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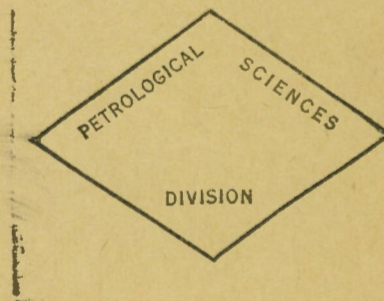
PAPER 43-15

GEOLOGY AND MINERAL DEPOSITS OF  
TYAUGHTON LAKE MAP-AREA,  
BRITISH COLUMBIA

( Report and Map )

BY

C.E. Cairnes



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OTTAWA

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Paper 43 - 15

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TYAUGHTON LAKE MAP-AREA,

British Columbia

By

C. E. Cairnes

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OTTAWA, 1943

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### Illustration

Preliminary Map--Tyaughton Lake, B.C.

# GEOLOGY AND MINERAL DEPOSITS OF

## TYAUGHTON LAKE MAP-AREA, B.C.

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### INTRODUCTION

Tyaughton Lake map-area lies on the eastern flank of the Coast Mountains and, particularly in its southern and southwestern parts, is extremely rugged and difficult of access. North of Gun Creek the topographic expression is more modulated; valley slopes, especially those with southern exposures, are open or sparsely timbered, and travel is relatively easy. The area is tributary to Bridge River, and is accessible by motor road from Shalalth on the Pacific Great Eastern Railway, a distance of about 35 miles.

The map-area includes the northern part of the area covered by the Gun Lake geological map.<sup>1</sup> Its geologic features are also

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1. Geol. Surv., Canada, Map 430A.

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partly discussed in the reports on Bridge River<sup>2</sup> and Gun Creek<sup>3</sup>

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2. Geol. Surv., Canada, Sum. Rept. 1915, pp. 75-85; also Mem. 130, 1922.

3. Geol. Surv., Canada, Sum. Rept. 1928, pt. A, pp. 78-93.

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areas, and "A reconnaissance between Taseko Lake and Fraser River"<sup>4</sup>.

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4. Geol. Surv., Canada, Sum. Rept. 1920, pt. A, pp. 70-81.

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With the exception of the first mentioned, these publications are out of print and no longer available for distribution.

Investigations in Tyaughton Lake area were undertaken in view of its mineral possibilities, and partly, also, to secure more complete information on the sequence and age of the formations of this and neighbouring parts of Bridge River district. Field work was done under the direction of the writer in 1937, and C.H. Crickmay in 1939. Grateful acknowledgment is made for facilities provided by owners and staff personnel at the various mining properties, and for assistance in the field work by Messrs. J.W. MacCammon and G. Mason, in 1937, and Magnus Lunde, in 1939.



## GENERAL GEOLOGY

### SEDIMENTARY and VOLCANIC ROCKS

#### Fergusson Group

The oldest rocks in the map-area, those of the Fergusson group (1)<sup>1</sup>, are the Fergusson series of Gun Lake map-area. They

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Numbers in brackets following formational and group names, etc., are those of the corresponding map-units on the map accompanying this report.

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consist of an alternating succession of sedimentary and volcanic rocks. The former (1a) comprise, very largely, thinly bedded, often much contorted, chert, with argillaceous partings between the chert "ribbons". Colours are mostly light to dark grey, but vary to dark bluish grey, greenish grey, buff, and reddish. Locally, argillaceous beds predominate. Pods and beds of crystalline limestone are not uncommon, and in places are several feet thick. They form a conspicuous series of light grey to white beds on the open slopes east of Tyaughton Creek north of Noaxe Valley.

The volcanic rocks (1b) are chiefly fine-grained, massive to schistose, altered, andesitic to basaltic lavas, commonly green (greenstones), but reddish in places. They are locally amygdular and rarely show pillow structures. Several of the more significant mineral deposits occur in these volcanic rocks.

No diagnostic fossils were found in the formations of the Fergusson group, but it is definitely pre-Upper Triassic and is placed tentatively in the late Palaeozoic, probably Permian.

#### Noel Formation

Sedimentary rocks of the Noel formation (2) overlie Fergusson beds and are exposed principally in the southern part of the map-area. They consist of banded and massive, grey to greenish grey, argillaceous and tuffaceous sedimentary beds, intercalated with occasional narrow belts of volcanic materials. The formation is structurally conformable with underlying Fergusson strata, but contacts may be disconformable. No fossils were found in the Noel. Its maximum thickness is probably not less than 1,200 nor more than 2,500 feet.

Bodies of metamorphosed, chiefly sedimentary rocks (3) observed in various parts of the map-area are probably, in the main, altered equivalents of the Noel formation, but may include some Fergusson strata. They comprise bleached, reddish brown, and mottled, dense quartzitic, argillaceous, and cherty beds, commonly heavily biotitized, and associated with some greenstone schists of volcanic origin.

#### Pioneer Formation

The Pioneer formation (4) of essentially volcanic rocks is typically developed in the extreme southern part of the map-area and

south of it where<sup>1</sup> its relations with the Noel seem to be partly

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1

Geol. Surv., Canada, Mem. 213, pp. 17, 18.

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conformable and partly intrusive. Similar relations seem to hold in Tyaughton Lake map-area where the Noel is present, and in part a distinction has been drawn between those bodies (4) consisting dominantly of lavas, agglomerates, and tuffs and others (5) of probably the same age and origin that, however, include an abundance of relatively more massive, fine- to medium-grained rocks whose contact relations are at least in part intrusive and whose textures lie about midway between those of andesitic lavas and of diorite.

The volcanic rocks comprise mainly green, massive, fine-grained andesitic types. Amygdular textures and pillow structures are not uncommon, and in places, as in the areas west of Eldorado Creek, the lavas are distinctly porphyritic and vary to light grey, more acid types. The greenstone-diorite bodies (5) are composed generally of pale amphibole, albite feldspar, and a variety of alteration products. Difficulties were experienced in making everywhere an effective separation between the Pioneer volcanic rocks and those of the Fergusson group (1b), though in the main the lithological distinctions<sup>2</sup> noted in areas to the south seem to hold.

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Geol. Surv., Canada, Mem. 213, pp. 12, 13 and 16, 17.

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#### Hurley Group

The Hurley group (6) of mainly sedimentary rocks is most broadly developed in the basin of Eldorado Creek where, hitherto, it had been supposed to form part of the much younger Eldorado group. Its present name is a revision from that of the Hurley formation of Gun Lake and Cadwallader Creek map-areas<sup>3</sup>. Except where in faulted contact, the

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Idem, p. 18.

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group overlies the Pioneer formation with apparent conformity and has provided scattered fossil collections, among which some Triassic forms have been recognized.

The group comprises an abundance and variety of argillaceous and fine-grained tuffaceous beds, conglomeratic beds, some limestone, and here and there, minor intercalations of volcanic rocks. Much of the Hurley sedimentary material is distinctly limy, as contrasted with that of the Noel formation and the Eldorado group. The conglomeratic beds contain a variety of pebbles and cobbles of sedimentary, volcanic, and perhaps intrusive rocks, among which greenish volcanic rocks, light-coloured felsites and porphyries, and dark argillaceous and cherty sedimentary types are generally conspicuous. Many of the beds also contain both well-rounded and quite angular fragments of limestone. The former are derived from older formations, but the angular fragments, which in places make up the bulk of the conglomerate beds, appear to be of contemporaneous origin with the enclosing strata<sup>4</sup> and in some instances

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Geol. Surv., Canada, Sum. Rept. 1920, pt. A, p. 75; also Mem. 213, p. 19.

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constitute the bulk of the conglomerate mass.

No complete section of Hurley strata was observed, but the group must comprise several thousand feet of beds. Within the largest single area of these rocks, in the basin of Eldorado Creek, there is much faulting. The beds of the fault blocks commonly stand at high angles, and the stratigraphic relations between one block and another are doubtful. The general structure appears to be synclinal to basin-shaped and the succession includes, towards the base, a number of conglomeratic strata, containing abundant limestone debris, interbedded with more sandy and shaly materials and some limestone. Overlying beds comprise a great thickness of mainly dark, thinly bedded argillaceous strata, commonly quite limy and in part interlaminated with light grey tuffaceous material. Occasional quite thick beds of light grey limestone occur in this part of the section. They and the limestone fragments in the conglomerate beds are commonly fossiliferous and have supplied most of the collections obtained from the group. The collections include specimens of corals, crinoid stems, bryozoa, echinoids, a variety of gastropods and pelecypods, pectens, brachiopods (Terebratulids), one ammonite resembling the Triassic genus *Arcestes*, and algal remains. Much of the material is poorly preserved or otherwise not determinable, but a few specimens, including the ammonite, some of the echinoids, a coral identified as *Isastrea* cf. *vancouverensis*, and a pelecypod identified as *Cassianella*?, point rather definitely to a Triassic age for this assemblage rather than Jurassic as provisionally assigned the Hurley formation in an earlier report.<sup>1</sup>

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Geol. Surv., Canada, Mem. 213, p. 21.

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Farther north, on slopes leading down to Tyaughton Creek, the prevailing rocks are grey to black, dense to cherty types, and around the exposed granitic intrusions are considerably indurated, metamorphosed, and in places conspicuously pyritized. Lithologically, these rocks (6a) are not unlike those of the Noel formation (2) and its altered equivalents (3) and, perhaps, should have been mapped with them. Their stratigraphic relations with the other, more typical Hurley rocks to the south is uncertain, but it is quite possible that they underlie them. However, as no intervening Pioneer greenstone (4) was observed, they have all been grouped, tentatively, with the Hurley formations.

#### Tyaughton Group

The Tyaughton group (7) is, on the whole, the most distinctive assemblage of sedimentary rocks in the map-area. Its contacts with the Hurley group are not well exposed, but where observed or closely approached seem, both structurally and lithologically, to indicate faulted relationships. It is probable, however, that no very considerable time interval separates the two groups, as at least a large part of the Tyaughton is of Upper Triassic age.

The rocks consist of interbedded grey, green, and reddish sandstone, shale, grit, conglomerate, and limestone, as well as thick beds of light grey limestone. No tuffaceous types, so common in both older and younger groups, were noted in the Tyaughton rocks. Fossils are sparingly distributed in the thick limestone beds, but are not well preserved, and the better collections come from thin beds of coloured limestone and other limy strata. The conglomerate and grit beds carry small pebbles and grains of sedimentary and volcanic rocks with considerable white quartz in a rather loose limy cement. On the whole, the

rocks are remarkably fresh and unmetamorphosed, and though intersected by many faults are no more deformed than adjacent much younger strata. The thick beds of massive, dense to semi-crystalline grey limestone are a conspicuous feature of the group, particularly in a zone several hundred feet thick that apparently crosses Tyaughton Creek northwest, just east of the small area of Middle Jurassic argillites (9).

The Tyaughton group occupies a single, somewhat crescentic-shaped block, probably faulted along its principal contacts with both older and younger groups. Within the block the strata are intersected by numerous minor faults, striking mostly southeasterly. Between the fault blocks, the structure is rolling, with dips alternating mainly to the southwest and northeast north of Tyaughton Creek, and more to the west and east south of the creek. Due to these structural complications and also to the difficulty experienced in identifying repetitions of beds, no satisfactory estimate of the total thickness of the group could be made.

The Tyaughton group is a distinctive lithological assemblage of marine formations, believed to be mainly, if not entirely, of Upper Triassic age. Many fossil collections from it have been studied and reported on by F.H. McLearn of the Geological Survey.<sup>1</sup> The fauna is

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<sup>1</sup> McLearn, F.H.: "The Neo-Triassic *Cassianella* Fauna of Tyaughton Creek Valley, B.C."; Can. Field-Naturalist, vol. 56, pp. 99 to 103, 2 plates, 1942.

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distinguished by a variety of the pelecypod species *Cassianella beyrichi* Bittner, and by several very ornate species of *Myophoria*. It includes as well a number of associated pelecypods and cephalopods, the former including *Monotis subcircularis* and the latter, representatives of diagnostic Upper Triassic ammonoid genera. These have made correlation possible, not only throughout the area of the Tyaughton group but also with similar rocks in widely separated parts of the province.

The group as mapped may include strata of Jurassic age, particularly on the eastern side where outcrops are few and no fossils have been found, but the known Jurassic strata are quite different lithologically from those typical of the Tyaughton group.

#### Lower Jurassic Rocks

The Lower Jurassic rocks (8) are partly in faulted contact with Tyaughton strata, but in places appear to overlie that group conformably. They consist largely of dark argillite and shale, in part calcareous. Thin bands of limestone, sandstone, and small pebble conglomerate are also present, and limy concretions are common in some of the argillaceous strata. Several collections of fossils, including the diagnostic ammonites *Arniotites*, *Asteroceras*, *Echioceras*, *Schlotheimia*, and *Metophioceras*, have been obtained from these rocks, which are of lowermost Jurassic age.

#### Middle Jurassic Rocks

The small area of Middle Jurassic rocks (9) lying within the large area of the Tyaughton group is occupied mainly by dark grey argillaceous strata, thinly interbedded in places with light grey and green, probably tuffaceous, beds. These are intruded by a number of grey, feldspar porphyry dykes. Fossil collections from the sedimentary beds have yielded an ammonite identified, tentatively, as *Sphaeroceras*, a diagnostic Middle Jurassic genus. The lithology of the beds is distinctive from that of surrounding Tyaughton strata and, though no contacts were

observed, it is believed that they are faults and that these argillaceous beds overlies those mapped as Lower Jurassic (8).

### Taylor Group

The Taylor group (10), named from its typical occurrence in the basin of Taylor Creek, is characterized chiefly by an abundance of conglomeratic rocks, but includes, as well, great thicknesses of finer grained, clastic materials and minor intercalations of volcanic rocks. The lower part (10a) consists largely of coarse pebble and cobble conglomerate in which the rock fragments are commonly well rounded, though in places somewhat angular. Interbeds of finer grained, sandy to shaly materials, together with occasional thin intercalations of greenish volcanic rocks, serve to give some idea locally of the structure of the conglomeratic mass though no continuous section was measured. The pebbles and cobbles are mainly of cherty sedimentary rocks and volcanic types, but include argillaceous to quartzitic rocks, some porphyritic types that may represent intrusions, and, rarely, some granitic detritus of unknown origin. The upper part of the group (10b) includes an abundance of fine pebble conglomerate and grit, commonly reddish, and consisting very largely of closely packed grains and pebbles of chert. In addition, there is much grey arkosic sandstone and dark grey shale, with lesser light grey to pink and reddish shale. A little interbedded dark limestone was observed in the belt that crosses Tyaughton Creek above the mouth of Relay Creek. The sandy beds commonly contain abundant small flakes of colourless mica, and similar flakes were seen in some of the shaly strata.

The group comprises altogether several thousand feet of beds. It is intruded by Coast Range batholithic rocks and otherwise is apparently in faulted contact on all sides with older as well as younger bedded formations, and is itself intersected by many faults of unknown displacement. As a result, no satisfactory estimate of its aggregate thickness was obtained. The heavy basal conglomerate is suggestive of a considerable interval of erosion between it and underlying formations. Further, the abundance of conglomerate, the arkosic character of the finer grained sediments, and the mixed association of plant remains and marine shells observed at widely separate localities, point to rapid accumulation under deltaic and estuarine conditions.

A few small collections of fossils were obtained from the Taylor group, but have done little to establish its age. Fragments of plant remains were seen in both upper and lower parts of the group, but included no diagnostic parts. Earlier collections obtained by Drysdale

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Geol. Surv., Canada, Sum. Rept. 1916, p. 47.

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from what is here regarded as the upper part of the group, exposed north of Tyaughton Lake, included a mixed assemblage of plants and marine pelecypods. The plants were poorly preserved, but suggested a Jurassic (perhaps late Middle or early Upper) age for the enclosing rocks. The associated shells were stated to indicate an Upper Jurassic or Lower Cretaceous age, but no genera were named. Another collection, obtained in 1939 from north of Tyaughton Creek above Relay Creek, included an uncoiled and platycone ammonite that has not yet been identified, but is probably a Jurassic species. The combined evidence from the collections seems to point to a post-Triassic, probably Jurassic, age. The paucity, in most places absence, of granitic debris in the Taylor conglomerates suggests that they probably antedate Lower Cretaceous conglomerates of the Eldorado group in which granitic detritus is common. Stratigraphically,



the group almost certainly overlies the mapped Lower Jurassic (8) and, probably also, the Middle Jurassic (9) strata. Further, as the Taylor group differs, lithologically, from the Eldorado group, and as it can hardly be younger than this group, the most likely position for it is beneath the Eldorado, in which case it is probably of late Middle or early Upper Jurassic age.

#### Eldorado Group

The Eldorado group (11) is a structurally conformable, locally disconformable, succession of Upper Jurassic and Lower Cretaceous sedimentary rocks from which a number of diagnostic marine fossil collections have been made. In places it has been possible to draw the contact between Jurassic and Cretaceous beds. Elsewhere the presence of representatives of the three subdivisions of the group (11a, 11b, 11c) is indicated on the map by the appropriate symbol, but no boundary lines are drawn. In general, the Jurassic strata (11a) comprise an abundance of dark, argillaceous beds, varying from massive types to thin papery shales, and from dense, flinty, commonly finely banded tuff and argillites to soft, friable beds. Occasional limy concretions and thin dark limestone beds were observed. The Cretaceous beds (11b), on the other hand, include an abundance of arenaceous as well as shaly strata; colours vary from grey to green; much of the clastic material has a pronounced tuffaceous appearance under the microscope; and chlorite is an abundant constituent of the green rocks. Coarse conglomerate beds carrying a variety of pebbles, including many of granitic rocks, were observed at or near the base of the Cretaceous section on the nose of the ridge between Leckie and Gun Creeks. In the valley of Tyaughton Creek, at the northwestern corner of the map-area, exposures of greenish, coarse, massive tuffs and tuffaceous beds (11c) carry unidentified plant remains, and, structurally, may overlie the Lower Cretaceous strata and be of later age. Contact relations, however, are not clearly defined; exposures are scattered, and for the present these rocks are included with those of the Eldorado group.

The principal marine fossils that serve to indicate the age of the Eldorado group include: an abundance of Aucella comprising both Upper Jurassic and Lower Cretaceous species; several genera of ammonites, including Anacardioceras, "Acanthoceras", and Olcostephanus; the pelecypods Pleuromya and Inoceramus; and species of Belemnites.

#### Leckie Group

The Leckie group (12) of principally volcanic rocks is named from its typical occurrence on the ridge between Leckie and Gun Creeks. The exposures are only the southeasterly tip of a large mass previously mapped by Dolmage<sup>1</sup> in Gun Creek area. The group overlies Eldorado strata with

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<sup>1</sup> Geol. Surv., Canada, Sum. Rept. 1928, pt. A, p. 84.

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apparent structural conformity, though on the whole the Leckie beds seem less deformed and less indurated than those of the Eldorado. The group consists of green, red, purple, and mottled agglomerates, breccias, and tuffs intercalated with grey, greenish grey, and mauve lavas, some containing abundant feldspar phenocrysts, and minor intercalations of dark grey shale, spherulitic tuffs, and conglomerate. Some plant remains have been found in the sedimentary beds and point to a late Lower or early Upper Cretaceous age.

### Sheba Group

The Sheba group of mainly extrusive and undifferentiated intrusive rocks occupies a single area on the ridge between Gun and Tyaughton Creeks west of Spruce Lake. The lower part (18) is a thin formation of grey and brown shales and arkoses carrying at its base a conglomerate member composed of large boulders of grey biotite granodiorite as well as detritus from underlying volcanic rocks. The whole rests unconformably across the upturned edges of members of the Leckie group. The upper and principal part of the group (19) consists mainly of reddish, purplish, and flesh-coloured lavas and associated tuffs, commonly carrying abundant crystals of white feldspar. In many places they are difficult to distinguish from associated porphyritic intrusive rocks that form dyke-like as well as irregular stock-shaped bodies in the volcanic members of the group and are either too small, too poorly exposed, or too uncertain in origin to be mapped separately. Perhaps the largest single intrusive body is one that forms the summit of Mount Sheba and is a mile or more in diameter. This is a light grey, fresh porphyry containing white phenocrysts of plagioclase feldspar. The volcanic members of the group rest with apparent conformity on the lower, sedimentary part (18) and unconformably on the Leckie and Eldorado groups. No fossils were found in these rocks, but their age is presumably late Cretaceous or Tertiary.

### Tertiary Lavas

Within the map-area are a number of areas of volcanic rocks lying for the most part nearly horizontal and resting unconformably on all other formations. They consist almost entirely of lavas and have the general composition of olivine basalt. They vary from highly vesicular to massive and from predominantly dark green to reddish. They are most conspicuous along the northern border of the map-area, where they appear in castellated forms crowning the higher ridges. A small circular body, the most southerly of a group of three in the basin of Eldorado Creek, is apparently the remnant of a volcanic plug and represents the vent from which the lavas in the vicinity were extruded. A similar vent lies high on the ridge at the head of an eastern tributary of Spruce Lake Creek. These lavas are probably of late Tertiary age.

### Volcanic Ash

Much of the southern, central, and eastern parts of the map-area is covered with a deposit of light grey, scoriaceous ash or pumice. The

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1. Geol. Surv., Canada, Mem. 213, pp. 40-41, and 73.

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deposit thins to the north and is inconspicuous or missing in the north-western part of the area. The material is of recent age and originates from some volcanic source or sources outside the map-area.

## INTRUSIVE ROCKS

### Ultrabasic Intrusions

The map-area includes an abundance of irregular-shaped and mostly rather small bodies of altered ultrabasic rocks (A1) that for the most part, if not entirely, represent peridotites and dunites, and, as such, may be correlated with the President intrusive rocks of Cadwallader and Gun Creek

map-areas.<sup>2</sup> Most of the bodies are partly or completely altered to ser-

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Geol. Surv., Canada, Mem. 213, pp. 28-31.

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pentine and form massive to highly sheared and polished dark green rocks that in places may be difficult to distinguish from sheared and altered green volcanic rocks. The more massive bodies commonly weather orange-red from oxidation of contained iron, and weathered surfaces are generally rough from the projection of altered crystals of pyroxene. Alteration of the serpentine bodies by hydrothermal solutions has, in many places, resulted in their almost completed transformation to magnesium-bearing carbonates, talc, free quartz, and, commonly, a bright green micaceous mineral resembling mariposite.

No time can yet be set definitely to the period of intrusion of these ultrabasic rocks. Within Tyaughton Lake area they are in contact mainly with members of the Fergusson group and intrusive into them. In turn they are themselves intruded by the Coast Range batholithic rocks. In Cadwallader Creek area, evidence was found to indicate that they are younger than certain rocks mapped there as Bralorne diorite, though it is doubtful if this relationship holds true for all Bralorne intrusions. The various conglomerates of the Hurley, Tyaughton, Taylor, and Eldorado groups have, so far as the writer is aware, yielded no boulders or pebbles of these ultrabasic rocks. It seems likely, therefore, that they were intruded in Mesozoic time and that they are of late Jurassic or early Cretaceous age.

#### Sumner Gabbro

The Sumner gabbro (A2) occupies a single area north of Gun Lake, near the head of Sumner Creek. The rock is dark green, minutely veined, and composed of abundant diallage, some pleochroic hornblende, altered basic plagioclase feldspar, and serpentine. It is bordered on the south and west by a body of partly serpentinized olivine diallagite (A1) and is presumably related in origin to that ultrabasic rock.

#### Bralorne Intrusions

Bodies of Bralorne intrusive rocks (B) are typically exposed in the southern part of the map-area within that part overlapped by the Gun Lake map, and are fully discussed by the writer in the report on that area<sup>1</sup>.

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Geol. Surv., Canada, Mem. 213, pp. 21-27.

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They are particularly interesting in the area to the south because of their presumed genetic relationships to the gold ores of Pioneer and Bralorne mines on Cadwallader Creek. Recognition of this association of rich, gold-bearing quartz veins with Bralorne intrusions has led to prospecting and staking of all or almost all ground around rocks of the Bralorne types. Prospecting this ground has resulted in many discoveries and a great deal of exploratory and development work, but to date has revealed no ore-bodies comparable with those at the two principal gold mines. Aside from the structural or other factors involved in mineral deposition, the failure to find ore occurrences commensurate with those at Pioneer and Bralorne may be attributed in part to incorrect identification of intrusive rocks with those of the Bralorne types, and in part to the probability that Bralorne-like intrusions were not all injected at the same time. The rich gold ores have been identified only with the younger phases of these intrusions, in which there is evidence of pronounced differentiation from typical augite

diorite to highly siliceous soda granite, accompanied by dykes of albitite and quartz albitite, and, at a late stage, by the gold-bearing quartz veins. These conditions are well exemplified at Bralorne and Pioneer mines, along the lower valley of Cadwallader Creek, but not in the upper valley of this creek where no significant gold-bearing quartz veins have been found and where the Bralorne diorite shows little evidence of differentiation and appears to have been intruded earlier than farther down the valley. Below Cadwallader Creek, along Hurley River and extending into the present map-area, some differentiation of the Bralorne intrusions has been observed, and some encouraging gold-bearing deposits have been found. North of Bridge River, between the mouth of the Hurley and a point below Wayside mine, are two considerable areas of Bralorne rocks showing abundant evidence of differentiation most nearly duplicating that at Bralorne and Pioneer mines. There, as at Wayside mine, some attractive gold-bearing vein quartz has been found. These areas are, in the writer's opinion, worthy of even more intensive exploration, and any quartz veins discovered in them should be thoroughly investigated.

Still farther north, within the map-area, several relatively small areas of dioritic rocks have been mapped as Bralorne (B). In none of them was any evidence of appreciable differentiation observed and all are believed to represent the older phase of Bralorne diorite and to be closely related in origin to the associated Pioneer greenstones and allied rocks (4, 5)<sup>1</sup>. The largest body of this type lies on either side of Gun Creek

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Geol. Surv., Canada, Mem. 213, p. 24.

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below the mouth of Eldorado Creek. The rock is a medium- to coarse-grained augite diorite, considerably fractured, and in places carrying heavily disseminated pyrite. It intrudes the adjoining large mass of greenstones (5) to the east and the latter includes numerous small irregular areas of similar dioritic rocks that, however, seem to grade texturally into the surrounding, fine-grained greenstone.

#### Coast Range Batholithic Rocks

The Coast Range intrusive rocks (13-16) occupy the rugged southwestern corner of the map-area and elsewhere are exposed chiefly in the high area about the headwaters of Eldorado and Taylor Creeks. The abundant type (14) is a medium-grained, massive to somewhat foliated rock, commonly carrying both biotite and hornblende and with a composition that varies mostly from basic granodiorite to siliceous quartz diorite.

A relatively basic phase is found in two localities. The larger body (13), exposed in the main valley of Bridge River, is a massive, coarse-grained, dark bluish grey rock composed largely of basic feldspar whose cleavage surfaces show a distinct iridescence. The feldspar crystals are clearly zoned. A little quartz, pyroxene, green amphibole, and biotite, with accessory magnetite and apatite and secondary chlorite are also present. This rock is intruded by the surrounding, more acid rocks (14). The smaller, somewhat dyke-shaped body (13a), in the valley of Roxey Creek, is a medium- to fine-grained, dark, massive dioritic gabbro-breccia containing numerous angular fragments of what seem to be finer grained material from the same source. These lend the rock an agglomeratic appearance.

In the extreme southwest corner of the map-area is a body of massive, coarse-grained, light grey, siliceous granodiorite (15) containing abundant quartz, considerable plagioclase, a little orthoclase, and both biotite and hornblende. The rock weathers readily and has provided extensive talus slopes of coarse arkosic sand. It is relatively younger than the intrusive rocks (14) with which it is in contact and cuts across a rude foliation developed in these rocks.

On the ridge between Slim and Leckie Creeks is a single body of massive, medium- to coarse-grained, pink granite (16) composed mainly of clear, unstrained quartz, orthoclase, albite-oligoclase, perthite, and a little chloritized biotite. The granite intrudes the surrounding batholithic rocks (14), and pink dykes of similar composition were observed elsewhere in the valley of Slim Creek on either side of the main stream. A small stock of pink biotite granite outcrops on the high ridge overlooking Eldorado Valley at the head of Freiberg Creek. It has been correlated tentatively with the body on the Slim-Leckie ridge.

#### Minor Intrusions

The map-area includes a great number and a considerable variety of minor intrusive bodies (17). Most of these are dykes too small and too imperfectly exposed to be shown on the map. Others are less regular to stock-shaped bodies and several of them have been mapped, though in places, due to paucity of outcrops, their extent beneath the drift can only be inferred. Exclusive of those small bodies correlated with the ultrabasic (A1), Bralorne (B), and Coast Range (13-16) intrusions, most of the minor intrusive bodies mapped are distinctly porphyritic rocks in which crystals of feldspar and, in fewer instances, of hornblende (17c), form conspicuous phenocrysts.

Between Bridge River and Tyaughton Lake are a number of dyke-like to stock-shaped bodies of porphyritic rocks (17a) containing conspicuous phenocrysts of white plagioclase feldspar and some of hornblende in a medium- to fine-grained groundmass composed essentially of the same minerals. These are intersected by, and offset along, vein-bearing fissures.

Some light-coloured, dense, non-porphyritic, altered, felsitic intrusive rocks (17b) appear in the southeast corner of the map-area, and in the same general area are several other, relatively small, fine-grained to dense, dark dykes, not shown on the map, but interesting because of their close association in place, and probably also in origin, with mineral deposits on either side of Bridge River.

In the northern half of the map-area most of the minor intrusive bodies are porphyritic rocks with white feldspar forming the abundant and characteristic phenocrysts. Mostly, however, these rocks (17d) are more acid in composition than those farther south. They are light coloured, commonly pinkish to reddish, and many, generally dykes too small to map, carry abundant minute rusty brown specks of iron oxide residual from the weathering of biotite. Such dykes are most conspicuous in the valley of Tyaughton Creek between the mouths of Taylor and Relay Creeks, and in the lower valley of Mire Creek. They may be related genetically to the mercury deposits there.

Above Relay Creek the comparatively large intrusive body (17e) consists of medium- to coarse-grained, pink, porphyritic rocks having about the composition of a biotite syenite or quartz syenite. Outcrops are insufficient to be certain whether the body is continuous as mapped or whether two or more separate intrusions may be present.

The porphyritic intrusions associated with the Sheba group (19), but not separately mapped, are quite likely related to those (17d, 17e) farther down Tyaughton Valley and are probably of Tertiary age. Other minor intrusions (17a) along Bridge River Valley may be considerably older and may antedate the Coast Range intrusive rocks.

In addition to the above-mentioned types there are, throughout the area, scattered, mostly small, dark grey to brownish grey dykes of mainly basaltic composition that intersect all pre-Tertiary formations. They are



dense rocks, occasionally vesicular, and in places have a well-defined columnar structure perpendicular to the dyke walls. Nearly all of these dykes carry small, lustrous, acicular, black crystals of basaltic hornblende. They are probably related to the period of extrusion of the Tertiary lavas (20).

## MINERAL DEPOSITS

### INTRODUCTION AND CLASSIFICATION

A variety of mineral deposits, several of which have produced, lie within the map-area. Some along Bridge River and in the upper basins of Taylor and Eldorado Creeks were discovered many years ago and have been described repeatedly in published accounts by the Geological Survey and the provincial Department of Mines. Others, including the Relay Creek mercury deposits, the Jewel and Gem gold and gold-cobalt ores, and the Tyaughton Creek tungsten deposits are comparatively recent discoveries and have maintained interest in the area despite the failure of the more extensively developed mines. At present no property is producing any substantial amount of ore, and interest has been diverted mainly to prospecting for strategic minerals.

The mineral deposits of Tyaughton Lake map-area may be classified according to the following types:

- (1) Placer gold deposits
- (2) Lode gold deposits
  - (a) Auriferous vein quartz deposits, related to Bralorne intrusions.
  - (b) Auriferous vein and replacement, heavy sulphide deposits associated with porphyrite dykes.
  - (c) Auriferous deposits related to Coast Range intrusions.
- (3) Antimony deposits.
- (4) Mercury deposits.
- (5) Tungsten deposits.

### PLACER GOLD DEPOSITS

Almost all placer mining of consequence has been done in the south along Bridge River and its tributaries Hurley River, Fergusson Creek,<sup>1</sup> and Gun Creek. These operations have been described in an earlier report to

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Geol. Surv., Canada, Mem. 213, pp. 46-49.

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which the reader is referred, as little has transpired since. Farther north, placer mining has been undertaken on many of the tributaries of Gun and Tyaughton Creeks as well as along these principal streams. Though there is no record of material production from these operations, they have in several instances proved useful in locating both gold-bearing and mercury-bearing lode deposits.

## LODE GOLD DEPOSITS

### Auriferous Deposits Related to Bralorne Intrusions

Gold-bearing quartz veins related to Bralorne intrusive rocks have proved particularly important to the south at Bralorne and Pioneer mines, the outstanding producers for the entire Bridge River district. In Tyaughton Lake map-area geological conditions most nearly duplicating those at these two properties were encountered at Wayside mine and vicinity and have been referred to rather fully in an earlier report<sup>1</sup>. More than 40,000

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<sup>1</sup> Geol. Surv., Canada, Mem. 213, pp. 25-27 and 49-64.

tons of ore, yielding about 0.13 ounce gold a ton, were recovered from Wayside, principally during the years 1935-1936 and mainly from the upper levels. Investigations at depth disclosed encouraging mineralization, but further financial arrangements were required and the mine discontinued operations in June 1937.

Other gold-bearing quartz veins related, or presumably related, to intrusions of the Bralorne type include those of the Arizona and neighbouring workings east of Hurley River and perhaps also those of the Veritas property on Lajoie (Little Gun) Lake and the Tuscarora prospect between Gun Lake and Bridge River. The Arizona workings<sup>2</sup> form part of an extensive

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<sup>2</sup> Geol. Surv., Canada, Mem. 213, pp. 97-100.

system of underground explorations extending for some distance south of the map-area and conducted laterly by B.R.X. (1935) Consolidated Mines, Limited. Principal work since 1935 has included sinking a shaft 500 feet below the low level Arizona crosscut adit and considerable lateral work from it. A 150-ton mill was also installed early in 1938 and operated for about 2 months. The property closed late in 1939 pending further financial arrangements. Encouraging values in gold were encountered at the Veritas<sup>3</sup> property,

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<sup>3</sup> Idem, pp. 131-32.

but no substantial quantity of commercial ore was proved and no production is recorded. At the Tuscarora prospect, between Bridge River and Gun Lake, owned by Tuscarora Gold Mines, Limited, of Vancouver, some siliceous, gold-bearing ledge matter is reported, in sedimentary rocks of the Fergusson group at their contact with greenstone masses. Few details are available, but the occurrence is in a favourable area with respect to nearby Bralorne intrusions.

Elsewhere some mineral is associated with a number of scattered bodies of dioritic rocks, closely resembling the older Bralorne types, but probably was derived from some more recent source. The considerable body of diorite on either side of Gun Creek below the mouth of Eldorado Creek has also been prospected<sup>4</sup> and disseminated sulphides, chiefly pyrite,

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<sup>4</sup> Min. of Mines, B. C., Ann. Rept. 1933, p. 268.

observed, but no significant vein deposits.

### Auriferous Deposits Associated with Porphyrite Dykes

In the southeastern part of the map-area, along and on either side of Bridge River, are numerous exposures of porphyritic intrusive rocks near which several mineral deposits have been found. Presumably both deposits and intrusions are related to the same source. The latter were not, however, all injected at the same time, and the larger are of pre-mineral age, as they are intersected and in places faulted by the vein-bearing fissures. Other dyke-like intrusions follow the same fissures and appear more closely connected in time with the mineralizing processes. The mineral deposits, of which those at Minto mine are examples, differ from the older Bralorne type in that the veins carry abundant mixed sulphides and the gold occurs in one or more of them, chiefly in arsenopyrite, and is rarely visible.

#### Dauntless

Reference: Min. of Mines, B.C., Ann. Rept. 1936, pt. F, pp. 6-8

The Dauntless prospect, previously owned by Reward Mining Company, Limited, lies near the head of Mowson Pond, about one-half mile north of Minto mine. The principal discovery, made about 1935, is a mineralized shear zone striking southwesterly across argillaceous and cherty sedimentary beds of the Fergusson group. The shear zone is investigated by a drift adit about 40 feet long, and has an average width of about 10 feet with a steep dip to the northwest. It is mineralized with disseminated arsenopyrite, pyrite, and stibnite, together with veinlets and irregular small lenses of stibnite, in a gangue of calcite, quartz, and altered sedimentary rocks. Samples taken along the drift and across widths of several feet have yielded gold assays ranging from less than 0.10 ounce to more than 0.50 ounce a ton, though the average content across the entire shear zone is doubtfully of commercial grade.

On the whole the sulphide content is less heavy in proportion to the amount of gold than in the nearby Minto mine. However, the width of the shear zone and the persistent mineralization are encouraging features and suggest that further investigations might be made along its southwesterly extension within the unexplored area between the Dauntless and the Minto workings.

#### Kelvin

Reference: Min. of Mines, B.C., special report, 1936.

The property, until recently owned by Kelvin Gold Mines, Limited, of Vancouver, consists of eighteen surveyed claims and fractions south of Bridge River between the Minto property on the north and the Olympic claims to the east. The workings are on either side of Davidson Creek and comprise three adits as well as a considerable amount of surface work. The claims were located in 1933 and 1934 and most of the underground exploratory work was done in 1936. Work was suspended in October of that year. The claims have since been permitted to lapse.

Davidson Creek, within the map-area, lies about midway of a belt of cherty sedimentary beds of the Fergusson group. The belt narrows toward the north and appears to pinch before reaching the mouth of the creek. It is flanked on either side by broad belts of Fergusson greenstone. Near the main workings, east of Davidson Creek, the sedimentary rocks are intersected by a fine-grained, dark porphyrite dyke about 50 feet wide that strikes southeasterly roughly parallel with the principal mineralized shear zone. The dyke rock is altered and difficult to identify, but is not unlike dykes seen on Olympic ground and at Minto mine.

The underground workings all lie within a few hundred feet of river level. The longest, or Pat Fraction adit, about 200 feet above the river, reaches a strong mineralized shear zone, exposed on the steep rocky hill-side above, by a crosscut 90 feet long in greenstone. Where intersected, the shear zone strikes north 20 degrees west, is 3 feet or more wide, and has a well-defined hanging-wall dipping 65 to 70 degrees southwest. A drift followed it for some 150 feet in greenstone to where cherty sedimentary rocks were encountered on the hanging-wall side. From there to the face, about 525 feet, the shear zone swings to follow a more southeasterly course, and in the last 200 feet or so is entirely in sedimentary rocks intersected by one or more andesitic dykes. The mineralized part is apparently confined mainly to the section between greenstone walls and there consists of narrow streaks and veinlets of vein matter within the shear zone. The ore minerals are chiefly pyrite and arsenopyrite, but locally there are masses of sphalerite, galena, and chalcopyrite. The gangue is quartz and calcite. Disseminated pyrite occurs in altered rock of the shear zone and is about the only ore mineral where the wall-rocks are sedimentary. In this inner part of the adit the walls of the shear zone are less well defined and shearing is more intense across the width of the zone.

Samples taken along the shear zone, within 150 feet of the crosscut intersection, and across widths of 6 inches to 3 feet or more, are reported by Mr. O'Grady to range from 0.02 to 0.94 ounce in gold a ton, but are mostly less than 0.20 ounce. Samples from surface workings along this part of the shear zone, as announced by Kelvin Gold Mines, averaged considerably higher.

The other two adits, one a few hundred feet south of the portal of the Pat Fraction adit and about 200 feet above it, and the other over 2,000 feet to the west and a little below it, are both relatively short and neither encountered encouraging mineralization. The first, about 35 feet long, was driven southeasterly in cherty sedimentary rocks along a shear that follows the foot-wall of the Davidson dyke and dips steeply south. The other, or Bridge adit, the first underground working on the property, drifts for 65 feet southwesterly along a curving shear zone in greenstone volcanic rocks mineralized with pyrite and carrying a little gold.

#### Minto Mine

References: Min. of Mines, B.C., Ann. Repts., 1930, p.202; 1932, p.217; 1933, p.270; 1936, pp.3-6F; 1937, p.34F; 1940, p.60; 1941, p.113; and Bull. No.1, 1932, p.72.

Minto mine, property of Minto Gold Mines, Limited, of Vancouver, is on Bridge River about a mile below Gun Creek, and is accessible by motor highway 34 miles from Shalalth on the Pacific Great Eastern Railway. The property comprises the Alpha and Omega groups, consisting of twenty Crown-granted mineral claims and fractions and extending across Bridge River in a general north-south direction. Most of the work has been done north of the river on the Omega No. 1 claim.

The property was held as a prospect for many years and little work was done prior to 1930. Since then the principal vein showings have been developed from four adits, the lowest near river level; and, at greater depth, by a winze and three levels, to a total vertical depth of 800 feet and for a length of 1,000 feet. The mine is equipped with a mill, first operated late in 1934 and increased from an initial daily capacity of 50 tons to about 125 tons (1936). During the principal period of production, 1934 to 1937, the mill treated ore to the value of over \$625,000. Most of the developed ore has, however, been stoped out and explorations at the lowest levels below the adit workings have been disappointing. Milling operations were suspended at the close of 1937. An option taken by

Pioneer Gold Mines, Limited, in August 1941 was abandoned early in 1942. The claims have since been kept in good standing and it cannot be said that the possibilities of the property have been exhausted.

The geological formations comprise greenstones and sedimentary rocks correlated with the Fergusson group; ultrabasic, serpentized intrusions; and dykes of feldspar porphyrite and small felsitic dykes. The general trend of formations is north to north-northwest and dips are mostly steep. The structures are complicated by much faulting and deformation and by original irregularities in intercalation of sedimentary and volcanic materials. The dyke rocks are considered to be related genetically to the mineralization, and one of them, known as the "Minto" dyke, a dark, fine-grained, massive body about 20 feet in maximum width, has played an important part in bordering the principal vein.

The principal vein-bearing fissure strikes northerly and dips to the east at about 75 degrees. It follows along or near the contact of a belt of sedimentary rocks with the Minto dyke or sheared greenstone. In its productive length the immediate hanging-wall rock of the fissure is the Minto dyke, and the dyke has, apparently, both directed and supported the fissure, which elsewhere is in rocks so heavily sheared as to be unfavourable for vein-formation. The uppermost two levels are essentially drift adits, but the next lower or Main adit is a crosscut 350 feet long, which, driven northwesterly, crosses a strongly sheared fault to encounter the fissure north of it. The fault strikes north 75 degrees west and dips northerly at about 48 degrees. Neither the vein fissure nor the attendant Minto dyke continues through the fault, but what appears to be their southerly continuations were picked up by the lowest or River adit and drifted on northerly to the same fault, which was encountered at 350 feet from the portal. From a point about 40 feet north of the fault, on the River level, a crosscut was run westerly, parallel with the fault, for 250 feet until the mineralized fissure and Minto dyke were again encountered in line with their dip below the Main adit level. The length of the crosscut is considered, therefore, to represent closely the horizontal displacement effected by the fault. The fact that there is little if any evidence of mineralization along the fault, strongly suggests that the fault is post-mineral. This being so, the greater width and richness of vein matter north of the fault as compared with that south of it, on the River level, may be explained on the basis that these two sections represent different horizons as a result of a vertical component of movement along the fault. Further, as the fault appears to be a thrust, and as the upthrust part of the vein, as developed north of the fault, contains the better grade ore, a shaft was started (October 1936) 50 feet north of the fault, in line with and on the level of the River adit, to explore the vein below the fault. So far as is known, however, this investigation was never completed.

In addition to the main fault, other faults have been encountered in the underground workings, but so far as is known have not effected any serious disruption of the vein fissure. One, 235 feet from the portal of the uppermost or Warren adit, strikes nearly west, dips northerly at 49 degrees, and has been followed down to the Main level. It has displaced the vein-fissure about 10 feet to the left.

For several hundred feet north of the main fault, referred to above, from the uppermost to the lowest levels the mineralized fissure is occupied by a continuous, well-defined, and fairly regular vein 3 to 4 feet wide. It carries a high proportion of sulphides in a gangue of quartz, less carbonate (chiefly calcite), and, in places, conspicuous malachite. The principal sulphides are arsenopyrite, pyrite, sphalerite, and, locally, stibnite. Others observed in small amounts include galena, tetrahedrite, chalcopyrite, pyrrhotite, native bismuth, and jamesonite (?). A little free gold is reported from veinlets of quartz and calcite crossing the deposit in the Warren adit and a little microscopic gold was observed in polished ore specimens. This gold occurred



as small grains in pyrite. The principal sulphides are generally coarsely crystallized and may occur in nearly solid masses, particularly the arsenopyrite. This was notably the case in the lower two adit levels.

The vein matter has, commonly, a banded structure developed by alternating deposition of gangue and the principal sulphides. It has also been considerably fractured during and after the period of vein formation and has incorporated fragments of the wall-rocks. The foot-wall rocks may be impregnated with iron sulphides for several feet from the vein. In other respects, however, wall-rock alteration is not a pronounced feature.

Values in the upper three adit levels were fairly consistent, though best in the straighter sections of the vein. In general, too, values are said to have improved somewhat at the lower adit levels and to have been best, locally, where the vein matter was notably brecciated and cemented by later ore and gangue minerals. With the opening up, in 1936, of the vein on the River adit level much higher grade ore was encountered, values for a distance of 152 feet averaging 1.66 ounces of gold to the ton across 4.9 feet. Much of this better grade ore has been mined out.

Exploratory work was also done some 1,200 to 1,500 feet east of the mine, on the Omega No. 3 claim, where a mineralized fissure or zone strikes north to northwesterly and dips, apparently, to the west. The zone follows a narrow ravine up a steep slope and, at intervals, was investigated by small surface and near-surface workings of which little can now be seen. The principal working is an adit about 475 feet long, which, at 70 feet from the portal, follows a strong shear in serpentine. The shear dips to the west and a crosscut into the hanging-wall, 100 feet or so from the face, reaches into sedimentary beds. Some vein matter, not unlike that at Minto mine, was encountered near the hanging-wall of the shear towards the portal of the adit. It may be cut off by the shear. At the surface the rocks at the adit portal and to the east of the portal are mainly sedimentary; those underlying the ravine include a narrow belt of serpentine; and west of the adit there is a wide belt of greenstone. Steep ravines cut into this greenstone body and may mark the course of other fault fissures favourable to the occurrence of vein deposits.

#### Olympic

References: Min. of Mines, B.C. Ann. Rept. 1934, p.31F. H.V. Warren and J. Moss Cummings: B.C. Miner, vol. 8, June 1935, pp. 22-23, "Mineralogy of the Olympic Veins."

The mineral showings of Olympic Gold Mines, Limited, Vancouver, are on the south side of Bridge River almost opposite those of Minto mine. The camp buildings are on the hillside about 1,000 feet above the river and 200 feet or more below the uppermost adit. The principal workings are, however, near river level.

The property consists of twenty-three Crown-granted claims staked 10 or more years ago, and worked principally during the years 1934-35. So far as the writer is aware no ore has been produced and no work done since 1936.

The claims lie in sedimentary and volcanic rocks of the Fergusson group intruded by basic and ultrabasic (serpentinized) rocks and by a variety of dykes, including two broad belts of fine-grained, altered felsite that lie on either side of the two lowermost and principal workings. These are adits and investigate a mineralized shear zone that extends southeasterly within a belt of partly serpentinized peridotite. The peridotite body is bordered on the northeast by a narrow rib of massive, medium- to coarse-grained gabbro, and this rock in turn is in contact on the northeast with a broad felsitic dyke that apparently intrudes the gabbro. To the

southwest the peridotite belt is intruded by another broad felsitic dyke. Within the peridotite body, along or near the hanging-wall of the mineralized shear zone, are one or more narrow, dark green, fine-grained dykes, striking southeasterly.

The mineralized shear zone is several feet wide at the portal of the lowermost or Lockie adit. It was driven on for about 65 feet from the portal, in which distance it strikes north 25 degrees west, dips about 55 degrees southwest, and is continuously and heavily mineralized. Beyond this point the shear zone apparently swings more nearly southeast, is less well defined, and though wide is less well and less continuously mineralized to about 210 feet from the portal. Beyond this point the drift was badly caved and could not be examined. What seems to be the same shear zone is followed by the Magee adit 150 feet above. This adit is about 275 feet long, but the only significant mineralization was observed at and within 50 feet or so of the portal where there is a width of several feet of oxidized ledge matter.

The ore minerals are arsenopyrite, sphalerite, pyrite, chalcopyrite, galena, and grey copper, and are present in about this order of relative abundance. Quartz is the chief gangue mineral and locally there is considerable carbonate and a bright green mineral resembling mariposite. Samples across selected widths assay up to  $\frac{1}{4}$  ounce or more in gold a ton, and the gold is reported to be most closely associated with the arsenopyrite and secondly with the pyrite. Average samples across widths of several feet run from a trace to 0.15 ounce gold and from about 2.5 to 7.0 ounces silver per ton, and about 1 per cent lead, 2.0 per cent zinc, and 0.3 per cent copper.

About 500 feet above and 2,000 feet east of these workings some investigation has been made on outcropping lens-like masses of mixed pyrrhotite and magnetite in metamorphosed Fergusson rocks. An adit 150 feet long run 50 feet below on of these outcrops encountered only beds with these minerals disseminated through them. Assays of \$1.70 in gold a ton are reported from the lens above the adit.

Still farther up the hillside, about 1,200 feet above the river and 1,700 feet east-southeast of the Olympic camp, an adit 150 feet long was driven south 65 degrees east to investigate a mineralized shear zone partly exposed in open-cuts 100 feet above. The shear zone is in metamorphosed Fergusson sedimentary rocks near the contact of an outcropping boss of medium-grained quartz diorite. The zone was encountered and driven on for 30 feet to the face of the adit where it apparently passes into the intrusive rock. The hanging-wall is a strong fault surface dipping northerly at 70 degrees. The zone carries veins and veinlets of calcite and quartz mineralized with stibnite, pyrite, and arsenopyrite.

Other short adits and surface workings on the property have investigated the continuity of the principal mineralized shear zones, as well as other mineral occurrences, fault fissures, and geological contacts. The property exhibits a rather tantalizing amount and variety of mineral deposits that neither in quantity or grade have yet afforded much likelihood of commercial production.

#### Peerless

Reference: Min. of Mines, B.C., Ann. Rept. 1937, pp.11-12F.

The Peerless property, formerly owned by Peerless Gold Mines, Limited, of Vancouver, consisted of thirteen mineral claims and fractions held by location. The company is now defunct.

The workings and camp buildings lie within half a mile of the southwest end of Tyaughton Lake, in an area underlain by greenstones and sedimentary rocks of the Fergusson group. The showings are explored by trenches, two adits, and a shaft. When visited (1937) the shaft, which is steeply inclined to the northeast, was full of water. It is sunk in greenstone and no mineral could be seen in the material taken from it. The two adits lie about 600 feet east of the shaft and between 65 and 100 feet above it. The intervening ground is mostly drift covered, but a trench exposes some greenstone and an outcrop of ribbon chert was observed. The upper of the two adits is 17 feet long, driven north 13 degrees west in shattered greenstone. No ledge matter was observed, but a small pile on the dump consisted of fragments of greenstone heavily mineralized with dark sphalerite, less galena, and pyrite. A shallow trench in altered and fractured greenstone above the adit shows a little disseminated sulphide and stringers of calcite and quartz carrying ore minerals. The portal of the lower adit lies 25 feet below and 100 feet south 25 degrees west of the upper portal. The adit is a crosscut run northerly for 125 feet in greenstone. At 60 feet from the portal it intersects a shear striking northeasterly and dipping 50 degrees northwest. The shear carries up to 5 inches of nearly solid sulphide ore composed of sphalerite and pyrite. A sample<sup>1</sup> across 7 inches of vein matter

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<sup>1</sup> Min. of Mines, Ann. Rept. 1937, p.12F.

assayed: gold, 0.28 ounce a ton; silver, 2.70 ounces a ton; and zinc, 10.4 per cent. From near the face of the crosscut a drift was run northeasterly for 170 feet, with short crosscuts to the northwest and southeast at a point 90 feet from the main crosscut. The drift partly follows and partly angles obliquely across a series of narrow shears or slip fractures that strike a few degrees more to the north than the drift. The most significant of these was encountered on the southeast wall of the drift about 100 feet from the main crosscut. It dips about 45 degrees northwest and was followed to the face of the drift. It is probably the continuation of the shear encountered in the main crosscut, and for a length of 20 feet and across a maximum width of 2 feet carries a heavy sulphide mineralization very similar to that in the crosscut. A sample<sup>2</sup> across 1.8 feet ran: gold, 0.30

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<sup>2</sup> Idem, p.12.

ounce a ton; silver, 2.7 ounces a ton; and zinc, 8.6 per cent. Between the face of the drift and the two short crosscuts the hanging-wall of the shear is composed of argillaceous and cherty sedimentary rocks. The foot-wall rocks are altered greenstones, composed largely of buff, ankeritic carbonate and carrying disseminated sulphides, mainly pyrite.

#### Auriferous Deposits Related to Coast Range Intrusions

Gold-bearing deposits related to the Coast Range intrusive rocks cover rather a wide range of types and occur partly within and partly without the intrusive masses with which they are presumed to be genetically related. This view is partly substantiated by the fact that both near the deposits and also where no discoveries have yet been made, the intrusive bodies near their borders carry disseminations and small lenticular masses of sulphide minerals. They are chiefly pyrrhotite and pyrite with lesser chalcopyrite, with perhaps others not identified. These occurrences, though not economic, definitely appear to be of magmatic origin and, in consequence, point to the possibilities of the magma as a source of more substantial deposits where structural and temperature conditions are more favourable. Those conditions are exemplified at the Gem property, where masses of an auriferous cobalt-bearing sulphide are believed to be of magmatic origin. Most of the significant deposits, however, are veins or vein and replacement bodies occurring along fissures in the intrusive rocks

or along fissures or shear zones in the older, invaded formations. Within the map-area these deposits are composed mainly of sulphides with relatively little gangue minerals. The proportions and variety of sulphides vary in the different deposits and the variation appears to be at least partly dependent on temperature conditions at the time of formation. Within or close to the intrusive bodies the abundant sulphides are pyrite and arsenopyrite; at greater distances these may be accompanied by sphalerite, galena, and sulph-antimonite minerals, such as jamesonite and bournonite (?), as conspicuous constituents. In contrast with the deposits along Bridge River Valley associated with porphyrite intrusions, no stibnite and no cinnabar were observed. On the other hand the deposits at the Pilot mine<sup>1</sup> on Gun Lake differ from all others related to the Coast

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Geol. Surv., Canada, Mem. 213, pp. 113-115.

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Range intrusions, and hereafter described, in the relatively small proportion of sulphide minerals either in the several quartz veins or mineralized shear zones. This property has been inactive since 1937.

#### Gem

References: Min. of Mines, B.C., Ann. Repts., 1936, pp. 16-17F; 1938, p. 67F. Warren, H.V., Leckie-Ewing, P., and Adams, P.A.: "The Miner", vol. 12, Aug. 1939, pp. 34-35, "Mineralogy of a Cobalt-Gold Occurrence in British Columbia."

The Gem property of eleven claims and fractions, owned until recently by J.M. Taylor of Vancouver, lies in the valley of Roxey Creek to the southwest of and adjoining that of the Jewel mine. The claims are now lapsed.

The workings are on the precipitous southeastern slopes of the valley about 700 feet above Roxey Creek. When last visited by the writer (1937) they consisted of open-cuts, surface stripping, and one adit a few feet long. Since then considerable additional work is reported to have been done, including several hundred feet of drifting and crosscutting. Part at least of this later development work was done by Bralorne Mines, Limited, who for a time held an option on the property.

The deposits occur within an area of the Coast Range intrusions, consisting here of medium-grained, massive, grey hornblende-biotite quartz diorite. In the vicinity of the deposits the quartz diorite is intersected by an irregular system of fractures striking easterly to northeasterly up the steep valley slope and standing vertically or dipping steeply to the south. Along or near the fractures the rock is partly carbonated and is brownish to buff coloured. The courses of the fractures are also marked at intervals by rusty streaks and patches due to the formation of hydrous iron oxide. The surface of the deposits is similarly stained and also shows occasional small patches of pink erythrite or cobalt bloom.

The mineral deposits lie within the fracture zone in the quartz diorite and are themselves considerably fractured. At the surface they appeared as two somewhat lens-shaped bodies of heavy sulphide ore striking easterly, dipping steeply to the south, and about 17 feet apart. The more northerly or foot-wall body had been traced continuously for a length of about 50 feet, varied from a few inches wide at its west end to more than 10 feet near the east end, and for much of its length was about  $2\frac{1}{2}$  feet wide. The more southerly or hanging-wall ore-body was exposed by surface work for a length of about 25 feet. The east end was about 5 feet wide and

lay a few feet east of the west end of the other body. The west end was also about 5 feet wide, but the ore-body narrowed to about 2 feet at one point. Other indications of mineral were said to have been discovered both east and west of the principal showings, but the precipitous character of the outcropping rocks, the abundance of snow at the time examined, and the profusion of talus on the lower slopes made close inspection difficult or impossible. Since this examination the continuity of the southerly body has been proved for a distance of some 200 feet and is stated to average over 6 feet in width underground.

The nature of the ore is relatively simple. The principal and almost only mineral carries abundant arsenic and iron, some cobalt and sulphur, a very little nickel, and appreciable gold. Warren, Leckie-Ewing, and Adams have identified this mineral as danaite, an intimate mixture of arsenopyrite and cobaltiferous arsenopyrite with minute inclusions of, probably, lollingite that form only a small part of the whole. Assays of three hand-picked samples consisting mainly of the 'danaite' were reported to run: 8.7 to 10.0 per cent cobalt; 25.0 to 28.7 per cent iron; 44.1 to 47.4 per cent arsenic; and 17.4 to 21.4 per cent sulphur.

On the other hand, a sample obtained by the writer that appeared to be typical of the deposit gave, on analysis: arsenic, 66 per cent; iron, 22 per cent; sulphur, 5 per cent; cobalt, 6 per cent; and nickel, 0.05 per cent. This analysis<sup>1</sup> is more nearly that of a cobaltiferous lollingite,

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with the low sulphur content indicating a slight variation towards arsenopyrite. None of the several small samples collected by the writer indicated under the microscope an admixture of two or more principal minerals, though this study can not be regarded as conclusive.

The principal ore mineral occurs either massive or heavily disseminated through the quartz diorite wall-rocks. Aside from a little secondary carbonate, and occasional stringers of quartz that appear to be later than the ore, the deposits contain little if any gangue. Furthermore, specimens were observed in which the ore mineral is intercrystallized with massive and comparatively fresh quartz diorite so as to suggest a common magmatic origin.

The ore deposits are of interest both because of their cobalt and their gold content. Analyses and assays of the nearly solid ore indicate an average of 4 to 7 per cent cobalt and 0.5 to 1.5 ounce of gold a ton. It is reported that some 1,500 tons of ore, containing 3 to 4 per cent cobalt and 0.8 ounces to 1.0 ounces gold a ton were available by July, 1942.

Jewel

Reference: Min. of Mines, B.C., Ann. Rept. 1937, pp. 8-11.

The Jewel property is one of the more recent discoveries in the district. It was staked about 1933 by J.M. Taylor, of Vancouver, and much of the exploratory work, comprising trenches, two shafts, and one adit, was done under option, in 1934, by Bralco Development and Investment Company, Limited of Vancouver. Later the property, consisting of seventeen claims, was further explored and developed by the owners, Jewel Prospectors' Syndicate of Vancouver, and a small tonnage of ore



extracted. The claims have since lapsed.

The principal showings are on the rocky and precipitous eastern slopes of the valley of Roxey Creek, between elevations of 5,500 and 6,000 feet. Camp was established on the creek east of Roxey Creek at an elevation of about 5,850 feet. The upper showings, on which most of the work has been done, trace an irregular fissure vein in serpentine for a horizontal distance of about 700 feet and a vertical range of over 100 feet. The serpentine is, on the whole, massive, and is supported at intervals by several east-trending porphyrite dykes. South of the vein deposits the serpentine is intruded by quartz diorite of the Coast Range batholithic rocks; the contact is only 100 feet from the vein at its east end, but swings farther from it toward the west.

Most of the work has been done on the eastern 250 feet or so of the vein, beyond which it is obscured by drift. This work includes surface stripping and trenching, the sinking of two inclined shafts, 100 feet apart, to depths of about 15 and 35 feet respectively, and the projection of two adit levels, 30 feet apart vertically, for distances of about 100 and 150 feet respectively along the vein. The portal of the lower and more westerly drift adit lies 100 feet south-southwest of the portal of the upper adit. The latter lies about 20 feet below and 35 feet north-northeast of the collar of the more westerly shaft and reaches the vein by a cross-cut driven to the east-southeast for 20 feet. The vein has a general west to southwest strike. For 100 feet or so from the most easterly exposure it follows along the foot-wall of a porphyrite dyke and dips south at about 65 degrees. It then crosses to the southern side of the dyke and at this point the more easterly shaft was sunk on it. Between the shafts the vein, as exposed, dips south at 50 degrees. About 10 feet below the surface, in the more westerly shaft, the dip flattens, and at this point the vein encounters a fault or shear zone dipping steeply to the south, along which there is considerable drag ore from the main vein. The lower adit encounters this shear about 15 feet from the portal and follows it east along the main vein intersection for about 125 feet, at which point a crosscut was driven north into the foot-wall for 75 feet without encountering much mineral. No attempt has yet been made to investigate the downward continuation of the main vein south of the shear.

In its exposed length the vein varies in thickness from a few inches or less to 2 feet and probably averages about 6 inches. The ore minerals comprise abundant pyrite and arsenopyrite and lesser copper sulphide (chalcopyrite). These occur in streaks, bands, and kidneys of nearly solid sulphide associated with minor quartz and calcite gangue. Oxidation is pronounced to a depth of 50 feet or more below the surface. The ore is chiefly valuable for its gold content, and samples have varied from less than an ounce to several ounces in gold a ton. One assay of hard ore reported by the management (1937) ran 7.086 ounces gold a ton, 1.26 ounces silver a ton, and 1.70 per cent copper. The average gold content across vein width would probably be close to 2 ounces. It is understood that a small tonnage of the richer ore was teamed out to the main Bridge River Valley during the winter of 1937-38.

The lowest adit on the property lies about 300 feet below and 400 feet west-northwest of the portal of the lower of the two adits described above. It explores a fracture zone of indefinite width in the batholithic quartz diorite rocks near the serpentine contact. The zone strikes east to southeast, dips steeply south, and contains stringers and small lenses of sulphide ore consisting of mixed pyrite, arsenopyrite, and chalcopyrite, and assays appreciable gold. The adit is a drift for about 175 feet, but includes one crosscut driven southerly for 100 feet.

### Lucky Jem

References: Geol. Surv., Canada, Su. Rept. 1912, p. 206; "White and Bell Group". Ann. Repts., Min. of Mines, B.C.; 1913, pp. 269, 270, "White and Bells claims"; 1924, pp. 142, 143; 1933, p. 2 68; 1940, pp. 59, 60; Bull. No. 1, 1932, pp. 73, 74.

The Lucky Jem is one of the older properties in the map-area. It was staked in 1910 and for a number of years was known as the White and Bell group. It was held until recently by Mr. Grant White of Rexmount and Bridge River. In the early years a great deal of surface exploration was done and two short adits driven. Subsequently comparatively little was accomplished until 1940 when the property was optioned to Britannia Mining and Smelting Company, Limited, by whom extensive surface cuts and over 300 feet of tunnelling were completed and considerable diamond drilling done. The results are not known to the writer, but apparently were not considered satisfactory as the option was dropped and the claims have since been permitted to lapse.

The property is in Eldorado Basin at the head of Eldorado Creek. The workings are on the steep open southerly facing slope that rises above creek level, about 6,200 feet above the sea, to the summit of the ridge overlooking the headwaters of Bon (Bonanza) Creek at elevations of over 7,400 feet. At the summit, directly north of the camp, a tongue of quartz diorite nearly 3,000 feet wide crosses to the south from the Bon Creek slopes and extends down into Eldorado Basin for a distance of 3,000 feet to an elevation of about 6,700 feet. The southern end of the intrusive mass is not well exposed, but is probably irregular in shape with dyke-like apophyses extending still farther down the slope. The quartz diorite is intrusive into sedimentary rocks of the Hurley group standing at high angles and striking in various directions, but mainly about parallel with the borders of the intrusive mass.

Mineralization, as observed (1937), has occurred over a wide area above creek level and in both the intrusive and the intruded rocks. Within this area, however, outcrops are rather scattered and small, and the old surface workings are caved, so that it is difficult to study the conditions of mineralization or to appraise the discoveries themselves. The more easterly of the two adits, at 6,600 feet elevation, is driven north in altered sedimentary rocks and into what appears to be a gently arched brecciated zone, about 2 feet thick, composed of decomposed rock and carrying narrow veins and nodular masses of mixed pyrite and arsenopyrite. The other adit, 200 feet to the west and on about the same level, runs north 30 degrees west in medium-grained altered porphyrite. It follows a sheared and shattered zone about 4 feet wide, standing nearly vertically and containing streaks of oxidized vein matter, in part sulphides. Within about 250 feet, vertically, below this adit are three or four small showings of decomposed rocks carrying streaks and small lenses of sulphide ore consisting mainly of arsenopyrite across widths of a foot or so. Another showing of broken oxidized ledge matter is exposed in a large ground-sluiced trench several hundred feet west of the adits. It seems probable that some of these showings are not quite in place and that a very considerable area about the adits lies in or near the plane of a mineralized zone following, approximately, the contours of the hill slope and partly exposed and partly removed by erosion. Decomposition of the exposed rocks, facilitated by oxidation of the contained sulphides, has resulted in much slumping and sloughing of ledge matter. Within this area gold colours may be obtained almost anywhere by panning the oxidized surface material, and this ground is no doubt the source of much of the fine gold picked up by old placer operations farther down Eldorado Creek

by the Eldorado Placer Mining Company of Vancouver<sup>1</sup>.

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<sup>1</sup> Min. of Mines, B.C., Ann. Ropt. 1913, p. 269.

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Higher up the slope and on the ridge top other showings have been encountered in the intrusive rocks and adjoining metamorphosed sedimentary strata. None of these could be traced any considerable distance, but they seem to characterize a large area about the headwaters of Eldorado, Taylor, and Bonanza Basins in which gold-bearing arsenopyrite is the principal economic mineral. On the Lucky Jem claim a series of twenty-one samples were taken by Mr. O'Grady from the various showings. The "gold values ranged from a trace to 1.28 ounces per ton, --- the better values being present in selected material or in channel samples over narrow widths".

#### Lucky Strike

References: Ann. Repts., Min. of Mines, B.C., 1933, p. 269; 1934, p. 32F; 1935, pp. 13-16F; 1936, pp. 13-16F; 1938, p. 67F; 1939, p. 73; and 1940, p. 59. Geol. Surv. Canada, Sum. Rept. 1912, p. 206.

The Lucky Strike property, owned by Lucky Strike Gold Mining Company, Limited, of Vancouver,<sup>2</sup>, lies in the upper basin of Taylor Creek

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<sup>2</sup> Latest information indicates that in July 1943 Certificates of Trust were filed declaring that Helen T. Mahood held two claims and Wm. Fairley, of Vancouver, eight claims and fractions in trust for and for the benefit of Lucky Strike Gold Mining Company, Limited, N.P.L.

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and is accessible either by road up Tyaughton and Taylor Creeks or by trail up Pearson Creek Valley from near the southwest end of Tyaughton Lake. The property was acquired in 1936 from Goldside Mining Company of Toronto to consolidate the Lucky Strike group of claims with the adjacent, original holdings of Goldside Mines, Limited, of Vancouver. The main camp is on the southeast side of Taylor Creek at an elevation of about 6,080 feet.

Work has been done on two adit levels and includes as well a great deal of surface stripping and trenching. The principal workings, including the two adits, are on the Lucky Strike group and extend over a vertical range of about 350 feet. The upper adit, at an elevation of about 6,550 feet, lies near the top and at the northern end of a narrow, southerly trending ridge about  $\frac{1}{2}$  mile east of the Taylor-Eldorado pass. It had been driven southerly for 35 feet (1937) along a heavy sulphide vein several inches wide. The vein stands nearly vertically in serpentine rock at or near its contact, on the east, with a narrow dyke of hornblende andesite porphyry. The vein matter consists of a mixture of arsenopyrite, zinc blende, jamesonite, and pyrite in variable proportions. Gangue minerals include quartz, calcite, and bright green malachite. South of the adit the dyke continues, but the vein appears to finger out in the serpentine. North of the adit the vein has been followed by trenching for 50 to 100 feet to where it is probably cut off by a fault.

The portal of the lower and main adit lies about 250 feet north-east of the upper adit and about 325 feet (by aneroid) below it. The adit is a crosscut driven southwest for 368 feet through greenstone, serpentine, and an altered porphyritic dyke, to a vein-bearing shear zone. The zone stands vertically, or nearly so, strikes south, and lies partly within the

dyke and partly along its western contact with a wide belt of cherty sedimentary beds of the Fergusson group. A drift runs 65 feet north of the crosscut intersection and about 200 feet south of it. In these distances the vein matter is up to several feet wide and concentrated mainly in a single strand or paystreak along the west wall of the drift. At and north of the crosscut a second strand, a few feet within the dyke, merges with the west-wall strand to give a maximum width of about 7 feet, on which a winze was sunk for 11 feet. Elsewhere the strands average only a few inches in width. The vein matter consists mainly of mixed sulphides with some quartz gangue. The ore minerals comprise sphalerite, arsenopyrite, jamesonite (?), and pyrite. One sample taken by Mr. O'Grady across a width of 64 inches of vein matter just south of the winze assayed: gold, 0.74 ounces a ton; silver 2.8 ounces a ton; zinc, 4.7 per cent; arsenic 1.15 per cent; antimony, 4 per cent. Other samples taken on the northern and southern sides of the winze, across a maximum width of  $7\frac{1}{2}$  feet of vein matter, gave respectively: gold, 0.44 ounces a ton; silver, 3 ounces a ton; arsenic, 5.3 per cent; and gold, 0.50 ounces a ton; silver, 1 ounce a ton; zinc, 8.2 per cent; arsenic, 0.65 per cent. The zone was followed south from the crosscut intersection for some 200 feet to where it is cut off by a fault striking south-southwesterly and dipping about 40 degrees to the northwest. From this intersection the adit was driven southwesterly, along the general direction of the fault, for about 100 feet and from there in a more southerly direction for an additional 145 feet to the face. In those distances the adit is mainly in cherty sedimentary rocks, but also intersects sections of altered, light-coloured dyke rock. At about 35 feet from the face a strong fault striking northwesterly and dipping vertically crosses the adit, cutting off a dyke section and, apparently, displacing it to the northwest. Nearer the face of the adit the probable continuation of this dyke was encountered along the west wall, and on being explored was found to contain stringers of vein matter carrying sphalerite and pyrite. At about 150 feet back from the face of the adit a crosscut was run southwesterly for 150 feet and then southerly for 85 feet to the face. This working is also in cherty sedimentary beds, but encounters dyke rock at the face. The dyke carried disseminated pyrite.

At the surface, the steep slope that rises to the southwest from the portal of the lower adit to the ridge top at and south of the upper adit exposes the same sequence of formations, dykes, and vein matter as encountered underground. The adit, however, has not been extended far enough west to reach the body of serpentine in which the vein at the upper adit lies nor the dyke rock observed at this upper adit.

In addition to work done on the Lucky Strike group much ground sluicing has been done on the property, particularly on the lower slopes of Taylor basin to the north and northeast of the camp. These operations have uncovered considerable heavily mineralized float, containing mixed sulphides, in the deep overburden.

Mineralization is widespread on this property. It occurs mainly as veins in fractures and along fracture of shear zones in dyke rocks and in serpentinized ultrabasic intrusive rocks that are themselves further altered by hydrothermal solutions to brown-weathering carbonate, talc, quartz, and mariposite. The dykes commonly carry abundant disseminated sulphides, chiefly pyrite, and are probably related to the neighbouring batholithic intrusions. For the most part, however, the veins are narrow and either pinch or feather in the incompetent serpentine rocks or are faulted into segments that are difficult to follow or correlate. Principal values are in gold, but substantial percentages of zinc, antimony, and arsenic are also present.

### Native Son

References: Geol. Surv., Canada, Ec. Geol. Ser. No. 4, p. 82;  
Sum. Rept. 1928, pt. A, pp. 92, 93. Min. of Mines,  
B.C., Ann. Rept. 1924, pp. 141, 142.

The Native Son property lies near the head of a small tributary stream that enters Leckie Creek from the south about 3 miles above its mouth. The workings lie at elevations between 6,000 and 6,500 feet, or over 1,000 feet above Leckie Creek. The claims were staked in 1923 by Messrs Henry Swartz and Joe Russell of Lillooet and were leased within a year to Trites, Woods, and Company of Vancouver, by whom most of the exploratory work was done before the close of 1924. The claims have been allowed to lapse recently (May 1943).

The showings lie in metamorphosed sedimentary rocks of the Eldorado group about half a mile north of the main contact of Coast Range batholithic intrusions. The sedimentary beds consist mainly of compact quartzitic and argillaceous rocks carrying an abundance of secondary biotite, quartz, sericite, and epidote, whereby their original characters are largely obliterated. The strata have a general northerly strike and steep westerly dips and are intruded by several dykes of quartz diorite.

The workings comprise five short adits and several open-outs and are arranged on either side of and close to the tributary creek over a distance of about 600 feet. The adits were all caved or partly caved when the property was visited (August 1937). The showings consist of nearly solid or disseminated sulphide ore composed mainly of arsenopyrite and pyrite, but containing also a little chalcopyrite and pyrrhotite and low values in gold. The sulphides form irregular replacement bodies in the sedimentary rocks and are associated with little or no gangue minerals. The largest showing is a lens-shaped mass about 80 feet long and 10 feet wide. It is composed of nearly solid sulphide at the two ends with disseminated sulphide material between.

Due to the abundance of slide debris along these lower valley slopes, the paucity of outcrops in the mineralized section, and the relative inaccessibility of the workings, no specific pattern or system to the showings could be worked out. A disappointing feature of the deposits is their low gold content. No assays are recorded above 0.10 ounce a ton, and, if anything, the disseminated sulphide material seems to carry somewhat more gold than the solid sulphides.

### Northern Light

References: Min. of Mines, B.C., Ann. Repts. 1934, p. 32F, "Goldside Mines, Limited"; 1935, pp. 13-16F.

The Northern Light group of eight claims, staked in 1932 by Mr. E. J. Taylor, occupies the northern slopes of the upper basin of Taylor Creek northwest of the Lucky Strike (Goldside) camp. The property has been explored by much surface stripping, trenching, and open-cut work; by some diamond drilling; and by the projection of two adits. Some prospecting was done over 30 years ago, but no appreciable mining was attempted until 1934 and 1935 when the group was worked under option by Goldside Mines, Limited. Subsequently this option was relinquished and the property was later sold to Mr. Grant Mahood, the present owner.

The principal showings lie at elevations of about 7,000 feet and higher, near the divide between Taylor and Eldorado Creeks. They lie in metamorphosed, chiefly sedimentary, rocks and serpentized ultrabasic intrusions surrounding small boss of quartz diorite, one of the Coast



Range intrusions. The uppermost adit, at an elevation of nearly 7,000 feet, on the Northern Light No. 6 claim, was driven west for more than 400 feet from near the eastern tip of the intrusive boss. It crosses narrow quartz-sulphide veins and veinlets mineralized with arsenopyrite, pyrite, and sphalerite, which follow fractures and shear zones in the intrusive mass; the shear zones also carry disseminated sulphides, mainly pyrite. The veins strike northeast and dip northwest at angles varying from 50 degrees to vertical. Two principal drifts, one to the northeast at 265 feet from the portal of the crosscut, and the other to the southwest, at 305 feet from the portal, have followed the principal veins encountered. The northeast drift is over 100 feet long, but was badly caved most of the way. It follows a vein several inches wide, carrying disseminated pyrite and arsenopyrite, which, according to company assay of a sample at the intersection, gave 1.89 ounces gold a ton. The southeast drift, 85 feet long, follows a shear zone, sparsely mineralized on the whole; but at one place towards the face it encounters a quartz vein 4 inches wide, containing banded sphalerite, pyrite, and arsenopyrite. About 25 feet past this drift a quartz vein, 10 inches wide and heavily mineralized, is exposed in the crosscut. It appears to strike nearly south, stands about vertical, and may be the continuation of the vein picked up in the southeast drift.

The conditions encountered underground are partly duplicated at the surface, about 200 feet above the adit, where the original work was done and where greater widths of vein matter were uncovered. There a shallow pit about 20 feet long exposes a vein 10 to 12 inches wide, carrying abundant arsenopyrite, from which a test shipment of more than 2 tons was made to the Tacoma smelter in December 1934. This shipment ran: gold, 1.74 ounces a ton; silver, 0.06 ounces a ton; copper 0.05 per cent; zinc, nil; arsenic, 19.56 per cent; antimony, trace; and iron, 13.9 per cent. On either side of the pit the vein follows an irregular northeasterly course for an investigated length of about 300 feet. Mostly the mineralization is scanty, but in places widths up to several inches of heavy arsenopyrite were encountered. Still higher up the hill other veins are reported to have been found.

The lower adit is on the Northern Light No. 1 claim and lies 1,300 feet north 65 degrees west of the Goldside camp. The surface above it had previously been explored by a long, ground-sluiced trench. It was reported (1934, page F 32) that several narrow quartz stringers carrying arsenopyrite were exposed by the operation. The adit was driven as a crosscut northwest beneath and more or less along the course of the trench for 275 feet. The principal rock encountered was massive to greatly sheared serpentine and partly serpentinized peridotite, but near the portal and also within 40 feet of the face the adit crosses wide dykes of granodiorite, probably related to the Coast Range intrusive rocks exposed elsewhere on this property. At about 100 feet from the portal a drift runs north in sheared serpentine. This drift was in bad condition for examination, but according to plan is 60 feet long with one branch 25 feet long to the northeast. No mineralization of apparent consequence was observed in this adit.

Robson

References: Geol. Surv., Canada, Sum. Rept. 1912, pp. 206, 207, "Bonanza Creek claims". Ann. Rept., Min. of Mines, B.C., 1933, p. 269, "Taylor and Bonanza Basins"; 1940, p. 59.

Considerable prospecting has been done over a long period in the basin of Bon (Bonanza) Creek, a southern tributary of Tyaughton Creek. Small veins composed mainly of arsenopyrite and carrying gold were explored about 1912 by Mr. Pearson. These veins intersected a decomposed granitic intrusion near the headwaters of Nea Creek, a tributary of Bon Creek. About 1933, Mr. Cooper Drabble, of Bridge River and Vancouver, and associates acquired

some thirty claims in the basin and proceeded to prospect them more thoroughly. These explorations were farther down the basin in a broad feldspathic dyke within which seams of gold-bearing arsenopyrite were found. From one such vein a sample across 5 inches of arsenopyrite is reported (1933) to have assayed: gold, 2.40 ounces a ton and silver 20.9 ounces a ton; another sample across 10 inches of vein matter ran: gold, 2.39 ounces a ton and silver 16.8 ounces a ton. Altogether, numerous veins were encountered, but few of them presented prospects of any considerable tonnage and, apparently, the claims were allowed to lapse. More recently other claims have been staked and some underground mining attempted. In 1940 the J.G. Mining Company, of which Messrs. J.G. Robson and J.A. Anderson were the principals, owned the Robson group of claims on which Bralorne Mines, Limited, held an examining option for six weeks. This group consists of some twenty-three mineral claims and fractions and is now held by Mr. Elmore Meredith of Vancouver.

The principal showing lies at an elevation of 6,000 feet on a small southwestern tributary of Nea Creek. It was examined (1939) by Crickmay, who reported it to be a mineralized shear zone averaging about 18 inches in width, striking southwest, and dipping 36 degrees northwest. The shear intersects highly altered sedimentary rocks near the northwest tip of a broad area of batholithic intrusions. It has been developed (1940) by two adits, 200 and 40 feet long respectively, and explored by open-cuts and 700 feet of diamond drilling. A sample collected in 1939 by Crickmay across the shear zone and assayed by the Bureau of Mines, Ottawa, ran 0.99 ounce in gold a ton. At that time the main adit was only in about 20 feet and the owners were shipping out ore on horse back at the rate of about 2 tons a day. Much of this ore was said to run over 3 ounces in gold a ton and also high in silver. The ore consists of an intimate mixture of several sulphides of which the most abundant are a grey lead-sulphantimonite, resembling jamesonite, a black, cupriferous mineral of doubtful identity, and zinc blende. Some arsenopyrite is also present and a trace of tin was noted in analytical studies. The occurrence of the antimony-bearing mineral is somewhat analagous to that of the abundant jamesonite in the upper Lucky Strike workings in Taylor Basin. The two showings are on opposite sides of and at about the same distance from the main body of intrusive rocks occupying the divide at the headwaters of Taylor, Eldorado, and Bon Creeks. Within this intrusion, or in the larger dyke-like apophyses that radiate from it, the common vein minerals seem to be arsenopyrite and pyrite.

#### ANTIMONY DEPOSITS

The antimony deposits are concentrated along a narrow section of Bridge River Valley in the vicinity of the mouth of Gun Creek. They vary from types such as the Reliance, in which stibnite is the abundant and almost only sulphide mineral and antimony the metal of principal if not only consequence, to others in which a variety of ore minerals are represented and in which the value of the deposits may rest on the gold as well as the antimony content. These more composite ores may in part be not distinguishable readily from other deposits in the vicinity that have been classified as gold ores and that also contain stibnite as one of their constituent minerals. Indeed it is believed that both types in this part of Bridge River Valley have originated from the same magmatic source, and that this source also supplied, at a somewhat earlier date or dates, the abundant associated dykes and small stocks of feldspar porphyrite that characterize the intrusive rocks of this part of the valley. Indications seem to point to the influence of a temperature gradient in controlling mineral deposition, with stibnite predominant in the upper parts of the ore-bodies and other sulphides increasing in proportion at depth. Among these other sulphides arsenopyrite seems, in general, to provide the best gold values, though stibnite itself, as well as other sulphides, may also carry some gold.

CONGRESS

References: Geol. Surv., Canada: Sum. Rept. 1915, pp. 84,85; Mem. 140, pp. 41 and 73; Mem. 213, pp. 74-76. Min. of Mines, B.C. Ann. Repts., 1932, p. 217; 1933, p. 270; 1934, pp. 30,31F; 1936, pp. 10-13F; 1940, p. 60.

The property of Congress Gold Mines, Limited, of Vancouver, consists of twenty-one Crown-granted claims. The mine is on the north bank of Bridge River less than half a mile west of Gun Creek. It is fully described by the writer in an earlier report<sup>1</sup> and is mentioned

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Geol. Surv., Canada, Mem. 213, pp. 74-76, 1937.

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again here mainly in connection with developments since 1935. Occurrences of stibnite ore had been known for many years, but the workings of the Congress mine, mainly since 1933, established considerable bodies of ore carrying gold as well as antimony, with indications that as depth was attained gold values were increasing at the expense of the antimony content.

Three adit levels, the lowest about 40 feet above the highway along Bridge River, develop a principal mineralized shear for a vertical range of more than 600 feet. The shear strikes northeast across sedimentary and volcanic members of the Fergusson group and a later feldspar porphyry dyke about 60 feet wide. It dips northwest at about 45 degrees, varies up to several inches in width, and is well defined in the dyke and in the volcanic rocks (greenstones), but disappears rapidly on entering sedimentary beds.

Stibnite and associated milky vein quartz have formed irregularly along the shear; on either side, especially in the greenstones, the wall-rocks are altered and partly replaced for 1 foot to 15 feet or more. The alteration is to a dense, light buff, ankeritic carbonate impregnated to a varying degree with finely disseminated pyrite, arsenopyrite, and a little sphalerite. In places these sulphides are more coarsely crystalline. Some cinnabar was also observed along minute fractures in the altered rocks and as impregnations between the fractures.

Gold values are found principally in the mineralized greenstone rather than in the stibnite-bearing veins along the shear. The average gold content along the lowest drift and across an average sampled width of 5.6 feet (1935) was about 0.196 ounce a ton. Ore reserves late in 1936 were officially estimated at 301,144 tons averaging \$5.48; 58,000 tons averaging \$11.11; and 168,818 tons averaging \$7.44.

Late in 1936 a 100-ton mill was obtained from Meridian Mining Company, Limited, but was found subsequently to be unsuitable for Congress ores and was sold. Arrangements were later made to run a mill test in the nearby concentrator of Wayside Consolidated Gold Mines, Limited, and it is reported that early in 1937 some 500 tons from the lowest, or No. 3, level was tested at this mill. Apparently the results were not unsatisfactory, as later in the year Congress Gold Mines entered into a contract with Bealemore Milling Company, Limited, a private company that had rented the Wayside mill, to continue shipments to the Wayside. The principal objective was to produce antimony concentrates, for which an attractive price was then being offered. Arrangements were made to sell them to Ayrton, Cohen and Company, metal buyers of London, and to ship the gold concentrate to the Tacoma smelter. Apparently, however, these arrangements

never reached a successful consummation, as the property is reported as inactive in 1938 and since.

#### Golden

References: Min. of Mines, B.C., Ann. Repts. 1932, p. 217; 1933, pp. 269, 270; 1941, p. 78.

The Golden group (also known as the Dominion) of eighteen claims and fractions lies north of Bridge River and east of Gun Creek. It adjoins and lies between Congress Gold Mines and Minto Gold Mines. The property is owned by Federal Gold Mines, Limited, of Vancouver.

Early reports indicate that the property, or part of it, was owned in 1932 by H.E. Rines of Vancouver. At that time oxidized sulphide-bearing veins were said to be exposed in the steep bluffs, 400 feet and more above the road, within a belt 30 to 40 feet wide. A little work was done on them. Late in the following year the group was acquired by Dominion Gold Fields, Limited, and a crosscut adit was started to explore the showings beneath their outcrops. Later, the property is recorded as owned by Goldmint Mining Syndicate, and in October 1934 it was secured, under option to purchase, by the present Company. There followed a period of active exploration both underground and at the surface, supplemented by careful geological mapping. Work on the property is reported to have been discontinued in 1937. An option taken on the property in 1941 by Pioneer Gold Mines of B.C., Limited, was relinquished early in the following year. A shipment of 13 tons of cobbled antimony ore (stibnite) is reported to have been made in 1941. No other production is recorded.

The property is underlain by sedimentary and volcanic rocks (greenstones) of the Fergusson group and by a belt up to several hundred feet wide of carbonatized serpentine rock. These are intruded by dykes and small bosses of feldspar porphyrite, like those on the adjoining Minto and Congress properties.

The workings are 300 to 800 feet above valley bottom in the face of a steep, bluffy slope. The lowest is a crosscut adit driven northeast for about 1,035 feet (October 1935) to get under the principal showings 500 to 800 feet above. At higher elevations the mineral deposits have been prospected by short adits and open-cuts and by much trenching.

The principal discoveries are in a body of greenstone outcropping in a general northwest direction and flanked by prominent dykes, of which the southern is coarsely porphyritic and the northern more uniformly fine-grained. Towards the southeast the two dykes approach each other, thereby limiting the width of greenstone to less than 100 feet. In the opposite direction the greenstone body widens within the prospected area to more than 400 feet. Little information was available to indicate the behaviour of the greenstone mass at depth. Apparently, the dykes stand steeply, but there is some suggestion that they dip towards each other and that the greenstone body between them will, in consequence, be cut off at their junction, though it should appear again at greater depth.

Within this greenstone body, the mineral deposits have formed along fracture zones striking northerly, dipping at various angles either west or east, and ranging from a few feet to 30 feet wide. The fracturing is attributed to strain set up within the less competent greenstone mass by differential movements between it and the massive dykes.

In detail, the fracture pattern is quite irregular. Faulting and shearing have occurred, but are not pronounced features. Fractures may be fairly continuous, as along one or other walls of a fracture zone, or may be short and occur at irregular intervals within the zone.

Three of these zones have been prospected and are mineralized over average lengths of about 200 feet. The most southeasterly lies above the face of the crosscut adit and, apparently, dips east at 50 to 60 degrees. It has an average width of about 10 feet and widens towards the south to where it is in sharp contact against the porphyrite dyke. That the contact is not a faulted one is indicated by a few minute fractures running into the dyke in line with the fracture zone. Mineralization, however, ends at the dyke. The intermediate fracture zone lies about 300 feet northwest and is less well defined than the first. It angles, in part, across a corner of the Omega No. 2 claim of Minto Gold Mines. The third zone lies 700 feet farther northwest and, at the dyke contact, is joined by a branch striking northwesterly along the dyke wall. Both this and the intermediate fracture zone swing southeasterly on approaching the porphyrite dyke and probably end along the greenstone-dyke contact.

Mineralization has given rise to veins in the fractures and disseminated sulphide deposits in the intervening greenstone. The principal vein mineral is stibnite, occurring mostly in coarsely crystalline masses associated with minor proportions of other sulphide minerals and gangue. The disseminated sulphides are chiefly pyrite and arsenopyrite. Values in gold are stated to be associated with these rather than with the stibnite. In the southeast fracture zone, assays are claimed of 0.20 to 0.95 ounce of gold a ton across average widths of about 4 feet. Values in the other two zones have, on the whole, been lower.

Mineral deposits have been discovered at other places and in different formations, but not enough work has yet been done on them to demonstrate either their continuity or probable value. One is a quartz vein encountered in the long crosscut adit, in a strong fault fissure along the southwestern flank of the more southerly porphyrite dyke. The fault strikes north 40 degrees west, dips 67 degrees northeast beneath the dyke, and has been drifted on for 50 feet northwest of the crosscut (October 1935). The vein carries a little scattered malachite and some sulphides, chiefly pyrite.

Elsewhere in the crosscut adit, narrow veins of heavy sulphide ore have been intersected but not explored. They occur in sedimentary beds and vary from a few inches to a foot or more in width. One such vein is composed mainly of stibnite. Another consists of coarsely crystalline pyrite, arsenopyrite, and sphalerite, in a gangue of calcite and quartz. Galena and chalcopyrite are minor constituents. In the bluffs, 300 to 400 feet above the adit portal and within the same belt of sedimentary rocks, three or four heavy sulphide deposits have been discovered and partly explored. They are composed mainly of iron sulphides, form lens-like masses up to 6 feet thick, and assay up to about 0.2 or 0.3 ounce in gold a ton. No continuity to these deposits has been established.

Several narrow stibnite veins have been found in the wide belt of highly altered serpentine rocks. They occur in part along closely spaced fractures between which the rock is impregnated with pyrite and less arsenopyrite; the fractures strike nearly east and west and dip north at 45 to 70 degrees. Some sampling by the company has indicated values ranging from little more than a trace to more than an ounce in gold a ton across widths of 4 or 5 feet.

The aggregate amount of mineralized ground at so many widely separated places, and in such a variety of formations and the significant amount of gold that assays have yielded are both interesting and impressive. The deposits are probably all related to one source, which also gave rise to the dykes, and there is therefore a possibility of discovering a more persistent trunk channel of deposition than has been found to date. The strong, vein-bearing fault fissure in the long crosscut at the southern contact of the porphyrite dyke has more than a suggestion of continuity, though, so far as the writer is aware, no attractive values have been found



in it. The wide belt of altered rocks through which it runs affords strong evidence of the action of thermal, probably vein-bearing, solutions and is therefore, worth further investigation, particularly along or near its contact with the porphyrite dyke. Deposits in the incompetent sedimentary beds are less likely to be continuous.

#### Reliance

References: Geol. Surv., Canada; Sum. Rept. 1915, p. 84; Mem. 130, 1922, pp. 73, 74. Min. of Mines, B.C., Ann. Repts. 1933, p. 271; 1936, pp. 8-10F.

The Reliance is one of the older properties and has been known from the beginning as an antimony prospect. The original group of four claims was staked in 1910 by Mr. F.A. Brewer, who relocated the property in 1915. By September 1915, it is reported, 4 tons of ore had been bagged for shipment, and the richest carried up to  $\frac{1}{2}$  ounce in gold a ton. During the First World War a small tonnage is reported to have been shipped to England. Comparatively little further information, however, is available until 1933 when Reliance Gold Mines, Limited, a Washington incorporation, is represented as owning the property. Most of the work has been done since that time. Late in 1937 it was reported that Reliance Gold Mines had entered into arrangements with Bealemore Milling Company, Limited, to treat Reliance ore at the Wayside mill. The precise outcome of this venture is not known, but apparently it resulted in no very significant developments. All the claims have since been permitted to lapse.

The property, consisting of nineteen claims, is on the south side of Bridge River Valley just above the mouth of Gun Creek. It is underlain by rocks of the Fergusson group, chiefly massive greenstones, but one north-striking belt of ribbon cherts, about 300 feet wide, crosses about midway of the workings and reaches the river a few hundred feet east of the portal of the lowest or River adit. Another and smaller body of cherts lies a short distance west of the portal.

The workings, consisting of four or five adits and several open-cuts and trenches, investigate three well-defined mineralized shear zones in the greenstone. These zones each carry one or more veins of nearly solid, fine to coarsely crystalline stibnite associated with more or less quartz and calcite gangue. Two sets of shear zones may be recognized, one striking southeast with steep dips to the southwest, and the other trending east-northeast, with steep dips to the northwest. Most of the exploratory work has been done on the latter set. The uppermost adit, at an elevation of 3,650 feet, is driven southeast for 25 feet along a shear several feet wide in purplish volcanic rocks. Except for some calcite little vein mineral could be seen, but an open-cut above the adit, displays several stringers of stibnite up to 1 or 2 inches wide. About 325 feet below and 600 feet to the northwest is the portal of the Fergusson adit. It runs east-northeast for 80 feet in greenstone along a mineralized shear zone 4 feet wide to a mineralized fault fissure which offsets the first shear 13 feet to the southeast. Beyond this offset the drift follows the main shear about 25 feet to the face. Between the portal and the fault the shear carries a vein of stibnite up to 6 inches wide with some quartz. Beyond the fault the stibnite vein is 3 to 4 inches wide and runs off into the foot-wall a few feet from the face of the adit, where, however, other small stringers of stibnite were seen. Above the adit the shear zone has been investigated by a long trench from which a shipment of hand-sorted stibnite is reported to have been extracted in 1917.

At an elevation of 2,725 feet, and 1,000 to 1,500 feet northwest of the Fergusson adit, is the portal of the Turner adit. This runs southeast

in green and purple volcanic rocks for 85 feet to a mineralized shear zone several feet wide striking east-northeast and dipping steeply northwest. This was driven on northeasterly for 55 feet and contains veinlets of stibnite in altered and pyritized greenstone. In the opposite direction the shear was followed for only a few feet to a fault striking southeasterly and dipping 50 degrees northeast. Where cut off, the shear zone contained a vein of stibnite several inches wide. Its probable continuation across the fault appears 6 feet to the northwest. Such a displacement is similar to that of the fault in the Fergusson adit.

At an elevation of 2,150 feet, less than 100 feet above river level, a crosscut adit, known as the River adit, was started to explore the downward extension of the mineralized shear zones mentioned above. It is in greenstone and when examined (June 1937) was 250 feet long.

#### MERCURY DEPOSITS

The mercury deposits occur in the northeastern part of the map-area, chiefly along Tyaughton Creek Valley in the vicinity of Relay, Mire, and Mercury Creeks. The chief ore mineral is cinnabar, and this sulphide, together with globules of free mercury derived from it, were long known to occur in placers before any serious attempt made to find them in place. The names of several of the streams, such as mercury, North Cinnabar, and Cinnabar (now Pearson) Creek, are reminiscent of the early discoveries. However, some 15 years ago claims began to be staked for lode cinnabar. These have included the Marion, now the Lillomer, at the head of Pearson Creek; the Cinnabar King, now restaked, on Mercury Creek; The Rose group, now part of Empire Mercury Mines, Limited, holdings; and other properties on Tyaughton Creek not far east of Tyaughton Lake area. More recently other properties have been staked on either side of Tyaughton Creek below Mire Creek; on Relay Creek; and at other localities to the north and northeast of the map-area. Cinnabar has also been observed in the underground workings of Congress mine and another probable occurrence was noted in green volcanic rocks at the southwest end of Hummingbird Lake in the valley of Gun Creek.

Most of the cinnabar has been found in sheared, fractured, and partly dolomitized volcanic rocks (greenstones) of the Fergusson group. Commonly the deposits, especially the more attractive ones, have followed shear zones in the greenstones along contacts with cherty sedimentary members of the group, but only rarely has cinnabar been seen, and only in negligible amounts, in the sedimentary rocks. Recent significant discoveries of cinnabar are, however, reported from conglomerate beds (Taylor group) on Relay Creek, and traces of cinnabar have been found along Tyaughton Creek in the same rocks. Cinnabar has also been seen in highly carbonated serpentine rocks on the old Cinnabar King (now Tungsten King) ground.

In most of the deposits cinnabar is the abundant and, in some cases, the only sulphide mineral. In others stibnite is common and may be in excess of the cinnabar. Globules of mercury may be seen in some of the richer parts of the deposits. Calcite, and, less commonly, quartz are associated gangue minerals, but much of the cinnabar occurs without either.

The origin of the cinnabar is uncertain. Presumably it was formed in relatively recent geological time. Its principal occurrences along Tyaughton Creek Valley, in an area riddled with porphyry dykes of probable Tertiary age, has suggested that these are in some way related to the source of the mercury deposits.

#### Cinnabar King

References: Min. of Mines, B.C., Ann. Repts., 1929, p. 234; 1930, p. 203; 1931, p. 113; Bull. No. 5, 1940, p. 85 "Lorntzsen Mercury Showings".

The Cinnabar King mercury showings are believed to have been investigated only by surface workings. The area in which they lie, now staked by Messrs. Gunnar Lundborg and Egil H. Lorntzsen, also includes the Tungsten King deposits elsewhere described. The original group of eight claims, known as the Cinnabar King, was located in 1929 by Grant White of Bridge River, who did the initial work on the property. Judging from published accounts, the discovery was made on the steep northern shoulder of Mercury Creek, about a mile southeast of the Manitou mine. The formations there include a considerable body of conglomeratic and sandy beds of doubtful correlation, but probably part of the Taylor group or younger. They are in contact with at least one rather conspicuous body of serpentine and are intruded by porphyritic dykes. The serpentine is, for the most part, extensively carbonatized to a light-coloured, somewhat porous mass and is probably the rock in which the mercury minerals were found. Traces of cinnabar were observed in it by the writer at one point, but no evidence of any considerable prospecting was encountered. More recently, Mr. Lorntzsen has prospected for cinnabar near the Manitou road crossing at Mercury Creek and in one open-cut, 330 feet south of the creek, is said to have encountered thin films of cinnabar along shear planes in purple volcanic rocks.

#### Lillomer

References: Min. of Mines, B.C., Ann. Repts., 1927, p. 217, "Marion"; 1928, p. 218, "Marion No. 2"; 1929, p. 234, "Marion"; 1937, pp. 31-33E; 1939, pp. 45-46E; Bull. No. 5, 1940, pp. 81-83, "Conardon Mercury Mines," Geol. Surv., Canada, H.M.A. Rice, unpublished account, 1940.

The Lillomer group of five claims was staked in the upper basin of Pearson Creek. The principal showings lie at an elevation of about 6,700 feet, a few hundred feet below the summit of the high open divide overlooking the headwaters of Taylor Creek, to the north, and North Cinnabar Creek, to the east.

The history of the property dates back 15 years or more to a period when lode cinnabar was being found in various places north of Bridge River. Early prospecting on this property, then known as the "Marion", was carried out by Lillooet Mercury Mines (N.P.L.) under the supervision of Mr. C.E. Cartwright of Vancouver. About 1929, material for a small retort plant was hauled up the trail from Tyaughton Lake and established at a convenient site some 1,000 feet below the workings, but, so far as is known, was not assembled. In 1936 the property was acquired by Conardon Mercury Mines, a syndicate consisting of C.E. Cartwright and associates, and renamed the Lillomer group.

The claims are underlain mainly by rocks of the Fergusson group, banded cherty and argillaceous sedimentary types intercalated with volcanic rocks (greenstones). Occasional narrow bands and lenses of reddish and grey limestone and small bodies of carbonatized serpentine are present. These rocks are broken at intervals by a series of faults, and strike and dip irregularly.

The workings comprise one adit and a dozen or more open-cuts ranging from 200 feet below to about 300 feet above the adit. They are mainly along shear zones and in part follow contacts of sedimentary and volcanic rocks. The adit, 100 feet long, is driven northerly along a shear zone that dips west at about 30 degrees. For most of its length it is in sedimentary rocks that strike easterly and dip steeply to the north. Towards the face it enters a narrow fault block of green volcanic rocks. A short inclined raise and crosscut investigate the greenstone mass.

The volcanic rocks are much shattered and carbonatized and carry numerous stringers and small veins of dolomite and calcite and some of quartz. With them are associated small streaks, veinlets, patches, and grains of cinnabar. Much of the best material has apparently been mined. Samples of rich ore, carrying considerable free mercury, were seen by the writer (1937) in a pile accumulated in a large open-cut above the adit. As the cinnabar seems to occur only in the altered volcanic mass and this body is small the prospects of securing any considerable tonnage of ore are quite limited. On all sides of the adit, for a radius of several hundred feet, the rocks, though poorly exposed, appear to be mainly sedimentary, but commencing about 250 feet above and 650 feet from the adit and extending from there to and easterly along the summit of the divide much larger bodies of greenstone are exposed. Open-cuts in these, and along their sheared contacts with sedimentary bands, have in places exposed some cinnabar, but as yet in no appreciable quantity. It seems unlikely, however, that the prospects of this particular area have been exhausted or that the locus of maximum deposition has been revealed.

#### Manitou Mine

References: Min. of Mines, B.C., Ann. repts., 1931, p. 113 "Rose Group"; 1936, pp. 58-61F; 1938, p. 69F; 1939, p. 100; 1940, p. 86; Bull. No. 5, 1940, pp. 70-81. Geol. Surv., Canada, H.M.A. Rice, unpublished report.

The Manitou property, consisting of fourteen mineral claims, is owned by Empire Mercury Mines, Limited (N.P.L.), of Vancouver. It lies on either side of Mire (Mud) Creek, near its confluence with Tyaughton Creek, in the northeast corner of the map-area.

The history dates back some 10 to 15 years when the nucleus of the Manitou, then known as the Rose group, was held by Mr. Ben Cromer of Tyaughton. In 1931 it is reported that "one short tunnel has been started, but the best specimens are obtained from open-cuts over a width of about 75 feet." Little more work was done until June 1936 when the property was acquired from Mr. Cromer by the Manitou Mining Company, Limited, of Vancouver. With the new ownership active exploration at once began and continued for the next couple of years. In 1938 the name of the company was changed to that of the one known at present and in the same year a reduction plant housing a crusher and a Gould rotary-kiln was erected at the portal of the main or No. 2 adit. The furnace has a rated capacity of 10 tons a day. Up to the end of the summer of 1940, 20 flasks of mercury had been produced. The property is now idle.

The area of principal interest is a part of the south end of the ridge between Mire and Relay Creeks. This is underlain by a variety of formations, including sedimentary and volcanic rocks of the Fergusson group; tuffaceous, chloritic sandstones, with minor shales and pebble conglomerate, probably part of a younger series; serpentized, ultra-basic intrusions that intersect the Fergusson rocks; and minor felsitic and porphyritic intrusions of comparatively recent age. The Fergusson sedimentary beds consist of characteristically contorted ribbon chert, with minor bodies of slaty argillite; the associated volcanic rocks consist principally of both green and purplish lavas, with minor flow breccias and tuffs. These and the associated serpentized rocks have been steeply compressed and partly overturned, with much shearing and faulting along directions roughly parallel with the bedding within the several fault blocks. The principal shear zones, as identified mainly in the underground workings, strike in part easterly and in part north-westerly to northerly. It is along these shear zones and almost entirely within the volcanic rocks that the cinnabar occurs. The presumably younger tuffaceous sedimentary series is less deformed than the rocks of the Fergusson group and, though partly in faulted contact with them, appears to rest unconformably on these older formations. It

occupies two considerable areas on the lower, steep southeasterly slopes of Mire Creek, to the southeast and south, respectively, of the principal workings, and is probably part of the same assemblage of beds that crosses Mercury Creek southeast of the Manitou property (See map).

The principal group of workings lies on the steep but largely drift-covered western slope of Mire Creek. It occupies an area about 1,600 feet square and ranges to more than 500 feet above creek level. The workings comprise numerous pits and open-cuts; some ten adits, varying in length from a few feet to 700 feet; and a series of seven deep, ground-sluiced trenches that range from less than 150 to more than 1,300 feet in length. Nearly all the workings of any size, and some that are quite small, have encountered cinnabar, but the principal discoveries were made in the No. 2 or main adit, the No. 5 adit to the south, and the No. 3A adit to the west.

The portal of the No. 2 adit is 200 feet above the creek and 350 feet from it. The adit was driven northerly for 325 feet, chiefly across volcanic rocks, to where it reaches the principal mineralized shear zone striking northwesterly and dipping steeply southwest. The shear lies mainly between green volcanic rocks, on the hanging-wall, and ribbon cherts along the foot-wall. It has been investigated on either side of the crosscut intersection for a distance of 200 feet. Near the southeast end a raise was put through to the surface, 180 feet above. At the crosscut intersection the shear splits and a branch extends northwesterly a few degrees to the south of the main shear. The course of the main shear zone is marked by a width of 1 foot to 10 feet of sliced and crushed rocks, chiefly greenstone. Cinnabar is irregularly distributed along this zone and its tributary branch. The mineral occurs chiefly along fractures and slip planes in the broken greenstone rocks; less commonly as small nodular masses and stringers in calcite veinlets up to an inch wide; and, to a minor extent, as disseminated grains in the greenstone. The more concentrated mineralization, and hence the ore, occupies irregular shoots along the zone with relatively lean material between. Assays of samples across widths of several feet have varied from less than 1/10 to more than 1 per cent mercury. Some of the best grade material was encountered in the vicinity of the raise and in workings off this raise. Much of the material run through the furnace is believed to have come from these workings.

The portal of No. 5 adit lies 290 feet south 81 degrees west of the portal of No. 2 adit, and at about the same elevation. This adit is driven northerly, as a crosscut, across green volcanic rocks for 35 feet to where it encounters a strong mineralized shear that strikes westerly and dips steeply to the south. The foot-wall rocks are mainly ribbon cherts. The shear was followed westerly for about 75 feet in well-mineralized greenstone, beyond which point very little cinnabar was encountered. The average width of the shear zone in this distance is reported to be about 6 feet.

At 600 feet north 64 degrees west from the portal of No. 5 adit, and a few feet higher, is the portal of No. 3A adit. This adit is driven northeasterly for 90 feet across ribbon cherts, and then easterly for over 200 feet to investigate a broad zone of sheared ground largely in volcanic rocks. Within this zone two principal and nearly parallel mineralized shears were followed for distances of about 80 feet each. Their average width is about 5 feet; they dip steeply south; and, as in the other two adits, the foot-wall rocks are mainly ribbon cherts. The indicated average mercury content, from samples taken by the British Columbia Department of Mines, is between 0.10 and 0.20 per cent.

In addition to these workings, some surface or near-surface work has been done on the eastern steep lower slopes of Mire Creek Valley,



and also on the upper western slopes of the Relay-Mire Creeks ridge. This work is all within short distances of the main investigated area and has encountered cinnabar in the same volcanic rocks and under similar conditions to those previously described. No appreciable body of ore was discovered in these operations.

Cinnabar is almost the only ore mineral in the Manitou deposits and much, perhaps most, of it occurs without associated gangue. Small globules of native mercury are seen occasionally in the richer parts of the ore shoots. Finely crystalline pyrite or marcasite also occurs sparingly in the deposits; metacinnabarite has been reported; and a little unidentified hydrocarbon mineral was seen. Calcite is the common gangue mineral and quartz is present in places. Almost all the cinnabar occurs in the volcanic rocks, and chiefly along sheared contacts with ribbon cherts. Rarely, thin films of cinnabar were observed in fractures in the adjoining cherty beds. Fracture zones in the younger tuffaceous sandstones should also provide favourable sites for mineralization, but to date have not been investigated.

The origin of these mercury deposits is not known, but it is suspected that they may be related to the period of intrusion of the abundant dykes of light pink to buff, brown-speckled, feldspar porphyry such as outcrop on either side of Mire Creek, below the workings, and, in numbers, along Tyaughton Creek Valley above and below the mouths of Mire and Relay Creeks.

#### Phillips' Cinnabar Showings

Reference: Min. of Mines, B.C., Bull. No. 5, 1940, pp. 83-85.

These showings lie in the same ground as the Tungsten Queen tungsten deposits elsewhere described. The property, consisting of thirteen claims lying on either side of Tyaughton Creek north of Noaxe Creek, is owned by Edwin Phillips of Minto Mine.

The cinnabar workings comprise several open-cuts and one short adit alongside and above the Manitou mine road south of Mercury Creek. Some prospecting has also been done below the road and on either side of Tyaughton Creek. Perhaps the best showing is that reported (1940) from a cut 360 feet above the road and about  $\frac{1}{4}$  mile south of Mercury Creek, where sheared greenstone (Fergusson volcanic rocks) is exposed. Thin veinlets of cinnabar occur along fracture planes in this rock and also rimming amygdulæ in the more massive lava. The considerable body of carbonatized serpentine rock along the road on either side of Mercury Creek (See map) should be searched more carefully for cinnabar showings, as also should the sandy and conglomeratic sedimentary rocks of the Taylor group along Tyaughton Creek.

#### Relay Creek Deposits

Reference: Min. of Mines, B.C., Ann. Rept. 1942, p. 76.

Deposits containing cinnabar and stibnite were discovered in 1942 on the lower west slope of Relay Creek close to if not actually within the map-area. They were not seen by the writer, and the geographic site of the discoveries is not yet fixed. According to the reference cited above, the deposits occur in conglomerate (probably of the Taylor group) and follow a shear zone striking north 28 degrees west and apparently dipping steeply to the northeast. This shear may correspond to or be closely associated with the fault separating Fergusson and Taylor group rocks, as shown on the accompanying map. The shear zone is reported to have been traced for some 1,500 feet. By the close of the year considerable surface and underground work and diamond drilling had already been done on it by Bralorne Mines,

Limited, who held an option on the property from the owners, Messrs. W. Riley and T. Schwartz. It is understood that other discoveries have since been made in the vicinity.

#### TUNGSTEN DEPOSITS

The tungsten deposits are recent discoveries and are confined to the northeast corner of the map-area. The ore mineral is scheelite, and, on the principal property to date, it occurs veining carbonatized serpentine. This rock was an ultrabasic intrusion and forms a conspicuous body crossing Mercury Creek near the Manitou mine road. The association of stibnite with the scheelite veins on the Tungsten Queen property, and the occurrence of both stibnite and cinnabar in the same area and, in some instances, in the same rocks, raises the interesting speculation that all three minerals have a related origin and comparatively recent age. Scheelite, however, has been found elsewhere in the map-area and under quite different geological conditions. It occurs in gold-bearing quartz veins associated with Bralorne intrusions, as in the Arizona deposits on Hurley River.

#### Tungsten King

References: Min. of Mines, B.C., ~~Ann.~~ Rept., 1942, p. 79; Bull. No. 10 (revised), 1943, p. 105.

This property, comprising eighteen claims lying east of Tyaughton Creek on either side of Mercury Creek, is owned by Messrs. Egil H. Lorntzsen of Minto Mine and Gunnar Lundberg of Gold Bridge, B.C. Two of the claims were staked in 1942, but the others represent ground located, in 1936, by Mr. Lorntzsen, for cinnabar, and, at a still earlier date, formed the original Cinnabar King group of claims referred to elsewhere in this report.

The discovery of tungsten ore in place was made early in 1942 following the identification of scheelite-bearing float on the hill slope below. The workings, consisting of open-cuts and two short adits, are on the north bank of Mercury Creek about 900 feet by skidroad east of the Manitou road.

The scheelite is reported to occur in a fracture zone several feet wide in limestone and to be associated with stibnite and dolomite. Several tons of medium grade ore have been mined and shipped to Bralorne for treatment.

#### Tungsten Queen

References: Min. of Mines, B.C., Ann. Repts. 1941, p. 81; 1942, p. 78; Bull. No 10 (revised) 1943, pp. 101-104. Geol. Sur., Canada, H.M.A. Rice, unpublished report.

The Tungsten Queen property, in the valley of Tyaughton Creek, consists of thirteen claims and is owned by Edwin Phillips of Minto Mine. The claims were staked originally for cinnabar and are referred to elsewhere in this report in connection with that mineral. The discovery of tungsten ore (scheelite) was not made until the summer of 1939 and the showings have not been seen by the writer. During the period from September 1941 to September 1942 the Consolidated Mining and Smelting Company held a lease on the property, and since that time further work has been done by the owner.

The discovery was made on the east side and 65 feet above the Manitou road, at a point about 3,500 feet south of Mercury Creek crossing,

and near the southern end of a considerable body of serpentine and carbonatized serpentine rock (See map). It cuts northerly across cherty sedimentary and volcanic rocks of the Fergusson group and is itself intersected by feldspar porphyry dykes. The following account of the deposit is based on references given above.

The outcrop of the deposit consisted (September 1939) of two small parallel veins, one predominantly of stibnite and the other mainly of scheelite. The veins lay 2 feet apart and ranged from 1-to 3 inches in width. Over the short distance then exposed the veins maintained a fairly uniform width and showed several branch veinlets that extended for a few feet into the wall-rock. There was no evidence of movement along the vein walls. The vein matter showed marked crustification or banding, with scheelite followed inwards from both walls by finely crystalline chalcedonic quartz, then by coarsely crystalline comb-quartz, and, finally, in the stibnite vein, by a central band of stibnite. The scheelite is light coloured, almost white to cream tinted and, on casual inspection, might readily be mistaken for the dolomite that forms numerous stringers in the altered serpentine. The presence of two minerals so utterly unlike in their normal associations and modes of formation as scheelite and stibnite is a remarkable feature of the deposits.

Since 1939 considerable work has been done, and a number of other small scheelite-bearing veins exposed. A little stibnite also occurs in them. The work has included several hundred feet of trenching and open-cuts, the projection of three adits, 171, 54, and 23 feet long respectively, and some stoping from these. Small shipments of high-grade cobbled ore have been made from time to time. Though the scheelite veins are quite small, the property possesses considerable attraction as a small-scale producer of tungsten ore. The association of the veins with the altered serpentine also suggests that prospecting for scheelite should be extended both along this serpentine belt and into the many other occurrences of like rock in the map-area.