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YMIR MAP-AREA, BRITISH COLUMBIA

(REPORT, MAP, AND FIGURE)

By

A. L. McAllister

OTTAWA

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YMIR MAP-AREA, BRITISH COLUMBIA

INTRODUCTION

Ymir map-area (lat. 49°15' to 49°30', long. 117° to 117°15') lies just southeast of Nelson in southeastern British Columbia.

Initial reconnaissance work in the area was carried out by R. G. McConnell and R. W. Brock (1904)[1] when mapping the larger West Kootenay area. Daly (1912), in his work along the International Boundary in 1902 and 1903, contributed much to the general stratigraphy of the area. The first detailed work in Ymir map-area was done by LeRoy (1911) during the field season of 1910, when he mapped an area around Nelson including the northwest corner of the Ymir area. Drysdale (1917), in his work in the Ymir mining camp during 1916, mapped the southwest part of Ymir map-area on a scale of 1 mile to an inch. Walker (1934), in his report on the Salmo area, and Rice (1941), in his report on the Nelson area, east half, have made more recent contributions to the general knowledge of the region, and W. E. Cockfield (1936) examined and reported on the mineral deposits of the Ymir-Nelson area.

The present work was commenced in 1947 by H. W. Little of the Geological Survey of Canada and completed by the author during the field season of 1948. Efficient assistance was given by W. H. Dow and R. G. McCrossan during 1947 and by A. K. Roberts, C. G. Hewlett, and I. M. Stevenson during 1948. Personnel at the various mining properties were especially co-operative in furnishing information. The writer, too, takes this opportunity of expressing his thanks to the National Research Council of Canada for time allowed in preparing a report of which this is a condensation.

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[1] Dates in parentheses are those of references in Bibliography at the end of this report.

GENERAL GEOLOGY

TABLE OF FORMATIONS

Era	Period or epoch	Group or formation	Lithology
Cenozoic	Pleistocene and Recent		Glacial till; clay, sand, and gravel
	Unconformable contact		
	Tertiary (?)		Alkaline intrusions
Relationship unknown			
Mesozoic	Cretaceous (?)	Nelson intrusions	Granite, granodiorite, quartz diorite, monzonite, aplite, pegmatite, and lamprophyre
	Intrusive contact		
	Jurassic and (?) Cretaceous	Hall group	Argillite, quartzite
	Conformable contact		
	Triassic (?)	Elise formation	Agglomerate, tuff, andesite, basalt, and related intrusions; minor argillite
Conformable contact (?)			
Mesozoic and (?) earlier	Triassic (?) and earlier	Ymir group	Argillite, slate, argillaceous quartzite; minor limestone

Relationship unknown			
Palaeozoic	Ordovician (?) and later	Seeman group	White quartzite, schist, limestone; minor argillite and greenstone
Relationship unknown			
	Ordovician	Active formation	Slate, argillite, argillaceous quartzite; minor limestone
Disconformable(?) contact			
	Middle Cambrian	Nelway formation	Argillite, slate, phyllite, limestone
Gradational contact			
	Lower Cambrian	Laib group	Argillite, argillaceous quartzite; limestone, schist
			Dolomite, limestone; minor schist and quartzite
		Conformable contact	
		Reno formation	Argillaceous quartzite, schist, quartzite, argillite
		Conformable contact	
		Quartzite Range formation	White, green, and pinkish quartzite; minor argillaceous quartzite and schist
Conformable contact			
Proterozoic (?)	Windermere (?)	Three Sisters formation	Green quartzite and conglomerate

SEDIMENTARY AND VOLCANIC ROCKS

PROTEROZOIC (WINDERMERE) (?)

Three Sisters Formation

The Three Sisters formation was named by Walker (1934) after the Three Sisters peaks east of the headwaters of Sheep Creek in Salmo map-area, where the formation is well exposed.

Two parallel bands, striking roughly north 10 degrees east, and exposing only the upper members of three Sisters formation, lie in the eastern part of the map-area. The two bands show marked differences in lithology and no correlation could be made between the various members. As the two bands have little in common, they can best be described separately.

Eastern Band

The upper part only of the Three Sisters formation occupies the southeastern corner of Ymir map-area. The members exposed there consist of the metamorphosed derivatives of highly siliceous clastic sediments. The section, from top to bottom, is about as follows:

	Thickness Feet
Quartzite, grey-green, gritty.....	1,000
Quartzite, pink, arkosic; interbedded with grey-green, gritty quartzite.....	200
Quartzite, grey-green, gritty.....	300
Conglomerate.....	45 ±
Quartzite, grey-green, gritty.....	1,000
Total thickness.....	2,545 ±

The quartzite occurs typically in thick, massive beds. It consists of 90 to 95 per cent quartz, with 5 to 10 per cent of alkali feldspar ~~and~~ fine mica. Rutile, hematite, and magnetite are accessory minerals.

The grain size of the quartz in the quartzites varies up to $\frac{1}{4}$ inch. Individual grains are squeezed and elongated parallel with a faint schistosity, and the larger grains are surrounded by finer grains of quartz and fine flakes of muscovite. The mica that surrounds the quartz is rarely visible in the hand specimen, but in thin section is seen to impart a schistosity to the rock.

The quartzites grade into an 'arkosic' member that in places contains up to 10 per cent alkali feldspar (microcline, orthoclase, and albite), and is pale pink-white in the hand specimen.

The conglomerate member of the Three Sisters formation lies 1,500 feet below the Quartzite Range. On the southern boundary of the map-area it is 34 feet thick, and on the eastern boundary 53 feet thick. It consists of quartz and quartzite pebbles enclosed in a matrix of grey-green, gritty quartzite similar to the quartzites lying above and below. A few pebbles of greenstone were also observed. The pebbles, which range in length up to 8 inches, have been squeezed and elongated to two or three times their shortest diameter, giving an excellent lineation that plunges 30 degrees south. This conglomerate forms the only good marker horizon in the eastern band of the formation.

Western Band

The western band of the Three Sisters formation is exposed along the core of a south-plunging anticline, from Porcupine Creek, on the south, to where it is cut off by a fault just south of Seeman Creek. It differs markedly from the eastern band in that it contains a large percentage of schistose rocks. The two limbs of the anticline also vary in lithology across strike, so that no correlation of members was possible. Considerable variation was also noted along strike in this western band.

The best exposures of the western band of the Three Sisters formation are along the ridges east of the Ymir-Seeman Creek divide.

In this area the variation in rock types is more extreme than farther south, and the abundance of closely interbedded quartzite and schist is a distinguishing feature. The section on the western limb of the anticline is as follows:

	Thickness Feet
Chlorite schist, grey weathering, grey-green, with numerous porphyroblasts of quartz and feldspar; narrow siliceous layers give a banded appearance; some beds of white quartzite and mica schist.....	1,000
Gap.....	60
Quartzite, massive, grey-green.....	100
Schist and argillaceous quartzite.....	200
Quartzite, white or grey, massive.....	120
Quartzite, grey, grey-green, and white; minor mica schist.....	70
Schist, micaceous; some with cyanite or apophyllite; grey or grey-green.....	300
Limestone, grey, with pink and yellow tinges.....	35
Mica schist, grey or grey-brown, some garnet bearing; minor grey-brown argillaceous quartzite	140
Limestone, grey or grey-brown.....	30
Mica schist; interbedded with beds of white quartzite 2 to 3 inches thick.....	120
Quartzite, grey-brown, argillaceous.....	50
Quartzite and argillaceous quartzite, white, grey-brown, or greenish; minor mica schist.....	315
Quartzite, green-white, gritty, with some pebbles of white quartz $\frac{1}{2}$ inch long.....	5
Quartzite, white and grey-brown.....	25
Quartzite and chlorite schist.....	40
Total exposed thickness.....	2,610

The exposed section of the eastern limb of the anticline is much thinner than the one described above.

The most abundant type of quartzite, which comprises about 10 per cent of the western band, is pale green and semi-translucent, and occurs in massive beds from 1 foot to 15 feet in thickness. It rarely shows the platy character of the whiter quartzites. Another, easily recognized member is the white, platy quartzite, which, due to the presence of 5 to 10 per cent of fine, scaly sericite, appears to be nearly opaque, and splits easily into thin plates that parallel the schistosity (which also parallels the bedding in the areas observed). It forms less than 5 per cent of the total exposure. The remainder of the quartzite is white or pink-white, generally platy, and consists almost entirely of quartz.

The argillaceous quartzites are transitional between the pure quartzites and the schistose members.

One of the most distinctive members of the Three Sisters formation is a chlorite schist, which varies from light grey-green to almost black according to the proportion of biotite present. In the southern part of the map-area, a thickness of 100 to 200 feet of this rock is exposed along the centre of the anticline. East from Baldy Mountain, it is found interbedded with grits through a thickness of 500 to 600 feet. Farther north, along a section measured southeast of Seeman Creek, chlorite schist forms 90 per cent of a section nearly 1,100 feet thick. It is also found in at least two narrow bands near the centre of the anticline in this area.

Throughout much of the section, the chlorite schist contains numerous porphyroblasts of feldspar up to $\frac{1}{2}$ inch in length. These are rounded, or are drawn out into elongated lenses as a result of intense shearing.

The mica schists are more abundant in the northern part of the exposed section. They are dominantly quartz muscovite or quartz-muscovite-biotite schists. In some of the highly contorted beds near

the crest of the Baldy anticline, grey-black garnet, probably almandine, is a prominent constituent.

Limestone is found only in the northern part of the western band of the Three Sisters formation, and is not exposed on the eastern limb of the anticline.

LOWER CAMBRIAN

Quartzite Range Formation

The Quartzite Range formation was named by Walker (1934) after the Quartzite (Nelson) Range, along the summit of which it is well exposed. It is one of the most striking and easily recognized formations of the area, and is continuous with much of the Hamill series as mapped by Rice (1941) to the northeast.

Three bands of the formation are exposed in the map-area: a broad eastern band, and central and western bands, which form the limbs of the Baldy anticline.

They consist almost entirely of white quartzite, with tinges of pink, green, grey, and yellow. Much of it is in massive beds 15 to 20 feet thick, in which it is impossible to determine bedding planes. In places a little quartz-sericite schist and chlorite schist are interbedded with the quartzite.

The most easterly band of the Quartzite Range, exposed from the southern border of the map-area northward almost to Seeman Creek, is the widest of the three bands exposed in the area. It is generally uniform in character, coarser than the more westerly bands, with many crossbeds. At one horizon near the southern border of the map-area, 100 to 300 feet of quartz-sericite schist lying about 1,500 feet above the base of the formation was used as a marker for a limited distance. A section of the eastern band, measured about 3,000 feet north of the southern boundary, is as follows:

	Thickness Feet
Quartzite, massive, white and pink-white.....	600
Quartzite, massive, pink and pink-white; some beds light grey to pale green.....	660
Quartzite, massive, pink-white and white.....	450
Quartzite, grey-green, massive.....	1,000
Sericite schists; some micaceous quartzite.....	215±
Quartzite, pink-white, platy to massive; minor amounts of grey quartzite.....	1,580
Total thickness.....	4,505±

In the east-central part of the map-area, the section across this band is quite similar to that described above. A minor amount of dark argillaceous quartzite, well banded, together with mica and mica-chlorite schist, lies about 1,750 feet above the base of the formation.

The central band of Quartzite Range formation is the thinnest of the three exposed. It has a maximum exposed thickness of only 1,400 feet near the southern border of the map-area, and this diminishes to 600 feet near the northern end of the band. Throughout its length, the band consists of platy white quartzites, which to the north are interbedded with a little mica schist.

The western Quartzite Range band is well exposed along high serrate ridges throughout much of its length. It is composed almost entirely of massive and platy white quartzite. As in the central band, the quartzites here are generally finer grained than those of the eastern band, and lack prominent crossbeds. Near Baldy Mountain the section is as follows:

	Thickness Feet
Quartzite, white; minor argillaceous quartzite and mica schist.....	70
Quartzite, fine-grained, pink-white and white, massive and platy.....	910

	Thickness Feet
Schist, grey-brown, micaceous.....	30
Quartzites, grey-white, massive; coarser than those above.....	320
Gap.....	550
Quartzite, white with tinges of pink-green and yellow-brown.....	310
Total thickness.....	2,190

As the eastern band of Quartzite Range formation is coarser and thicker than the other two bands, and shows numerous crossbeds, the source of the sediments probably lay to the east.

The boundary between the eastern band of Quartzite Range formation and the Three Sisters formation is fairly well defined, and its position is in accord with mapping in adjoining areas. The contact is placed where there is a fairly rapid transition from the pink-white quartzites of the Quartzite Range to the pale green, somewhat coarser, gritty quartzites of the underlying Three Sisters formation. It lies about 1,500 feet above the conglomerate horizon of the Three Sisters formation.

The upper contact of the Quartzite Range is placed where a fairly rapid transition was observed from pink-white quartzite to the darker argillaceous quartzite and mica schists of the Reno formation. This transition zone may vary in thickness from 200 to 300 feet, but, in the eastern band at least, the upper boundary of the Quartzite Range can be considered as accurately defined. In the southeastern corner of the map-area it lies 700 feet below the basal limestone of the Laib group, an excellent marker horizon.

The western band of Quartzite Range is well exposed, and shows no evidence of folds throughout its thickness of 2,000 to 3,000 feet. The maximum thickness of the central band of Quartzite Range is, however, only 1,400 feet, indicating that a part of it must have been removed by faulting or by flowage. Although the concept of extreme flow does find

support in the thinness of the western band of overlying Reno formation, the former alternative seems more probable, and the western (lower) contact of the central band of Quartzite Range with the Three Sisters is assumed to be a fault contact. The upper contact is again placed at an horizon where there is evidence of fairly rapid transition into overlying Reno schists.

The contact between the Quartzite Range and the Three Sisters formations on the western limb of the Baldy anticline is defined by a fairly sharp transition from pink-white, platy quartzites to underlying grey-green, chlorite schists,

Thus, within the western anticlinal belt of these formations, the central part, containing a high percentage of schistose members, has been mapped as Three Sisters, and the two flanking bands with little schist as Quartzite Range. The reason for this is as follows. The schistose members are interbedded in places with coarse green quartzites and arkosic quartzites that strongly resemble members of the Three Sisters formation. In Salmo map-area (Little, 1950), recent mapping has shown that the corresponding Sheep Creek anticline contains a similar succession of coarse grits interbedded with schists. As these grits are coarser than members of the eastern band of Quartzite Range and are similar to members of the eastern band of Three Sisters, and as the source of these sediments is considered to be to the east, it follows that these beds belong to the Three Sisters formation.

However, the coarse-grained rocks upon which the above correlation is based lie near the centre of the anticline and, consequently, prove only that the central part is to be correlated with the Three Sisters. The several hundred feet of quartzite and schistose rocks lying above this are, therefore, lying between rocks known to be Quartzite Range and rocks believed to be Three Sisters. The Quartzite Range-Three Sisters contact, as mapped in the western belt, may thus lie stratigraphically several hundred feet above that in the eastern band.

Reno Formation

The Reno formation was named by Walker (1934) from its occurrence on Reno Mountain. It was redefined by Little (1950) to include only those members lying between the Quartzite Range formation and the first band of limestone lying above it, namely, the basal limestone of the Laib group of this report.

In Ymir map-area, the Reno outcrops along the flanks of the Laib syncline. On the eastern flank it is well exposed across a width of 700 to 1,100 feet. The corresponding band along the western flank of the syncline is poorly exposed and much thinner.

As the Reno formation comprises the transition zone between the pure white, Quartzite Range quartzites below and the Laib schists above, it contains members similar to both, but is dominantly mica schist and argillaceous quartzite. Near the southern border of the map-area, it consists of grey-green, argillaceous quartzites that grade into the quartzite Range below and through the Laib limestone into the Laib schists above. A section measured in this area showed the following succession:

	Thickness Feet
Quartzite and argillaceous quartzite, grey-green and grey-brown.....	115
Quartzite and siliceous argillite, grey-black to dark green; in part slaty and phyllitic.....	142
Quartzite, massive, yellow-brown to green.....	165
Quartzite, light grey-brown, argillaceous.....	60
Argillite and phyllite, light green, siliceous.....	80
Phyllite, light green, siliceous.....	60
Phyllite, quartzite, and calcareous argillite.....	47
Quartzite, light to dark green and dark grey; minor white quartzite.....	70
Total thickness.....	739

From this point northward, the Reno formation becomes successively more schistose and less well exposed. Just southeast of the Laib Creek plug, a band of limestone lies nearly 1,100 feet stratigraphically above the nearest exposed massive quartzites. If this is the Laib and not an overlying limestone it indicates a probable thickness of 1,100 feet, the greatest thickness attained by the Reno in the map-area. The poorly exposed area between the limestone and quartzite is, apparently, all underlain by quartz-muscovite schist. Just north of the same plug, the thickness is about 600 feet, of which the upper 400 feet are grey-brown mica schist and the lower 200 feet consist of interbedded mica schist and white quartzite. The schists are in part chloritic.

On the western limb of the syncline the Reno formation is thinner than on the eastern. Just north of Porcupine Creek it is only 130 feet thick, and consists of the following:

Top of Section	Thickness Feet
Mica schist, grey-green, coarse	25
Quartz-mica schist, grey-green to brown	45
Quartzite, white, with tinges of grey, pink, and green; interbedded with mica schist	60
Total thickness	130

Farther north, where the Reno outcrops in the trough of the syncline, it has a thickness of 300 feet. At this point the formation consists of well-banded schist and impure quartzite, and grades imperceptibly into the underlying Quartzite Range formation. The bands range from $\frac{1}{2}$ to 1 inch in thickness, and are generally grey-brown, and grey or green-brown on the weathered surface. The quartzite contains about 10 per cent fine biotite, which is set in a fine, brown, siliceous groundmass. Interbedded schists are siliceous, muscovite-biotite rocks, with small amounts of chlorite.

Laib Group

The Laib group is named from Laib Creek in the west part of Ymir map-area, where much of the group is exposed. It is a thick assemblage of coarse mica schist, phyllite, argillaceous quartzite, argillite, and limestone, in decreasing order of abundance. The upper members are more argillaceous than the lower, and grade into the overlying strata of the Nelway formation. The base of the group is placed at the base of a persistent band of limestone, which overlies conformably the Reno formation. The upper contact of the group is placed at the base of a 30-foot band of white limestone, which is exposed in the southeast corner of the map-area, and is the uppermost band of white limestone above the basal Laib limestone.

In the southeast corner of the map-area, the section, from top to bottom, is as follows:

	Thickness Feet
Argillite, light grey-green, darker near top, phyllitic	1,700
Limestone, light grey to brownish, siliceous	18
(Fault, displacement undetermined)	
Limestone, grey-buff, brecciated	3
Argillite and phyllite, grey-green; minor argillaceous quartzite	600
Phyllite, light grey-green, soft	90
Argillite, siliceous, grey-green	90
Limestone, buff, honeycombed	6
Argillite or phyllite, grey-green, massive	100
Quartzite, massive, grey-green, argillaceous	50
Phyllite and argillaceous quartzite, grey-black to grey-green	165

	Thickness Feet
Quartzite and argillaceous quartzite, grey-brown, massive	180
Limestone, argillaceous	35
Limestone, white, massive, siliceous, magnesian, becoming less siliceous at the top; buff, honeycomb-weathered	135
Total thickness ...	3,172

North of this section, the rocks are schists, with lesser amounts of fine phyllite and argillaceous quartzite, and the basal limestone band becomes thinner; it is only 65 feet wide where it passes beyond the map-area in the vicinity of Laib Creek. The schists are mainly brown, medium-grained, quartz-mica rocks, in places grey-green as the chlorite content increases (up to 5 per cent). Along Cultus Creek, much of the schist is interbedded with fine laminae of quartzite. West of the Laib Creek plug, the rocks are green, bronze weathering, mica schists, with one 4-foot band of buff limestone exposed near the centre of the syncline.

The basal limestone band of the Laib group is one of the most easily recognizable horizon markers in the district, owing to its position with regard to the quartzite formations below and the schistose rocks above, and its remarkable persistence. It varies somewhat in character, however, and in places, as mapped, includes some interbedded schists and even quartzites. Its thickness is variable, and in places the band may be missing, but it is mapped as a continuous horizon, though locally its width is greatly exaggerated.

On the western side of the Laib syncline, this basal limestone band differs somewhat in appearance from that in the

type section measured on the eastern side of the syncline. One mile north of Porcupine Creek a section of the basal limestone band measures as follows:

	Thickness Feet
Limestone, siliceous, grey-white, with some mica	20
Limestone, grey-white and pink-white, banded	30
Mica schist, bronze weathered, grey-brown	50
Quartzite and mica schist	36
Limestone, white, massive	47
Limestone, siliceous, grey-white	5
Total thickness	188

Farther north, along the west limb of the syncline, the limestone is thinner.

The basal limestone band of the Laib group has been traced almost continuously southward beyond the International Boundary. It was in this limestone band that Little (1950, pp. 17-18), working in Salmo map-area during the field season of 1948, found Lower Cambrian fossils. These were the first to be found in the Laib group on the Canadian side of the border, and confirmed the correlation with Cambrian rocks mapped by Park and Cannon (1943) in the Metaline quadrangle, Washington.

The Laib group can be correlated with rocks mapped by Walker (1934) as Reno and lower Pend d'Oreille, and corresponds roughly with the upper part of Daly's (1912) Beehive formation and the Lone Star formation. Together with a part of the underlying Reno formation (as redefined by Little), it is the equivalent of the Maitlen phyllite as mapped by Park and Cannon (1943). The

basal limestone member may be correlative with the Badshot limestone, which has been mapped by Rice (1941) and by Walker, Bancroft, and Gunning (1929) northward along and beyond Kootenay Lake nearly to Revelstoke. If this be so, the remainder of the Laib group represents the lower part of the Lardeau series.

Nelway Formation

The Nelway formation was named by Little (1950) from its occurrence near Nelway in the Salmo map-area. It outcrops along the trough of a south-plunging syncline in the southeastern corner of the map-area. The formation is poorly exposed throughout most of its extent, but fair exposures are found along the headwaters of Porcupine Creek and along a small creek that flows northwest into Porcupine Creek at an elevation of 4,550 feet.

That part of the Nelway formation here exposed consists of a series of black phyllites, argillites, and slates and thin beds of black limestone, and represents only the lower part of the formation as exposed in Salmo map-area.

Near the southern border of the map-area, the formation outcrops across a width of 2,200 feet. The western 1,000 feet comprise calcareous phyllite and argillite, becoming more calcareous toward the east. The striking features of these rocks are their black colour, comparative lack of schistosity, fine grain, and high lime content. Bedding may be fine and prominent in places, but the rocks are generally so uniform in composition and colour that bedding planes may be difficult to distinguish. The calcareous argillites contain interbedded black limestone near the top of the formation.

The eastern 1,200 feet of Nelway strata show the reverse gradation to the western 1,000 feet, becoming more calcareous toward

the west. Thus, the soft, calcareous members lie in the centre and grade eastward and westward into more typical black argillite. Secondary structures, such as fracture cleavage and drag-folds, indicate that this zone lies along the trough of a syncline, and evidence from regional structure and stratigraphy supports this view. A fairly accurate estimate of the stratigraphic thickness in this area is, therefore, about 1,000 feet.

Along the north fork of Porcupine Creek, the Nelway formation is represented by black slate, in which the well-developed, steeply dipping cleavage, running parallel with the creek, has resulted in numerous steep gorges. The slates contain fine flakes of mica, and in some places graphite, on cleavage surfaces.

Elsewhere, the rocks may be more properly classed as phyllite. In these, the poorly developed planes of schistosity are more crumpled, and flaky minerals are more easily distinguished.

The lower contact of the Nelway formation with the Laib group schists is placed at the base of the uppermost band of white limestone above the basal Laib limestone. There is, however, no sharp break in the general character of the rocks, which become gradually more calcareous and blacker higher up in the section. The upper limit of the formation is not found in the Ymir map-area.

The age and correlation of the Nelway formation are fully discussed by Little (1950), who correlates it with the Metaline limestone (Park and Cannon, 1943) of Middle Cambrian age.

THE PRECAMBRIAN-CAMBRIAN SUCCESSION

Three methods of delineating the base of the Cambrian system are in present use. The first, which designates the lowest horizon at which Lower Cambrian fauna have been collected, is not practical in this region where fossils are rarely obtained. The second, which designates the first unconformity below this horizon

as the base of the Cambrian System is likewise not practical where, as here, such an unconformity lies at the base of the Monk formation, 12,000 to 14,500 feet below the lowest fossil horizon. Furthermore, evidence that this unconformity is relatively local is presented by Rice (1941, pp. 15 and 18). The third method, which is rapidly gaining favour among field geologists, designates the base of the lowest formation bearing Lower Cambrian fossils as the base of the Cambrian System. This method has been adopted by Little (1950) and is followed by the present writer.

The basal limestone of the Laib group has yielded pleosponges of Lower Cambrian age, and Park and Cannon (1943, p. 15) collected trilobite fragments from an horizon that appears to be several hundred feet below the basal Laib limestone, or near the top of the Quartzite Range formation. The base of that formation, then, is tentatively assumed to represent the base of the Cambrian System.

ORDOVICIAN

Active Formation

Rocks of Ordovician age are found enclosing a small stock in the south-central part of the map-area. The best exposures are along Porcupine Creek and on the slope east of Active Creek, from which the formation derives its name.

Rocks of the Active formation consist of slates and argillites, with lesser amounts of hornfels, quartzite, and limestone. The slates and argillites of the formation consist mainly of fine quartz, with various amounts of graphite, fine mica, and calcite.

The graphitic slates are poorly exposed, and slopes underlain by them are mantled by coarse, black soil. More calcareous members are poorly exposed on valley slopes, but outcrop fairly well along Porcupine Creek.

The remaining members generally have a platy fracture, and in places break up into wide, slaty slabs. These rocks weather black or dark, rusty brown. Bedding is generally shown by fine laminae or by beds up to 1 inch in thickness.

A little quartzite occurs in the formation. The most prominent bed is only 18 inches thick; it is pink-white, and consists almost entirely of quartz. A few narrower beds of quartzite underlie it.

At least three limestone bands are interbedded with the slates and shales. One of these, just west of the granite contact on Porcupine Creek, has an outcrop width of nearly 250 feet. This limestone is white, with light grey bands, but some beds have a pink tinge. On the eastern side of the granite stock, three bands of limestone, each at least 20 feet thick, are exposed. Weathered surfaces are grey or yellow-grey, and commonly have a finely striated appearance due to differential weathering along bedding laminae. Fresh surfaces are white or banded grey-white.

Where exposed in Ymir map-area, the Active formation is in faulted contact with other sedimentary rocks, except possibly in the upper reaches of Wren Creek. On the west, the Oxide fault can be traced from the Oxide property northeast for about 2 miles. On the southern side of Porcupine Creek, the Active-Seeman group contact is not exposed; outcrops of the two, several hundred feet apart, show no angular discordance, but are sharply distinct lithologically. On the east, the Ordovician slates are down-faulted into contact with rocks of the Quartzite Range formation, but again no marked angular discordance was noted.

During the field season of 1947, one specimen of what appeared to be a poorly preserved fossil gastropod was collected

from rocks of the Active formation, and was tentatively identified by Dr. V. J. Okulitch, of the University of British Columbia, as Hormotoma, of Ordovician age. In 1949, he and Dr. Little returned to the locality and were successful in finding poorly preserved graptolites. From this collection Alice E. Wilson of the Geological Survey of Canada identified the following:

Totragraptus ? sp.

Didymograptus sp. A near Didymograptus hirundo occidentalis Reudemann

Didymograptus sp. B.

Dicranograptus sp.

Climacograptus ? sp.

Dr. Wilson commented on the collection as follows:

"The graptolites are not well preserved for specific determination, but the genera appear to correspond more with those of the upper horizons of the Ledbetter beds. It may also be significant that the better preserved species of Didymograptus resembles a Glenogle form."

The age of the Active formation, therefore, is established as Ordovician, and possibly early Middle Ordovician.

ORDOVICIAN(?) AND LATER

Seeman Group

The Seeman group is named from Seeman Creek, along the valley walls of which it is well exposed. It is composed of quartzite, schist, and limestone, with minor slate and basic flows or sills.

The schistose members of the group were formed from the more argillaceous bands. Where these bands are associated with abundant quartzite they are coarser grained and are composed essentially of quartz and muscovite. Where broad bands of argillaceous sedimentary rocks are found, metamorphism is not so marked, and a fine, grey-black phyllite or fine biotite schist results. A little

chlorite and graphite schist were also observed.

The quartzite members are predominantly white, with faint tints of pink, yellow, brown, and green. They occur in beds up to 200 feet thick, and are in places massive, elsewhere platy. In part they are indistinguishable from the quartzite in the Cambrian formations.

At no place in the map-area is a good section of the Seeman group exposed. It can, however, be divided into three zones having indefinite boundaries:

(1) An eastern zone (oldest?) characterized by 'ribbon quartzite' (±3,000 feet thick)

(2) A central zone of quartzites and schists lacking the 'ribbon quartzites' (±2,000 feet thick)

(3) A western zone (youngest?) of limestone and schists, with minor quartzite, slate, and intermediate to basic igneous rocks (±3,000 feet thick)

The eastern zone is best exposed along the southeastern side of Seeman Creek Valley, along the upper reaches of Seeman Creek, and along the walls of Porcupine Creek Valley just east of Active Creek. The 'ribbon quartzites' are the most striking rocks of this zone. They consist of bands of nearly pure quartzite, generally less than 2 inches thick, separated by narrow bands of quartz-mica schists. The schists weather more easily than the quartzites, in many places resulting in a rough washboard effect on the weathered surface. This, together with the dark red, grey, and grey-brown colours of the schists contrasting with the pale quartzite gives the rock its strikingly banded appearance. Associated with the ribbon quartzites in this zone are broader bands of schists and quartzite, in some places up

to 50 or 60 feet thick. Some of those thicker beds of white quartzite are well exposed and can be used as marker horizons for limited distances.

The eastern zone contains at least two bands of limestone. One of these, a dolomitic limestone, is well exposed along the southern side of Seeman Creek Valley, near the fault separating this formation from the older Quartzite Range beds. At that point it has an outcrop width of 450 feet, but minor folds may account for some of this width. It is a white, buff weathering rock, with a sandy feel on the weathered surface, the carbonate forming crystals $\frac{1}{4}$ inch in diameter. The rock contains small amounts of talc, tremolite, and muscovite. Apparently the same limestone band, with an outcrop width of about 300 feet, and associated with schists and 'ribbon quartzites', is found on the Ymir-Seeman Creek divide. If this band continues to the south it must change in character and become much thinner, as it resembles none of the limestones found along Porcupine Creek.

Seven hundred feet southeast of this band, on the Ymir-Seeman Creek divide, a second, 20-foot band of grey limestone is interbedded with banded quartzite and schists. Only one band of limestone was found in this zone along Porcupine Creek. This, a grey-banded limestone, lies near the junction of Active and Porcupine Creeks.

The central zone consists of white quartzite, schist, and limestone. One calcareous band occurs in this zone. It is about 200 feet thick on Porcupine Creek, and consists of grey-banded limestone in beds up to 20 feet thick interbedded with calcareous mica schists.

The western zone is poorly exposed. To the south, along Porcupine Creek, it has suffered extensive alteration. From here to

the northeastern corner of the map-area it is traced mainly through small isolated roof pendants in the Nelson batholith. In the northeastern corner of the map-area it is again highly altered and poorly exposed. In the southern part of the area the zone consists dominantly of dark, grey-brown mica schist, with minor bands of white, feldspathized quartzite and paragneiss. To the north, this zone becomes more argillaceous and limestone is much more prominent. Along the ridge between Seeman and Kutetl Creeks, one band of sheared argillite, 500 feet thick, and five bands of limestone were recognized. In this area they occur in a group of hybrid rocks ranging from biotite-chlorite and muscovite schists through paragneisses into massive granitic rocks.

Along the northwestern side of Ymir (Wildhorse) Creek Valley and the northwestern side of Seeman Creek Valley a band of limestone conglomerate is poorly exposed. It is grey-white to grey-black. Pebbles are of fine granitic material, quartz, and feldspar. The granitic pebbles are the most prominent, and stand out on the weathered surface as coarse nodules up to 2 inches in diameter. In thin section, these pebbles are seen to consist of highly altered alkaline feldspar, of which some at least is albite, together with biotite and quartz in a groundmass of calcite. Smaller, rounded pebbles of quartz are abundant. Flowage in the limestone has drawn the larger pebbles into irregular crenulated lenses, whereas the smaller pebbles have retained their well-rounded form.

Two isolated bodies of dioritic rocks occur in the vicinity of Kutetl Creek, near the upper (?) part of this zone. One of these is a black, grey-black weathering, medium-grained rock showing moderate schistosity. It consists of hornblende, biotite, andesine, and magnetite. The other is an altered augite-feldspar porphyry consisting

of augite, biotite, andesine, microcline, orthoclase, and quartz. The rock has been extensively granitized. Both bodies are sill-like in form but may be flows.

The age of the Seeman group is unknown. It is bounded throughout the greater part of Ymir map-area by granite. In the northeast, it is separated from the Cambrian sedimentary rocks by a fault and from the Ymir argillites by an area of highly altered and intruded sedimentary rocks, which, for the most part, cannot be classified into their proper formations. In the southern part of the map-area the contact of the Seeman group with the Active formation is, where exposed, along a fault. The western contact with the Ymir argillites is again in an area of metamorphosed, hybrid rocks.

There is, however, no evidence of discordance between the Seeman group and either the Ymir group or the Active formation. Little (1950) reports that the rocks of the Seeman group, just south of the Ymir map-area, overlie the Active formation along what appears to be a gradational contact.

In general, the Seeman group resembles the Milford group as described by Rice (1941), especially as to the presence of 'ribbon quartzite'.

In the adjacent part of the Nelson (east half) map-area, Rice has mapped the rocks of the Seeman group as part of the Lardeau series. In that area they are in contact with the Quartzite Range formation, but are separated from it stratigraphically by a fault of unknown magnitude and are quite different lithologically from the strata overlying the Quartzite Range formation along the Laib Creek syncline.

In the light of present evidence, the Seeman group can only be regarded as probably younger than the Active formation and older than the Ymir group.

Ymir Group

Members of the Ymir group outcrop along a band 1 mile to 3 miles wide extending from Ymir to the northwestern corner of the map-area. Highly altered roof pendants of these rocks are also found over much of the northern part of the area, which is underlain by rocks of the Nelson batholith. Indeed, it seems obvious that at the time of intrusion of the batholith nearly half of the map-area was underlain by highly folded members of this group.

The Ymir group consists of interbedded slates, argillites, shales, argillaceous quartzites, quartzites, limestones, and minor amounts of mica and mica-chlorite schists. Colours are mainly dark grey, green, and brown, and in places black, with here and there, lesser amounts of light grey and light green rocks. On the weathered surface, the colour varies from dark brown and black to rusty brown.

Primary structures such as ripple-marks and crossbedding were observed only rarely, and then generally in the more quartzitic layers.

One belt of argillaceous quartzite at the base of the Ymir group has a minimum thickness of 400 feet, and is prominently banded. The bands are uniformly 1 inch to 2 inches thick, and are coloured alternately light grey or grey-green and dark grey or dark green. These rocks are well exposed along Porcupine Creek just below the Maple Leaf property, and can be traced northeast across the map-area through a number of roof pendants of various sizes. In these pendants the banding persists despite alteration of the sediments. The same beds are found in the northeastern corner of the map-area, north of Kutetl Creek, in a comparatively unmetamorphosed state, and are more argillaceous and slightly darker than along Porcupine Creek.

A minor amount of limestone occurs in the Ymir group, but as only eight or ten outcrops of it were observed in the entire area it was impossible to either trace or correlate the various bands.

In the vicinity of Apex, isolated occurrences of small, sill-like bodies are found in the Ymir group. They consist of dark grey or black, fine- to medium-grained rocks, in bands 15 to 20 feet thick, perfectly conformable with the bedding. They are similar to no rocks known to be associated with Nelson intrusions, but may be intrusive members related to the Elise formation.

Throughout most of the Ymir group, effects of metamorphism have not been intense, though regional metamorphism has resulted in the production of fine flakes of muscovite and biotite and, less commonly, fine crystals of amphibole. Near contacts with the Nelson batholith, however, Ymir strata are more strongly metamorphosed. Typical contact rocks grade from hard, siliceous quartzites, knobby graphitic schists, andalusite-mica schists, biotite schists, and talc schists to various types of paragneiss. Some of these paragneisses found in roof pendants on the batholith grade imperceptibly into the granitic rocks.

The contact relations of the Ymir group with the underlying Seeman group have already been discussed. Contacts with the overlying Elise volcanic rocks are commonly represented by a zone of alternating bands of andesitic and sedimentary rocks. The andesitic rocks may be flows or sills, but their concentration near the contact and lack of crosscutting relationships suggest that they are flows that lie in a zone representing a transition from sedimentation to volcanism.

In Ymir Creek, about one-quarter mile above its mouth, the contact of Ymir strata with flows of the overlying Elise formation is well exposed at low water, and is clearly conformable. Elsewhere, within one or two hundred feet of the contact the bedding planes on either side are parallel or nearly so.

The Ymir group is correlated with the Slocan series, which according to fossils collected by Cairnes (1934) are probably of Triassic age. Although the Ymir formation is separated from the Slocan series by intrusive rocks, numerous roof pendants within the batholith, and believed to represent metamorphosed Ymir strata, strike northeast and line up fairly closely with the Slocan series as mapped by Rice. Lithologically, the Slocan and Ymir are similar, but it is possible that the Ymir may include equivalents of the Milford group.

Overlying the Elise formation conformably is the Hall group, which has yielded fossils of Jurassic, possibly early Middle or late Lower Jurassic in age (Little, 1950). Thus the Ymir group lies several thousand feet stratigraphically below Jurassic fossil horizons.

TRIASSIC(?)

Elise Formation

The Elise formation constitutes the lower part of what McConnell and Brock (1904) defined as the "Rossland Volcanic group". It receives its name from Mount Elise in the west-central part of Ymir map-area, where it is well exposed and reaches its maximum outcrop width of about $3\frac{1}{4}$ miles.

Lavas of andesitic to basaltic composition comprise the greater part of the formation. One of the most common types is augite porphyrite, although hornblende and plagioclase porphyries

are found. Flow breccias are well exposed along the Ymir-Nelson highway.

The lavas are in places amygdaloidal or vesicular. Amygdules are formed generally of calcite and less commonly of quartz. Pillows are found only rarely, and where observed are in the fine-grained facies. In colour the rocks are predominantly dark grey or grey-green, but a few flows are black, brown, or light green. On the weathered surface they are dark green, brown, or black, more rarely light green.

Pyroclastic rocks range from fine, banded tuffs to coarse agglomerate, with angular inclusions up to 2 feet in diameter. They grade through tuffaceous sediments on the one hand into flows containing bombs and lapilli on the other.

A few narrow lenses of sedimentary rocks lie interbedded with the volcanic rocks. These are generally 10 to 15 feet thick, but one band along the Ymir-Nelson road is 150 feet thick. The rocks are primarily black slates and argillites resembling those of the Ymir group. A few beds are similar, both in hand specimen and thin section, to tuffs, but semi-rounded fragments indicate some abrasion before deposition. It is probable that these beds were laid down in small lakes on the lava surfaces, and that the material composing them was incompletely weathered and poorly sorted prior to deposition, and thus differed little from the volcanic rocks themselves.

Shearing and low-grade metamorphism are pronounced in the formation. Most of the feldspar has been saussuritized, and the augite and hornblende are mostly altered to actinolite, biotite, and chlorite. Other minerals such as calcite, epidote, zoisite, clinozoisite, low aluminous amphibole, sericite, and sodic plagioclase are abundant in rocks of the Elise formation; textures are also typical of low-grade metamorphism.

The contact of the Elise with the overlying Hall group is not well exposed in Ymir map-area, but both Drysdale, in his 1917 report, and R. Mulligan (personal communication), who has done recent work in the area, report the two as being conformable. Little (1950) collected fossils from the Hall group, which indicate that it is in part Jurassic in age.

The Elise formation is thus known to lie above rocks probably of Triassic age and conformably below rocks whose age is in part Jurassic. The age of the Elise is, therefore, late Triassic or early Jurassic.

JURASSIC AND(?) CRETACEOUS

Hall Group

The Hall "series" was named by Drysdale (1917) from its occurrence along Hall Creek, just west of Ymir map-area. In this map-area the group is represented by only a narrow band near the western border just west of Ymir.

As represented in this band, the rocks are grey and grey-black argillites and quartzites, in places altered to a dense, hard, black hornfels.

Little (1950) collected fossils from the group during the field season of 1949, and established the age of the middle part of the group as Jurassic.

PLEISTOCENE AND RECENT

Glacial and Fluvial Deposits

The steep valley walls and fast flowing streams of Ymir map-area are not favourable for the preservation of unconsolidated rocks, and deposits are found over only limited and isolated areas. They consist of a thin veneer of sand, gravel, till, or boulders scattered over valley bottoms and the lower parts of valley walls.

Crossbedded sands and gravels occur near the head of Porcupine Creek. Below the Oxide property, Porcupine Creek has cut down through deposits consisting mainly of fine quartz sand. These deposits are apparently fluvioglacial material deposited before a retreating valley glacier.

Along Seeman Creek, the valley bottom is floored by glacial debris consisting of small deposits of clay associated with a little coarser material, and more extensive deposits of sand and gravel form a thin veneer well up the valley walls.

About 2 miles north of Ymir, glacial clays are found overlying well-sorted sand and gravel.

Elsewhere, as along Salmo River, thin deposits of glacial and fluvioglacial material cover valley bottoms, but as a whole the region must be described as relatively free of drift.

INTRUSIVE ROCKS

Nelson Intrusions

The Nelson intrusions of Ymir map-area are mainly granite, much of which is characterized by phenocrysts of orthoclase. A large sill-like body on the west slope of Mount Elise is an albite porphyry. Diorite, quartz diorite, granodiorite, and monzonite are much less abundant than granite. Lamprophyres, aplites, and minor pegmatites are found throughout the area.

The intrusions cut the Beaver Mountain formation (Little, 1950), which rests conformably on the Hall group. The age of the intrusions is, therefore, Jurassic or younger. An upper limit to the age has not been established.

Alkaline Intrusions

Three small bodies of intrusive rocks, each distinctly alkaline in character and outcropping over an area of less than half

a square mile, are found within the map-area. Two of these, one a basic syenite-pulaskite plug, the other a basic syenite chonolith, lie in the southwestern corner of the area. The third, a melanocratic shonkinite, lies in the east-central part of the map-area near the headwaters of Laib Creek. Mineralogically, the three are remarkably similar. Several basic dykes are associated with them.

The Salmo River plug is crossed by the railway and main highway about a mile south of Ymir. It consists of mesocratic basic syenite, which in places grades into a shonkinite, and a small leucocratic core of pulaskite.

The basic facies is a dark grey rock with a typical monzonitic texture, slightly porphyritic, medium to coarse grained, and consists of augite, olivine, labradorite, soda-orthoclase, and biotite, with accessory apatite, amphibole, magnetite, hydrous iron oxide, and certain alteration products.

The pulaskite core of the body is well exposed in a small quarry along the railway. It is a coarse, mauve-coloured, leucocratic rock, with a pronounced trachytoid texture, and consists of orthoclase, cryptoperthite, augite (sodic), biotite, and amphibole, with accessory oligoclase, apatite, magnetite, and alteration products believed to have formed from nepheline.

The contact between the pulaskite and basic syenite, where examined by the writer, was found to be gradational across a width of 5 or 6 feet. Angular fragments of basic syenite are found in the pulaskite, and small stringers of pulaskite, with gradational boundaries, cut the basic syenite.

The May Blossom chonolith of basic syenite outcrops over an area of about one-quarter square mile in the southwest corner of the map-area. Drysdale (1917) reports the body as being irregularly shaped, with contacts dipping steeply in places and flatly in others. The

rock is similar in mineral composition to the basic facies of the Salmo River plug. The old May Blossom and Free Silver properties lie along the margin of this body.

The third alkaline rock body found in the map-area lies near the headwaters of Laib Creek. It also is roughly oval in shape. The walls are well exposed on a steep cliff face, where they are found to be almost vertical, giving the body a true, plug-like form.

Mineralogically the rock is similar to that of the two bodies described above, though, due to a greater proportion of mafic minerals, the rock is classed as a shonkinite.

The chilled border of the plug is almost black, but with a faint mauve tinge, and weathers grey-black. It consists of phenocrysts of aegerine-augite up to one-quarter inch in length, together with finer phenocrysts of olivine, set in an aphanitic groundmass.

The coarse, grey-black central part of the plug is more amenable to study in thin section. It is composed of orthoclase, biotite, augite, amphibole, and fine-grained alteration products of olivine and(?) nepheline, with accessory apatite, magnetite, and calcite, and fine grains of pyrite and angular inclusions of quartzite.

The age of the alkaline intrusive rocks has not been accurately determined. The rocks are fresh and uncrushed. Vertical walls, apparently unaffected by folding, are especially well exposed in the Laib Creek plug. It is apparent that these bodies are younger than the main period of intrusion of the Nelson batholith, and similar alkaline bodies elsewhere in southeastern British Columbia have generally been regarded as of Tertiary age.

STRUCTURE

The general structure within the Nelson Range is a broad homocline dipping steeply or overturned toward the west, and complicated by steep isoclinal folds and extensive faults. The complexity of structure, together with the lack of adequate marker horizons in many formations, has allowed only a partial solution of the problems involved. The abundant close folds that must exist in certain formations, and indeed the relations between certain formations themselves, will be demonstrated only by detailed mapping in critical areas.

The most persistent fabric element in the pre-Nelson rocks of the area is schistosity, which is almost invariably parallel with the bedding planes. This relationship is so consistent that schistosity has not been indicated on the accompanying map except where it is known to be at an angle to the bedding or where the attitude of the beds was not determined.

In the massive quartzites, schistosity is not normally visible in the outcrop. In certain places, however, fracture cleavage intersects bedding planes to produce a well-defined pencil structure. This lineation is one of the most consistent structural features in the area and was observed at numerous places in the Quartzite Range and Three Sisters formations. Theoretically, it represents the plunge of the major structure, and its consistency allows a fair degree of confidence to be placed in it. In Ymir map-area it indicates a general plunge of about 35 degrees south.

Lineations produced by elongation of mineral or rock particles are not easily studied in the fine-grained rocks of the area, but are well developed in the conglomerate rocks of the Three Sisters formation. There, the pebbles have been elongated to two or three times their shortest diameter, and axes of elongation plunge consistently southward at an angle of about 30 degrees.

FOLDS

Rocks in the area have been folded along an axis striking just east of north. The folds are steep, isoclinal, and even fan shaped, with a plunge to the south of about 30 degrees as indicated above. It was found possible to map only two of the major folds of the area, and even this involved some speculative interpretation.

Laib Creek Syncline

The Laib Creek syncline is overturned steeply to the west. In the southern part of the map-area, most of the western flank has been removed by faulting. At no place in the area was the actual trough located accurately. The general structure is based on the following facts:

(1) The structure lies in line with, and is presumably an extension of, a broad syncline mapped in the Salmo map-area.

(2) Both secondary structures and general stratigraphic sequence in the Nelway formation suggest the trough of a syncline.

(3) The correlation of bands of limestone on opposite sides of the syncline, together with the correlation of the two bands of quartzite of the Quartzite Range formation, indicates a synclinal structure.

Baldy Anticline

The Baldy anticlinal structure is an overturned fan fold. It is, presumably, an extension of the Sheep Creek anticline, although an area of down-faulted younger rocks and granitic intrusions separates the two. The anticlinal structure in the Ymir area is indicated by the following facts:

(1) Beds along the crest of the anticline are correlated with part of the Three Sisters, whereas flanking beds are of the Quartzite Range formation.

(2) The crest of the anticline is marked by a zone of highly contorted beds.

(3) The general spread of the limbs northward conforms with the general southward plunge of rocks of the area.

On the other hand, it must be admitted that no success was found in attempting to correlate members on opposite flanks of the anticline.

Folds in the younger rocks of the area have not been satisfactorily mapped. The areal distribution of the Ymir formation suggests that it has been highly folded, although folding is not indicated in the Ymir-Elise contact. In only a few other places such as in the Active slates east of the Oxide property can crests of folds be seen, but the magnitude of such folds is unknown.

FAULTS

Major faults of the map-area generally strike parallel with the bedding in surrounding rocks or cross the beds at acute angles. The dominant strike of the faults is, therefore, just east of north; and dips, though commonly not determinable, are believed to be mainly steep to the east. An unnamed, major fault in the southeast corner of the area is an important exception in that it trends about north 75 degrees west and dips southwest at about 60 degrees. Numerous smaller faults, such as those discovered on various mining properties, are not recorded on the accompanying map; most of them strike northeasterly and dip either to the northwest or southeast.

Unnamed Fault

The unnamed fault in the southeast corner of the map-area is clearly marked by the offset of the Three Sisters conglomerate and Quartzite Range formation. In this area it has a left-hand displacement of about 1,500 feet. The western band of Laib limestone is not offset by this fault, and it is, therefore, assumed that it does not cut the Laib Creek fault.

Laib Creek Fault

The Laib Creek fault has been extended between two areas where its position has been determined. On the south, the Nelway formation has been faulted into contact with lower Laib schist beds. Assuming uniform thicknesses throughout the formations concerned, this represents a displacement of more than 2,000 feet. The general strike of the fault in this area is marked by the Nelway-Laib schist contact. Near the fault the Nelway formation has a steeply dipping slaty cleavage striking north, which may or may not indicate shearing along the fault.

Near Laib Creek, the fault is marked by the offset of the Quartzite Range and Laib group rocks. It has a left-hand displacement in this area of about 10,000 feet. Neither the direction of movement nor total displacement along the fault is known.

Baldy Fault

The Baldy fault was observed at only one place along the north wall of Porcupine Creek Valley, where strata of the Quartzite Range formation have been faulted into contact with those of the Three Sisters. Here, recent movement has thrust the west side up, producing a small fault scarp.

The fault has been extended from this locality northward to join the Seeman Creek fault, where similar scarps were observed,

although at only one intermediate point, east of Baldy Mountain, was any evidence of faulting noted. There abundant drag-folds were observed in quartzites. The presence of the Baldy fault accounts for the thinness of the central band of the Quartzite Range formation.

Throughout much of its length the attitude and exact position of the fault are unknown. Accordingly, it is mapped along the western boundary of the Quartzite Range formation to the point where it joins the Seeman Creek fault.

Seeman Creek Fault

Just south of Seeman Creek, the Quartzite Range and Three Sisters formations abut the Seeman group, the contact lying along the Seeman Creek fault. As mentioned before, the northeastern part of the Seeman Creek fault is marked by well-defined fault scarps. Near the point where it is cut off by the Baldy sill, its position is marked by brecciated quartzite. The Seeman Creek fault may be the equivalent of the Porcupine fault.

Porcupine Fault

The Porcupine fault separates down-faulted strata of the Active formation from those of the Quartzite Range and Reno formations. Where it crosses the Porcupine Creek-Wren Creek divide, its course is marked by a deep notch in the ridge. Farther north, it apparently runs into the Baldy sill, and may have controlled to some degree the shape of this igneous body. Where observed, the fault dips steeply eastward.

Oxide Fault

The Oxide fault is well exposed in the workings of the Oxide property, where it strikes north 10 degrees east and dips steeply eastward. Its exact position south of Porcupine Creek is not known. About 1¼ miles north of the Oxide property its position

marks a discordance between the Active formation and Seeman group.

The amount of movement along the Porcupine fault on the Oxide property is unknown, but is not believed to be great. It may be a hinge-fault, as it apparently disappears north of the lakes at the head of Oscar (Bear) Creek. In the valley of Wren Creek, the contact between the Active formation and Seeman group is assumed to be normal, though overturned.

ECONOMIC GEOLOGY

INTRODUCTION

In 1917, C. W. Drysdale examined and reported on the mineral deposits of the Ymir area, and W. E. Cockfield examined and reported on them in 1936. During the field work carried out in 1947 and 1948, the only properties examined were those undergoing development and those on which a considerable amount of work had been done since Cockfield's examination.

The first claim in the Ymir area was staked in 1885 by the Hall brothers on Ymir (Wildhorse) Creek. Mining began 11 years later when miners from the Rossland camp were attracted to the area. Most of the active mines had been staked in 1896 and were rapidly brought into production. Stamp mills were erected on many of the properties. Lead ores were shipped to the Hall smelter at Nelson. In 1905, a sharp decline in production occurred, and by 1908 large scale production ceased. The depression in the early 1930s was relieved in 1934 by a rise in the price of gold, as a result of which many of the old mines were reopened. Of these the largest producers were the Yankee Girl and the Centre Star (Wesko) mines, from which ore was carried by aerial tramways to newly constructed mills on the railway near Ymir. Since 1940, mining has been confined to small leasing operations. The ore, all hand sorted, is shipped to the Trail smelter where it demands a favourable bonus as a result of its high quartz content.

Active development work is proceeding (1947-48) on two prospects, the Oxide zinc property and Ymir Good Hope gold-silver property.

As both Cockfield and Drysdale have presented fairly complete general discussions, the present account is limited to a brief description of properties.

DESCRIPTION OF PROPERTIES

Maple Leaf

(See Figure 1A)

References: Ann. Repts., Minister of Mines, B.C.: 1925, 1930, 1939, 1944 1946, 1947, 1948.

The Maple Leaf property is on Porcupine Creek about 2 miles east of the Ymir-Salmo road. It embraces three full claims and four fractional claims of the Porcupine group, as shown on Figure 1A. It is a lead-zinc prospect carrying a little gold and silver, copper, and traces of tin, in a quartz gangue. During the past few years the Maple Leaf Gold Mining Company has carried out intermittent exploration work.

The rocks are highly silicified and granitized quartzites, argillaceous quartzites, and schists cut by numerous acidic, fine-grained dykes. Lamprophyre dykes in places cut the veins. The general trend of the structure is southeast.

The showings on the property are exposed by ten short adits and several open-cuts (See Figure 1A).

The principal ore minerals are galena and sphalerite. These occur in several narrow, irregular quartz veins, some of which are rich in pyrite, which in places is also found in the wall-rocks well out from the veins. Pockets rich in silver have been mined. Several small shear zones are exposed in the workings.

Anno Prospect

(See Figure 1A)

The Anno prospect lies about ½ mile northeast of the Maple Leaf property. During 1948, a tractor road was cleared part way up to this claim and work has been done on open-cuts along the hillside between it and the Porcupine group. An old adit on the property, comprising 425 feet of drifts and crosscuts, intersects grey-brown quartzites, schist, and acidic intrusive rocks. Veins exposed are of blue quartz mineralized with pyrite, presumably carrying gold. Several such small veins are exposed by the workings, and along each vein the wall-rock is impregnated with pyrite.

The main showing is near and along a drift running northeast from a point 160 feet beyond the portal, where a vein of white and blue quartz cuts schistose argillites. Both the vein and wall-rock are pyritized. This vein may be the one exposed in surface cuts above the adit, where a vein is traced to the southwest for about 300 feet. In these pits the vein is seen to pinch and swell; in places it is as much as 4 feet wide; at other places it almost disappears.

About 100 feet east of the adit a series of pits exposes what is believed to be a second vein. This vein consists of white quartz up to 4 feet wide, in places narrowing to a few inches, and elsewhere splitting to form two veins. In places it is mineralized with pyrite, sphalerite, and galena.

Samples of vein matter from this property assayed only traces of gold.

About halfway between the Anno and Porcupine claims, at an elevation of 2,800 feet, a quartz vein, varying in width from 18 inches to 3 feet, carries pyrite and a little galena. The vein strikes north 62 degrees east and dips 75 degrees northwest.

Oxide Group

(See Figure 1B)

References: Ann. Rept., Minister of Mines, B.C.: 1944, 1945, 1946, 1947, 1948.

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The Oxide group, owned by Ed. Haukedahl, A. Bremner, and A. Phare of Ymir, lies about 4 miles east of Ymir on the divide between Porcupine and Oscar Creeks. The property was staked by Haukedahl in 1943. Subsequent trenching showed a considerable width of oxidized gossan material carrying values in zinc and lead. A road about 2 miles long joins the property with the Porcupine Creek road near the Maple Leaf (Porcupine) property.

An option was taken on the property by the Leta Exploration Company of Vancouver in 1944. Under the direction of Dr. D. F. Kidd, a program of diamond drilling was carried out, and two holes, each about 300 feet long, were driven to intersect the mineralized zone at depth. At the intersection, the zone consisted of oxidized clay-like material. The company relinquished its option.

From 1945 to September 1947, an option on the property was held by the International Mining Corporation, Toronto. During 1948 and 1949, New Jersey Zinc Exploration Limited optioned the property and continued exploration work. Dr. J. M. Baker of the International Mining Corporation and members of the New Jersey Zinc Exploration Company were especially co-operative in making all information available.

Workings on the property at the time of the writer's visit included extensive trenching, one long and several short adits, and diamond drilling along the pass through the ridge, at an elevation of about 5,100 feet. Several open-cuts traced the deposit southward toward Porcupine Creek for several hundred feet (See Figure 1B), and at about 600 feet below the upper workings an adit was driven to cut the zone at depth.

The deposit occupies a fault zone that strikes north 10 degrees east and dips 75 to 80 degrees east. The wall-rocks east of the fault zone consist of argillite, quartzite, and limestone. The limestone is grey-white, banded, and contains numerous chert lenses. Near the north end of its outcrop it has been serpentinized. Due to local complexities of structure, it is not known whether these rocks are members of the Active formation or the Seeman group. West of the fault, the rocks are schist, quartzite, argillite, and minor limestone, mainly at least of the Seeman group.

The oxidized mineral zone has a length of nearly 1,500 feet and a width varying up to more than 30 feet. It is well exposed in workings near the pass through the ridge, where several short adits, now caved, and trenches show the zone to consist of muddy clay-like gouge grading into bleached schistose wall-rock. During 1948, an adit, not shown on Figure 1B, was run just below the surface working shown on that figure. This adit, 78 feet long, cuts the mud zone at an angle of about 30 degrees. By September the inner 15 feet had caved, but the outer 65 feet was open for examination. The material was limonitic, with small veinlets of calamine easily visible. Assay values for samples taken along the wall of this adit, as report by the B.C. Department of Mines, are as follows:

Location	Gold Oz. per ton	Silver Oz. per ton	Zinc Per cent	Lead Per cent
Portal to 13 feet (lagged)	--	--	--	--
13 to 25 feet	Nil	0.4	16.7	0.7
25 to 35 feet	0.01	0.1	15.7	1.4
35 to 45 feet	Trace	Nil	2.5	2.0
45 to 55 feet	Nil	Nil	2.9	3.0
55 to 65 feet	Nil	Nil	2.0	1.3

Oxidation of metallic minerals has been nearly complete; zinc occurs as a silicate (calamine) and as the phosphate (parahopeite) whereas the lead is chiefly in pyromorphite. A few nuggets of galena

were found. From this area a diamond drill-hole cut the oxidized zone at a depth of 500 feet.

Late in 1946, work began to extend an old 60-foot adit lying south and about 600 feet below the highest showings near the ridge top. The mineral zone was intersected about 120 feet from the portal. From the point where first encountered this oxidized zone was followed about 105 feet, but because of running ground this part of the drift had to be abandoned. From a point 105 feet from the portal drifting was continued about 30 feet in the foot-wall, and was extended to 643 feet from the portal (information on the geology along the northern end of the drift is not available). Three cross-cuts were driven to investigate the zone, one at 135 feet from the portal, one 400 feet from the portal, and one at the face. The last crosscut was extended west 75 feet, and a hole was drilled at an inclination of 54 degrees for 378 feet. This hole cut through a zone that appeared to be about 15 feet wide and contained 5 feet of pyritic quartz. This vein is reported to have shown a low gold content, and a little sphalerite.

Throughout the length of the adit no primary ore minerals were encountered, but an oxidized zone up to 30 feet in width carried a zinc content of as much as 10 per cent. The average was, however, only 1 to 4 per cent. Less than 1 per cent of lead and only a trace of silver were recorded, but as much as 23 per cent manganese was reported. Pyromorphite is not visible on this level.

One post-ore fault parallels the drift throughout at least half its length. This fault, believed to be of small displacement, is marked by a gouge seam about 18 inches wide. It dips 20 to 40 degrees west.

Work in this adit shows the zone to be oxidized 600 feet below the highest showings and at least 300 feet below the surface.

Further exploration has been carried out by New Jersey Zinc Exploration Limited since the writer's visit.

Centre Star (Wesko) Mine

References: W. E. Cockfield (1936). Ann. Repts., Minister of Mines, B.C.: 1934, 1935, 1936, 1937, 1938, 1940, 1942, 1944, 1946, 1947, 1948.

The Centre Star property, consisting of six Crown-granted claims (Redman, Twilight, Gold Island, Crowfoot, Blend Canyon, and Centre Star) and ten others held by location, lies on the western slope of Jubilee Mountain just southeast of Ymir. A 3-mile road joins the workings to the Nelson-Salmo highway at Ymir.

Initial staking took place in 1900, and some work was done at that time. The first large scale development began in 1934 when the property was acquired by the Wesko Exploration and Development Company. Production was continuous during 1937 and until August 1938. The mill closed in October of that year, since when small, intermittent shipments have been made by lessees.

The property lies in a broad contact zone between the Nelson batholith and rocks of the Ymir group. The zone consists of sheared and altered argillites and quartzite cut by innumerable small bodies of granite and granite-gneiss. Small bodies of aplitic intrusive rocks are found in the workings as well as lesser amounts of andesitic rock related to the Elise formation. Lamprophyre dykes cut the orebody and follow post-ore faults.

Numerous faults complicate the structure. Of these the most prominent strike north 30 to 55 degrees east and dip vertically or steeply southeast. Two such faults are exposed for hundreds of feet in the 300-foot level, from the eastern and western limits of the ore shoots. The ore shoots lie in veins along fault fissures striking north 60 to 80 degrees east and dipping steeply northwest. The veins vary in width up to 25 feet. Brecciated wall-rock is common in many of them.

The veins are cut by numerous faults, most of which strike between northeast and north, and dip to the east or southeast. Movement along these faults has been such as to offset the eastern side to the south. Other faults offsetting the veins strike northwest and dip northeast.

The veins consist of pyrite, pyrrhotite, sphalerite, and galena in a quartz gangue. Values are mainly in gold, and considerable silver is also present. Pyrrhotite is more common on the lower levels. On the surface, the veins are oxidized and the vein matter consists of honeycombed masses of limonite, quartz, manganite, and some pyromorphite and cerussite.

At present the mine workings consist of five main levels and a few subsidiary levels. Much of the vein material has been stoped. Although considerable work has been done on the property since Cockfield's examination much of his general descriptive material still holds good, and the reader is referred to his report for a fuller treatment.

The best showings were found in the vicinity of the 300-foot level, where one shoot attains a width of 25 feet near one of the wide, northeasterly trending shear zones. The wide part of this shoot rakes steeply east along the junction of the vein and the fault referred to above. On this level the shoot has a length of more than 200 feet, and is cut off to the east by a north-south fault. East of the fault the vein is followed for 170 feet by a drift. This eastern part of the vein has again been offset to the south about 50 feet. The most easterly workings on this level consist of a long drift following a second, northeast trending fault. Little evidence of mineralization was noted along this drift, and no ore shoots have been found east of it, although small veins were observed striking northeast and even west of north.

Numerous lamprophyre dykes are found on this level. They cut the ore veins and are definitely post-mineral.

The geology on other levels is similar to that on the 300-foot level, and veins striking north 60 to 80 degrees east are offset by minor faults.

Several small veins are exposed in surface cuts on the property, but these have not been correlated with underground ore shoots. Some are described by Cockfield.

The most striking feature of the veins is their localization in the fissures running north 60 to 80 degrees east, and their sharp truncation against two bounding northeasterly striking fault zones. Cockfield believes that these faults are pre-mineral; if so, the chances of finding ore beyond them are materially lessened.

Protection (Goodenough) Mine

References: W. E. Cockfield (1936). Ann. Repts., Minister of Mines, B.C.: 1899, 1923, 1926, 1928, 1932, to 1939 incl., 1942, 1943, 1944, 1946, 1947, 1948.

The Protection mine lies about 4½ miles northeast of Ymir on the north slope of Ymir (Wildhorse) Creek Valley. The property was staked in 1897. In 1899 it was optioned to the Ymir Gold Mining Company, who sank a 60-foot shaft. No further work is reported on the property prior to 1923, at which time the owners began to explore the property in search of an extension of the vein shown on the Ymir Consolidated property, which lies northeast of the Protection. In 1926, it was optioned to Porcupine Goldfields Development and Finance Company Limited; in 1928, to the Enterprise Consolidated Mining Company Limited; and later, to the Ymir Consolidated Gold Mining Company, which was organized to mine the Protection and Ymir properties in conjunction. Accordingly, a flotation mill, with a capacity of 125 tons daily, was constructed on the Ymir property, and ore from the Protection was trucked to it. The mill closed down after only 4 months operation.

Activity at the Protection began again during the summer of 1936, when a large-scale development program was carried out. During 1938 and 1939, the mill operated continuously under the same company, and in 1940 and 1941 under lessees who operated the mill one shift daily. Since this time, intermittent shipments have been made by various lessees. Production has been mainly from stope remnants and pillars, and the hand-sorted ore has been shipped to the Trail smelter. The name was changed from "Goodenough" to "Protection" in 1945.

The rocks on the property are mostly argillite and argillaceous quartzite of the Ymir group, cut by tongues of granite and lamprophyre and aplite dykes. The bedding strikes roughly northeast.

The veins strike north 60 degrees east, cutting the bedding planes at acute angles. They dip steeply northwest. The ore is valued chiefly for its gold content, but good percentages of sphalerite, galena, and some chalcopyrite are found. A little cadmium apparently accompanies the other sulphides. The gangue is milky quartz, with lesser amounts of brecciated wall-rock and some stringers of calcite. A few grains of brown tourmaline have been reported.

Two shafts, sunk on a shoulder of a hill between the Protection and Ymir mines are now inaccessible. Five adits reach the mine below these shafts. No. 1 level is 225 feet below the collars of the shafts, and follows the Goodenough veins north 70 degrees east for 1,200 feet. The vein occupies an irregular fault fissure, and shows marked variations in width over short distances; the maximum width observed was 5 feet, but wider parts have probably been mined out. It consists in places of a single, well-defined vein and at other places of several veinlets along a crushed shear zone. At least six ore shoots have been mined along this level. A crosscut, 780 feet from the portal, has been driven north 20 degrees east for 75 feet. At 60 feet from the drift it intersects a small shear zone, which was followed northeast for 60 feet, but encountered no vein material.

No. 2 level runs slightly north of, roughly parallel with, and 132 feet below No. 1 level. The main drift is 1,158 feet long, and seven short crosscuts have been driven from it. The rock is almost entirely argillite and quartzite, with some granite. No vein is encountered for 100 feet beyond the portal, at which point a 6-inch quartz vein with little sulphides was followed for 20 feet before it gradually petered out into a broad shear zone. Between 300 and 570 feet beyond the portal the vein has been almost completely stoped. Sixty feet above the drift, and about 500 feet beyond the portal, lessees have uncovered a pocket rich in sulphides. At this point a sample taken across a 5-foot width assayed 0.55 ounce of gold and 3.97 ounces of silver a ton. Six hundred and forty feet from the portal a crosscut runs southeast for 100 feet and terminates in a small stope running north 25 degrees east. On this level the vein is 6 inches wide, but 30 feet below, where it was being mined at the time of examination, it reaches a width of 18 inches. Beyond this, in the main drift, at least four small shoots have been mined, one just beyond the crosscut mentioned above, one 800 feet, one 830 feet, and one 975 feet from the portal. At 975 feet from the portal two small crosscuts, each 35 to 40 feet long, leave the drift. They encounter no vein material. Beyond these crosscuts the quartz vein becomes much wider, and near the face is as wide as the drift. Values have, however, apparently not warranted stoping.

At 575 feet from the portal of No. 2 level a manway leads to No. 3 level, on which 1,500 feet of drifts and crosscuts have been run to explore parallel veins. Stoping has been more continuous on the most northerly of these and in the western part of the workings. Veins up to 4 feet wide are exposed, but are mostly stoped.

No. 4 level cuts through barren argillite and some intrusive rock for 592 feet, at which point a short crosscut runs north to join

a 100-foot drift. This drift has a timbered back and several ore chutes. Whether or not the orebody extended down to this level is not known, but no evidence of mineralization was noted at either end of the drift. Across the trend of this zone is a 68-foot crosscut running northwest from the main drift at 694 feet from the portal. No vein was found in this crosscut. Between 815 and 975 feet from the portal the main drift follows a shear zone up to 4 feet wide. Although the zone contains numerous small quartz veins it carries little sulphides. At a point 565 feet from the portal an 80-foot crosscut runs southeast to join a subsidiary drift 430 feet long. This drift, parallel with the main drift, shows only narrow quartz veins and little sulphides. Ore chutes lead to stopes above, but little has been mined near this level. A narrow shear exposed in a crosscut running east from the main drift 740 feet from the portal is probably an extension of this zone.

Production from the 400-foot level has been confined almost entirely to a drift running north 80 degrees east for 513 feet beyond the point where it joins the main drift 880 feet from the portal. Along this drift an ore shoot has been mined almost continuously for 200 feet to a point 513 feet from the main drift, beyond which the workings are inaccessible. Pillars show the vein to be 1 foot to 5 feet wide in this area, and to consist of sulphides in white quartz. The white quartz has itself been fractured, and the fractures filled with drusy quartz.

No. 5 level is a drift 143 feet long following a vein that in places is 14 feet wide and carries good values in lead, zinc, and copper, but little gold. At a crosscut 65 feet beyond the portal the vein splits, a part going into the foot-wall, and a part following the main drift. It gradually narrows toward the face and becomes barren. Several tons of ore have been shipped from near the portal.

No. 6 level[1] lies 100 feet below No. 5. Near the portal

[1] This level has been driven since Cockfield's examination.

of this level several quartz veins occupy a shear zone 30 feet wide that pinches out almost completely 70 feet beyond the portal. At 175 feet beyond the portal a narrow, unmineralized vein enters the drift from the north wall. The main drift follows this vein for 130 feet, and from there for 50 feet farther along a branch drift running north 47 degrees east. This drift continues 63 feet beyond to where it intersects a small, barren shear zone. Beyond the junction of this drift with the main drift, the latter follows a fairly persistent quartz vein and shear zone. The vein is in places 3 feet wide, and a small part of it has been stoped. It narrows and disappears before the face is reached.

Ymir Good Hope

(See Figure 1C)

References: Ann. Repts., Minister of Mines, B.C.: 1944, 1945, 1946, 1947.

The Ymir Good Hope property, operated by the Ymir Good Hope Mining Company of Seattle, Washington, includes the X-ray group of claims, about 6 miles from Ymir along the north fork of Ymir (Wildhorse) Creek, workings on the adjoining Carthage group, and one adit, at elevation 4,747 feet, on the old Canadian Pacific property.

Extensive prospecting was carried out on the property as a whole during the early part of the century in a search for the continuation of the Ymir vein (Ymir Consolidated mine). The work included numerous open-cuts and adits, many of which are now either sloughed or caved.

During 1944, 1945, and 1946, the Ymir Good Hope Mining Company did much exploratory work, largely on the X-ray claim, but trails were

cleared to adits and open-cuts on the Carthage claim to the northeast and to an old adit and pits lying half a mile southeast of the main workings, on the Canadian Pacific property. In 1944, a road was constructed, with government aid, from the old Ymir millsite to the buildings near the creek. In 1946, a tractor road was extended from this point to workings on the X-ray claim.

The accessible workings (1949) consist of eight adits and numerous open-cuts. Several hundred feet of diamond drilling have recently been completed along the zone running northeast through the X-ray claim. This zone is underlain by sedimentary rocks of the Ymir group, which at this point consists of argillite, mica phyllite, and small amounts of chlorite and andalusite schist. The zone roughly parallels the granite contact, which lies 700 to 1,000 feet to the southeast. Numerous dykes and sills related to the batholith cut the sedimentary rocks, which have in most places been highly silicified and granitized. On some outcrops granitization has made it impossible to distinguish altered sedimentary rock from intrusive rocks.

The mineral deposits are mainly narrow irregular veins and stockworks of white quartz carrying pyrite, pyrrhotite, and sphalerite, with lesser chalcopyrite, and a little gold and silver.

The old Canadian Pacific adit, driven northeast into sheared granite at an elevation of 4,747 feet and about ½ mile southeast of the X-ray workings, consists of a drift 68 feet long and a 19-foot crosscut. The drift follows a feeble shear. The zone contains small lenticles of barren, rusty quartz. Nearly 500 feet southeast of this adit, at an elevation of 4,599 feet, an open-cut exposes a 7-foot vein of white quartz containing pyrite. This vein lies in sedimentary rocks of a small roof pendant.

Three adits and several open-cuts were excavated some years ago on the Carthage claim, which lies north of the area of present

development. Many of the open-cuts are sloughed. Little work has been done since.

The most southerly Carthage adit, at an elevation of 4,320 feet, is a drift that follows a shear zone striking north 50 degrees east and dipping 85 degrees northwest. No evidence of mineralization was noted in this drift. Pyritic quartz observed on the dump may have come from a shaft near the portal. This shaft is now caved.

A second adit, 450 feet northwest of the first, also follows along a barren shear zone. The shear zone, in siliceous argillites, is from 6 inches to 1 foot wide.

A longer adit, at an elevation of 4,607 feet, is accessible for 400 feet from the portal, but is caved. It follows a shear zone that varies in width from 15 inches to several feet. A quartz vein follows the shear zone for about 30 feet, beginning at 50 feet from the portal, but carries no visible ore minerals. Beyond this only one or two narrow quartz stringers and no sulphide minerals were noted.

Golden Age

References: W. E. Cockfield (1936). Ann. Repts., Minister of Mines, B.C.: 1922, 1923, 1924, 1928, 1929, 1931, 1941, 1942.

The Golden Age property consists of nine claims straddling the Nelson-Ymir road about 10 miles south of Nelson, and just opposite the Euphrates mine.

The property was first prospected in 1922 in an effort to locate the source of gold-bearing quartz float found on the slopes below, and several short adits and open-cuts are reported to have been made. In 1923, the Golden Age Mining Company was formed to develop the property. Intermittent work continued until 1928. A stamp mill was erected, but little ore was available for it, and in 1929 the mill was destroyed by fire. During 1941 and 1942, Trimetals Mining Inc. of Spokane held the property. Some diamond drilling and drifting

were done, and a small mining plant was installed. The ore was to be treated in the Euphrates mill. Work ceased in April 1942.

The veins cut sheared volcanic rocks of the Elise formation and several, dark, unsheared dykes. Both veins and shear zones strike northwest. Values are principally in gold, which accompanies galena, sphalerite, chalcopyrite, pyrite, and nests of scheelite, all in a quartz gangue. Some gold is reported to occur in the wall-rocks. The vein walls are indefinite in most places, the quartz occurring in numerous small veinlets across widths of as much as 5 feet, but generally less than 1 foot.

Workings on the property consist of three adits and a few open-cuts. The lowest and shortest adit is 50 to 60 feet below the road. At the time of the writer's visit it was inaccessible, but Cockfield reports that it comprises a 130-foot drift running northwesterly, and a 20-foot crosscut to the southwest. Two small dykes are exposed in the adit, and a narrow band of sulphides follows one of these on its western side. Other small bunches of sulphides occur along the zone, which may or may not be continuous with the zone exposed in the upper workings.

The middle adit, at road level and 100 feet northwest of the lower adit, is 1,442 feet long. It is a drift on a shear zone that strikes north 40 degrees west. Three crosscuts, southwest from the drift, at 350, 670, and 950 feet respectively from the portal, are in sheared volcanic rocks, but show no evidence of mineralization. The veins along the drift reportedly reach a width of 5 feet, but stoping has evidently removed the wider parts, and widths now visible range from mere stringers to 3 feet. Stopes are found 249 feet from the portal, and in the vicinity of the first and third crosscuts. Beyond the last crosscut the vein is very irregular in width. At the face it is 3 feet wide and well mineralized.

The upper adit, 92 feet above the main adit, is apparently on the same zone and lies above an ore shoot exposed in the level

below. At the portal, a shear zone strikes north 10 degrees west and dips westerly at 60 degrees. The vein consists of irregular lenses and stringers of quartz. About 90 feet from the portal a small stope extends upward only a few feet. Narrow veins at this point carry pyrite, chalcopyrite, and galena.

Hummingbird

(See Figure 1D).

References: Ann. Repts., Minister of Mines, B.C.: 1921, 1930, 1932, 1933, 1946.

The Hummingbird property lies on the divide between Apex and Five Mile Creeks, at an elevation of 5,450 to 6,300 feet. It is readily accessible by means of an excellent pack-trail from Apex.

The prospect consists of seven claims staked by E. McDanniels, Leslie Hall, and Harry Wassick, and two bonded claims belonging to the estate of Robert Qua, the original owner.

Between 1934 and 1946, some development was carried out by McDanniels, Hall, and Wassick, who optioned the property in 1946. During 1948, Mr. McDanniels spent the summer on the property preparing for a program of underground exploration during the next winter.

Of the workings on the property, two adits are now accessible, the others are completely caved. The lower of the accessible adits follows a mineralized quartz vein that strikes north 80 degrees east and dips 45 to 50 degrees south. The upper adit, at an elevation of 5,775 feet, consists of a 70-foot crosscut and a 130-foot drift. The drift runs north 55 degrees east, presumably on the same vein as the lower adit. Numerous open-cuts and areas uncovered by sluicing are now completely sloughed; other open-cuts reveal barren and mineralized quartz veins.

The veins on the Hummingbird property cut members of the Ymir group, but granitic rocks underlie much of the area. Members of the

Ymir group are mostly grey-black argillaceous quartzite, which has been silicified along the contact zone. A few small bands of fine chloritic schist are interbedded with the quartzite, and one 20-foot band of white, calcareous quartzite is found in the canyon walls south of the lower workings.

Granitic rocks lie north, south, and east of the workings on the property. The most common facies is a medium-grained gneissic granite or granodiorite. Foliation, due to the alinement of biotite, is concordant with the bedding in the nearby sedimentary rocks. Numerous granitic sills, averaging 2 feet in thickness, cut the sedimentary rocks.

The best showings on the property are found in bedded fissure veins, and these have been responsible for the aggregate small production. The lower adit and the main adit drift follow two such veins or, what is more probable, the same vein. In the main adit, the drift follows a single persistent quartz vein between well-defined walls. This vein reaches a maximum width of $1\frac{1}{2}$ feet, but averages less than 6 inches. An ore shoot containing abundant sphalerite and galena, found at the northeastern end of the drift, has been stoped to the surface along 18 feet of the vein. The shoot rakes steeply to the northeast, and has been further developed by a 50-foot inclined shaft. In this part of the vein, the galena and sphalerite are confined to the white quartz and do not replace the wall-rock. Pyrite occurs as fine-grained stringers through the vein and is highly oxidized. A little pyrrhotite was seen.

In the lower adit, the mineral deposit lies roughly parallel with the bedding, and comprises several discontinuous veins. At a point 115 feet from the portal one such vein attains a thickness of a foot. Much of the zone here consists also of brecciated wall-rock, which has been heavily mineralized with sphalerite and pyrite. Small

amounts of arsenopyrite and chalcopyrite were noted.

A single vein, parallel with the bedding, is exposed 80 feet to the southwest of the portal of the lower adit. It is well mineralized with galena and sphalerite, and is probably an extension of the vein followed in the lower adit.

Old reports refer to a vein 75 feet northwest of, and parallel with, the vein now exposed in the upper adit. The exploratory adit to this vein is now completely caved. Two other quartz veins, lying parallel with the bedding, but barren where exposed, are found near the lower adit.

Smaller quartz veins, either barren or sparsely mineralized, are found striking north 70 to 80 degrees west along the canyon walls near the lower workings.

About 2,000 feet northwest of the mine buildings, at an elevation of 6,300 feet, a vein striking north 30 degrees west and dipping 40 degrees northeast is contained entirely in granitic rocks. It has been traced along its strike for nearly 300 feet. Where it reaches its maximum width of 4 feet, it has been explored by a 50-foot inclined shaft. The shaft encountered a lens of massive pyrrhotite, which contained accessory quantities of sphalerite, galena, chalcopyrite, marcasite, pyrite, limonite, and hematite.

Although well mineralized with pyrrhotite, the low gold content appears to have been the reason for the lack of interest in these veins in recent years.

Several minor faults, all post-ore, were noted in the adits; they vary in strike from north 10 degrees west to north 20 degrees east and dip steeply westward. A persistent joint set on the property strikes north 70 degrees west and dips 70 degrees northeast.

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