy, about 1½ miles by trail from the road up Weaver creek. Most of the work on this property was done about 1896 and it is difficult to report much from an examination of the workings in their present condition. These consist of two caved tunnels, a 30-foot winze in poor repair, and three open-cuts. One or more veins of white, vuggy quartz carrying a little pyrite are poorly exposed. The vein in the winze is in Aldridge argillaceous quartzite and appears to strike north 35 degrees west and dip about 50 degrees southwest. The vein in one of the tunnels is apparently in a Purcell diorite sill. High gold assays are reported from pockets in this deposit, but no idea as to the average could be obtained from the present limited showings.

Quartz-Sulphide Veins in Sediments

Boy Scout Group (9)

References: Ann. Repts., Minister of Mines, B.C., 1924, p.186; 1926, p.243; 1929, p.297; 1930, pp. 241-242.

The Boy Scout group lies on the east side of Hellroaring creek about 3 miles by trail from the head of the automobile road that crosses St. Mary river at the outlet of St. Mary lake. The group consists of nine claims, four of which are Crown granted, controlled by N.A. Wallenger of Cranbrook, B.C., and associates.

The deposit consists of several quartz veins occupying shear zones in Aldridge quartzite near the southwestern edge of a large pegmatite stock and not far from the Hellroaring fault. The veins appear to be well mineralized with galena, sphalerite, pyrite, and, in places, arsenopyrite; some siderite occurs in the gangue. The ore is said to carry only small amounts of gold and silver. The veins

pinch and swell rapidly and are interrupted by faults and, as a result, the lenses of ore exposed are short and discontinuous. Whether ore-shoots of commercial size exist remains to be demonstrated by further exploration.

Present development work consists chiefly of three tunnels, of which the lowest one is now caved in. The intermediate tunnel was driven in the foot-wall of the vein for most of its length, but four crosscuts, driven into the hanging-wall, picked up the deposit. The two nearest the portal expose a small vein striking north 35 degrees west and dipping 40 degrees southwest. The two inner crosscuts expose a well-mineralized vein about 3 feet wide striking north 65 degrees west and dipping 45 degrees southwest. This vein shows considerable promise and deserves further exploration. Between the two veins the tunnel is crossed by a strong shear zone which may be a fault cutting off the southerly extension of the main vein.

The upper tunnel exposes a strong, well-mineralized quartz vein. At about the centre the vein is offset a few feet by a small fault. At its inner end the vein swells out apparently against a zone of shearing beyond which no vein matter can be seen. If this shearing is a fault zone it is pre-mineral in age. Later movements along the fault may however have cut off the extension of the vein.

The vein in the lower tunnel is reported to have been more continuous and from 4 to 12 feet wide. The writer was, however, unable to enter this tunnel.

Some good grade ore is present in places in the veins, but it is evident that the economic possibilities of the property depend on the solution of the faulting problem and the discovery of longer continuous stretches of well-mineralized vein matter. Further exploration seems warranted.

Birdiel Group (6)

The Birdiel property lies on both sides of Perry Creek road a little more than 4 miles from the bridge across the creek at Old Town. It is owned by R.L. Bird, Cranbrook, B.C., and associates.

The workings consist of two fairly long tunnels and some old open-cuts. The tunnels have been driven in sheared and faulted argillaceous quartzite in the zone of the Perry Creek fault. Irregular quartz veins occur all through this zone and are, in places, well mineralized with galena, sphalerite, and pyrite.

The lower tunnel, just below the road, exposes several flat-dipping quartz veins and also some that strike north 20 degrees to 30 degrees east anddip steeply. A strong thrust fault, striking north 45 degrees east along the foot-wall of this tunnel, and dipping 80 degrees northwest, is exposed in two crosscuts. Most of the vein matter is almost barren of sulphides. A considerable amount of post-mineral movement has taken place in the faults, but some movement is pre-mineral.

The upper tunnel, the centre of which is more or less directly above the face of the lower tunnel, is shorter than the lower. Here, also, the country rock has been badly sheared and faulted and irregular quartz veins occur in many places. Some excellent ore lies on the dump, but very little was seen underground. The property was, however, visited in the absence of the owners and the best ore may not have been seen.

The Dominion Group (11)

Reference: Ann.Rept., Minister of Mines, B.C., 1925, pp. 230-231.

The Dominion group is located at an elevation of about 4,000 feet above sea-level on the north side of St. Mary river about one mile by trail from the end of the automobile road up the river. It is owned by Frank Tracy of Vancouver, B.C. No work has been done for a considerable time.

The workings consist of a shaft, two short tunnels, and several open-cuts. The deposit consists of discontinuous lenses of quartz in a north-south shear zone in Aldridge argillaceous quartzite. Very little sulphide can be seen in the workings, but some good ore is piled on the dump of one of the open-cuts. This ore consists mainly of galena with a little chalcopyrite in a quartz gangue.

To the east of the main showings some work has been done on small quartz-calcite veins carrying chalcopyrite in a large diorite sill.

Great Dane Group (15)

Reference: Ann. Rept., Minister of Mines, B.C., 1904, p. 109 (Bracebridge).

The Great Dane group is located at an elevation of about 7,500 feet on the north side of the West Fork of St. Mary river close to the summit of the ridge. An old trail leads to it from the "Office camp" on the St. Mary River trail.

The workings examined consist of two or three open-cuts and a tunnel about 100 feet long. From the face of this tunnel a crosscut has been driven to the left for over 300 feet. The open-cuts and the tunnel expose one or more veins in Creston argillaceous quartzite. The vein at the collar of the tunnel is about 5 feet wide and both there and in the open-cuts is well mineralized with galena, sphalerite, chalcopyrite, and pyrite. A considerable amount of erythrite (cobalt bloom) is exposed at one place in the collar of the tunnel but no primary cobalt mineral could be identified. Some siderite occurs in the gangue.

Information as to the continuity and average value of the vein is very scanty as the tunnel, although collared in the, vein, swings to the left after following it for a few feet and does not pick it up again, unless a vein appearing in the right hand corner at the face of the tunnel be its continuation. The crosscut

is in barren rock throughout. There are several siliceous zones to the left of the open-cuts and it may be that the cross-cut was driven to explore the possible continuation of these.

Kole Prospect (13)

The Kole prospect is located at an elevation of 5,200 feet on the south slope of the ridge running southwest from Bootleg mountain to Matthew creek.

Several open-cuts or shallow shafts have been sunk in highly siliceous Aldridge quartzite traversed by small stringers of vein quartz. One 2-foot vein composed of brecciated quartz "healed" with limonite is exposed in a couple of deep open-cuts. No sulphides could be seen in it.

A little to the west of these workings a tunnel has been driven in a shear zone in diorite. The shear zone carries quartz stringers in places and a little galena and arsenopyrite can be seen in specimens from the dump.

Petty Prospect (14)

Reference: Ann. Rept., Minister of Mines, B.C., 1898, p.1024.

The Petty prospect lies on the divide between the head of Alki creek and one of the tributaries of Matthew creek. It is reached by a rather poor trail about 3 miles long connecting with the end of the trail up Alki creek to the Mystery mine. The claims have been allowed to lapse.

The deposit consists of a quartz vein occupying a strong thrust fault striking north 40 degrees west and dipping 60 degrees southwest. The workings consist of an open-cut and shaft on the divide, and two tunnels, one on the Matthew Creek side of the divide and one on the Alki Creek side. The latter was not examined by the writer.

The open-cut and shaft expose a persistent quartz vein over 10 feet wide in thoroughly crushed Aldridge argillaceous quartzite. The quartz carries a considerable amount of pyrite, but otherwise no sulphides were seen. The tunnel examined has been driven northwest along the fault zone where it crosses a steep-sided spur. It is about 120 feet long and crosscuts 25 feet long have been driven each way from the face. The tunnel is in vein matter for its full length. The right branch of the crosscut driven into the foot-wall, is in crushed quartzite and diorite with about 50 per cent of vein quartz until near the face where it becomes barren. The left branch of the crosscut, in the hanging-wall, is in almost solid quartz throughout and the hanging-wall of the vein has not been reached. The vein at the face of the tunnel is, therefore, over 40 feet wide.

The vein is well mineralized with arsenopyrite and also carries galena, and pyrite in places. Some siderite occurs in the gangue.

The vein is continuously exposed from the tunnel to the top of the ridge and is well mineralized throughout. From the summit the fault can be seen crossing the ridges for a mile or more to the northwest and everywhere it appears to be occupied by a quartz vein.

The writer was unable to obtain any figures as to the precious metal content of the ore. In view of the size, continuity, and degree of mineralization of the vein it at least warrants careful sampling.

This deposit is interesting as it gives direct evidence of the relationship between the faulting and the mineralization. The fault is very clearly exposed and is evidently a thrust, the southwest block having moved up with respect to the northeast block. The amount of movement is not known, but the size of the fracture zone and the fact that a diorite sill, 100 feet or more in thickness, in the northeast block, has been cut off and does not appear in the

southwest block suggest that it is considerable.

As the fault is occupied by a large quartz vein the period of mineralization is clearly later than the principal movements along the fault, but as the vein has itself been somewhat shattered the last movements must have been after the deposition of the vein.

Rose Pass Prospect (17)

This prospect lies near the summit of Rose pass at an elevation of about 5,800 feet above sea-level, the showings being located a few yards northwest of the trail. The claims were staked in the "nineties" and have since been allowed to lapse.

The deposit consists of one or more quartz veins occupying fractures in black argillite of the Mount Nelson formation. Close to the deposit the sediments have been intruded by a small dyke of fine-grained, light-coloured granite porphyry.

The workings consist of two small, shallow open-cuts and a short crosscut tunnel. The main showing is in the lower open-cut. Here an irregular quartz vein, with an average width of about a foot, striking roughly northeast, has been stripped for about 10 feet. The possible extension of the vein in both directions is completely masked by overburden. Ten to 20 feet to the northeast of the open-cut, on the foot-wall side of the vein, the granite porphyry dyke outcrops. The vein is well mineralized with galena, sphalerite, chalcopyrite, pyrite, and stannite and carries some silver.

The tunnel is located about 1,000 feet to the southwest of open-cut 1. For most of its length it is in barren black argillite. At the face the tunnel has been stopped against a granite porphyry dyke similar to that outcropping near open-cut 1. It is probable, from the projected strike of the vein and the presence of the dyke, that the vein, if it continue so far, has not been reached by the tunnel.

Open-cut 2 occurs about 700 feet farther southwest and appears to be well to the southeast of the projection of the vein in open-cut 1. It exposes a quartz vein carrying a little galena occurring in a tightly folded argillite. The vein appears in general to be flat lying, but has either been closely folded or has followed closely folded beds in the sediments.

The most interesting feature of the deposit is the occurrence of stannite. So far as is known the only other occurrence of this mineral in Canada is at the Snowflake mine near Revelstoke, B.C.[1] The stannite (copper, iron, tin, sulphide) is a dark grey, fine-grained mineral with a slightly greenish cast very closely resembling tetrahedrite (grey copper) both in the hand specimen and under the microscope. It occurs intimately intergrown with sphalerite, chalcopyrite, and galena. So little of the vein is exposed that it is impossible to give any estimate of the tenor of the ore as a whole, but a partial analysis of a picked specimen from the dump assayed by the Bureau of Mines returned 9.10 ounce a ton in silver, a trace of gold, and 1.51 per cent of tin. In addition to the constituents determined the specimen contained important amounts of lead, zinc, and copper.

[1] Cunning, H.C.: A Tin-silver Vein at Snowflake Mine, B.C.; Ec. Geol., vol. 26, No. 2, pp. 215-224 (March-April 1931).

The economic possibilities of the deposit remain to be determined. No estimate can be made of the size, extent, or richness of the vein from the present limited showings. Very little information is available regarding the economic possibilities of stannite as an ore of tin, as nearly all the veins being operated in which it occurs contain cassiterite (tin oxide) as the most important tin mineral and cassiterite has not been recognized in this ore.

The writer draws attention to the following facts: stannite occurs near Revelstoke in the Snowflake mine and cassiterite is reported some 15 miles southeast of this occurrence[1]. An unidenti-

[1] Idem., p. 224.

fied tin mineral occurs in some of the Slocan ores, principally at the Payne mine[2]. Cassiterite occurs at the Sullivan mine, Kimberly,

[2] Cairnes, C.E.: Description of Properties, Slocan Mining Camp, B.C.; Geol. Surv., Canada, Mem. 184, p. 100 (1935).

B.C.[3] Stannite occurs at the prospect being described. There,

[3] Schwartz, G.H.: Microscopical Features of Sullivan Ore; Eng. and Min. Jour., vol. 122, No. 10, pp. 375-377, (Sept. 1926).

therefore, seems a possibility that there is a tin belt in British Columbia running from Revelstoke southeast to Kimberly. Whether or not this belt includes any commercial deposits it is, of course, impossible to guess. In view of the difficulty of distinguishing between stannite and tetrahedrite it is suggested that owners of properties containing a considerable amount of the latter mineral should have their ore tested for tin.

Welcome Group (16)

References: Ann. Rept., Minister of Mines, B.C., 1904, p. 109.

The Welcome group is located on the south side of St. Mary river about 7½ miles west of the forks. The deposit consists of a quartz vein 3 to 4 feet wide in a shear zone in Kitchener dolomitic argillite. The quartz is generally well mineralized with chalcopyrite and pyrite. Siderite occurs in the gangue. Small subsidiary stringers and lenses of quartz traverse the shear zone on either side of the main vein.

The workings consist of some open-cuts and three tunnels, two of which are now caved.

Wellington Group (7)

References: Ann. Repts., Minister of Mines, B.C., 1915, p. 113; 1932, p. 162 Schofield, S.J.: Geol. Surv., Canada, Mem. 76, p. 135. Cairnes, C.E.: Geol. Surv., Canada, Sum. Rept. 1932, pt. A, pp. 92-94.

The Wellington group, formerly known as the Mascot, is owned by the estate of James Angus of Marysville, B.C. It lies at an elevation of 5,700 feet on the east slope of Angus creek (east fork of Hellroaring creek). It is reached by a trail about 7 miles long from the road at the outlet of St. Mary lake.

The workings consist of twelve or more open-cuts, a 55-foot shaft, and a tunnel 127 feet long, both of which are in poor repair. The deposit consists of a narrow, persistent quartz vein traceable for nearly 1,000 feet, occupying the strong fissure of the Sawmill Creek fault. The Kimberly Goldfields property is near the same fault about 4 miles to the northeast. The vein varies in width from 6 inches to 2 feet and probably averages about 1 foot. It strikes from north to northeast and dips from 65 degrees to 85 degrees east. The vein consists of banded white quartz carrying galena, pyrite, some chalcopyrite, and possibly some tetrahedrite. Cairnes (See References: Idem, page 83) reports assays ranging from 0.02 ounce a ton to 4.80 ounce a ton in gold and from 0.3 ounce a ton to 57.5 ounce a ton in silver. A fair-sized stock of pegmatite occurs between Hellroaring and Angus creeks, and a short distance to the west of the Wellington workings there is a small stock of granite. It is not surprising, therefore, to find that the rocks in the vicinity of the deposit have been so metamorphosed as to be almost unrecognizable.

The vein is very narrow, but its persistence and the excellent assays obtained in places suggest that further exploratory work is advisable.

Copper Deposits in Diorite

Evans Group (10)

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 109; 1915, p. 111; 1920, p. 118. Schofield, S.J.; Geol. Surv., Canada, Mem. 76, pp. 144-145 (1915); Cairnes, C.E.; Geol. Surv., Canada, Sum. Rept. 1932, pt. A, pp. 98-101.

The Evans group lies on the west slope of Evans mountain at an elevation of about 6,000 feet, and is owned by Charles and William Evans of Marysville, B.C. It is reached by a trail about 11 miles long up Whitefish creek from the outlet of St. Mary lake. There is a good camp at the mouth of Fiddler creek and a small cabin in Pollen basin on Evans mountain near the main workings.

The ore consists of two types, both in diorite sills intruding Aldridge argillaceous quartzites. Type 1 consists of very irregular bodies of sulphides disseminated through Purcell diorite. These sulphides are mainly chalcopyrite and pyrrhotite, and pyrite with small amounts of galena and sphalerite. The gangue consists solely of minerals that form the constituents of the diorite. This type of ore Schofield has called "differentiate" ore. Deposits of type 2 are quartz-calcite veins cutting across the sills carrying the same minerals as the "differentiate" ore. These veins do not penetrate into the sediments. The two types are closely associated and evidently have a common source.

The workings consist of two groups. Near the main camp a number of open-cuts have exposed a body of "differentiate" ore in a large diorite sill. The limits of this body are not known nor has the writer any information as to the average grade of the ore exposed. In Pollen basin, 1,000 feet or more higher up the hill, another group of open-cuts have developed two or more quartz-calcite veins cutting through another large diorite sill. In one of these open-cuts a well-mineralized, steep-dipping vein over 6 feet wide is exposed for 20 or 30 feet.

No work has been done for some years but the property seems to justify more thorough exploratory development.

Mystery Mine (12)

References: Ann. Repts., Minister of Mines, B.C., 1904, p. 109; 1920, p. 119; 1927, p. 267. Cairnes, C.E.: Geol. Surv., Canada, Sum. Rept. 1932, pt. A, pp. 98-101.

The Mystery mine is located on Alki creek at an elevation of about 5,000 feet. It is reached by a good trail from St. Mary River road near the head of St. Mary lake. It is owned by Bob Dewar of Fort Steele.

The workings consist of three tunnels and a number of open-cuts. The deposits are all in Purcell sills and consist of "differentiate" ore and quartz-calcite veins closely associated. The "differentiate" ore is exposed in the main tunnel and, as it itself carries some quartz in the gangue, it appears to be more nearly related to hydrothermal activity than to straight differentiation. To the northeast, in the same working, the "differentiate" body passes into a quartz-calcite vein. The other workings, up the hill to the north, are in quartz-calcite veins occupying pronounced fractures. The mineralization consists of chalcopyrite with pyrite and pyrrhotite and small amounts of galena and sphalerite. Some well-mineralized sections have been exposed, but the continuity of the ore-bodies is not yet established. An assay made of 250 pounds of ore from a pile estimated at 250 tons on the dump of the main tunnel is reported to have returned 19.5 per cent copper and 0.50 ounce a ton gold.

Assessment work is being carried on, but the property seems to justify more extensive development in order to ascertain the continuity of the ore-bodies.