BRITISH COLUMBIA DEPARTMENT OF MINES
Hon. W. J. ASSELSTINE, *Minister*　　JOHN F. WALKER, *Deputy Minister*

BULLETIN No. 13

Supplementary Report
on
Bedwell River Area
Vancouver Island
British Columbia

by

H. SARGENT

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INTRODUCTION

Field-work in 1939 and 1940, followed by office work including microscopic studies, is the basis for this bulletin, which deals with an area in the Alberni and Clayoquot Mining Divisions, Vancouver Island, British Columbia. The geology of the area, as far as mapped in the two seasons, is represented on (Fig. 1), scale 1 inch to the mile, with topography in the northern part indicated by contours at 200 foot intervals. The topography is taken from part of Map No. 92 F/5, released in 1939 by the British Columbia Department of Lands, scale 2 inches to the mile, contour interval 100 feet. The base for the southern part of (Fig. 1) is the drainage pattern, prepared by the writer from airplane photographs borrowed from the Department of Lands. The accuracy of this part of the base map is therefore not of the same order as the part to the north.

Some general information which appeared in the Preliminary Report on the Bedwell River Area, Bulletin No. 8, British Columbia Department of Mines, 1940, is reproduced in the present bulletin. Mining properties are indicated by reference numbers on (Fig. 1); the same numbers have been used in this bulletin for those that appeared in Bulletin No. 8. Mineral deposits on properties examined in 1940 are described under "Properties and Mineral Deposits", in the order of the reference numbers. These include the Musketeer and Buccaneer properties, described in Bulletin No. 8, on which a great deal of work had been done since the 1939 examinations. A good deal of work has also been done on the Avon, Noble, Trophy and some other properties which it was not possible to examine in 1940. For descriptions of properties indicated on (Fig. 1) but not described in this bulletin the reader is referred to Bulletin No. 8.

The reports on properties include details concerning general geology, mineral associations and history. Some of this material is summarized in the general part of the bulletin. Annual Reports, Minister of Mines, British Columbia, from 1898 to 1933 are the sources for most of the historical information.

Limits of Map-area

The irregular outlines of the area mapped geologically lie within a rectangular map-area (Fig. 1), about 10 miles from north to south and a little less than 14 miles from east to west, of which the northern boundary is less than quarter of a mile north of 49 degrees 30 minutes north latitude, and the eastern boundary is 126 degrees 30 minutes west longitude. The southern boundary of Strathcona Park crosses the area a little more than 6 miles from the northern boundary of the map-area. The greater part of the area is drained by Bedwell River, which discharges into the head of Bedwell Sound. This stream is referred to in old reports as "Bear River" and that name is still used frequently. The eastern part is drained by Drinkwater Creek which enters Great Central Lake near the western end, about 5 1/2 miles south-easterly from the point where the creek reaches the eastern boundary of the map-area. Moyeha River flows westerly to a point beyond the western boundary of the map-area, then turns south-westerly and discharges into the head of Herbert Inlet, some 7 miles north-westerly from the head of Bedwell Sound. The part of the area drained by Drinkwater Creek is in the Alberni Mining Division, the remaining and much larger part is in the Clayoquot Mining Division.

History

For many years deposits of copper, gold and iron have been known on the west coast of Vancouver Island and there has been some production of copper and gold ores. Copper was shipped from Sydney Inlet principally in 1907, 1908 and 1909, concentrates were produced at Sydney Inlet principally in 1923. From then until 1937 production on the west coast consisted of occasional small shipments of gold-bearing ore. Between 1936 and 1938 it became apparent that there were gold-bearing veins of exceptional interest in the Zeballos camp. Spectacular gold ore was shipped from the Privateer in 1937, other properties in that camp also became shippers and in 1938 three properties were equipped with mills. The successful developments in the Zeballos camp stimulated prospecting along the west coast, and particularly in the country tributary to Bedwell River, some 65 miles south-easterly from the Zeballos camp. The activities of prospectors in 1938 resulted in discoveries of gold-bearing veins on Bedwell River, later discoveries were made on upper Drinkwater Creek. Already substantial development work has been done on several properties located in 1938 and 1939 and it now seems almost certain that there will be some gold production from the area which is the subject of this bulletin.

Reports of the Minister of Mines, British Columbia, for 1898 and 1899, contain brief references to placer-mining on Bear (Bedwell) River in the 'sixties and to Chinese placer-miners abandoning the district in the late 'eighties, but give no information about the extent of the operations and the quantity of gold recovered.

On lower Bedwell River, between 1898 and 1900, surface and underground work, exploring copper-bearing mineralization, was done on the Seattle group; on ground known as the Castle, now included in the Avon located in 1938; and on the Galena, now covered by a group located in 1938 also known as the Galena. On the Castle some work was also done on gold-bearing veins. Copper-bearing mineralization was discovered and claims were located on Big Interior Mountain in 1899. Although situated at a high elevation in rugged country, about 12 miles from tidewater and partly covered by a glacier, this occurrence was considered to have attractive possibilities of developing into an important copper producer. Four claims, now known as the Ptarmigan group, were acquired in 1912 by Ptarmigan Mines, Ltd., an English company. It was proposed to build a road up Bedwell River and to connect the road to a point near the summit of the mountain by an aerial tramway. Road-construction had reached a point about 7 miles from tidewater, and equipment for the tramway was at the head of Bedwell Sound when work was stopped on the outbreak of war in 1914. Before 1906 some work was done on the Big I adjoining the Ptarmigan and in 1916 preparations were made for a diamond-drilling program. Since that time no activity has been reported at either property.

The Prosper group on lower Bedwell River covers ground, believed to have been staked in 1903 as the Pakeha, on which an adit was driven following a gold-bearing vein. About 1900 gold-bearing veins were discovered near Della Lake, reached from Drinkwater Creek, and claims known as the Della group were staked. An arrastra was built in 1906 but there is no report of gold produced. The claims of the You group, covering a vein on the south-western slopes of Big Interior Mountain, were recorded in 1912. Later reports refer to development work and the construction of an experimental cyanide mill but do not mention the recovery of any gold. There was activity periodically at this property from 1912 until about 1933 or 1934 during which time there was little activity elsewhere in the area.

Prospectors discovered gold-bearing veins north-west of Bedwell River on Noble (Clarke) Creek, and staked the Noble and Noble B groups in August and September 1938. This was followed by discoveries south of the river near Sam Craig Creek, and the staking of the Musketeer, Shamrock, Joker and Buccaneer groups. Pioneer Gold Mines of B. C., Limited, and Anglo Huronian, Limited, became interested in the Musketeer-Shamrock property. Underground work, started before the end of the year, was carried on through the winter. A company known as the Musketeer Mines, Limited (N. P. L.), was incorporated and has continued active development of the property. Late in 1939 Bralorne Mines, Limited (N. P. L.), became interested in the Buccaneer which is operated by Buccaneer Mines, Limited (N. P. L.). Substantial underground work has been done on the property and it is reported that a mill of 25 tons daily capacity is to be built in 1941. Underground work has also been done on the Avon and on the Trophy. and the surface explored on a number of other properties on Bedwell River and its tributaries.

In July 1939 the first claims of the Sherwood property on Drinkwater Creek were staked. The Sherwood vein northeast of the creek was examined for Pioneer Gold Mines of B. C., Limited, late that year. In 1940 that company did substantial underground work on the Sherwood; prospected gold-bearing veins discovered that year on the P. D. Q. property, adjoining the Sherwood; and prospected silver-bearing mineralization also discovered in 1940 near Cream Lake, about 1 1/2 miles to the north.

Thirty claims in the area, located from 1896 to 1912 and originally Crown-granted from 1907 to 1926, were in good standing at the end of 1940. Most of the other claims held at the end of 1940 were located in 1938, 1939 and 1940. In the three years a total of about 735 claims were staked and recorded. Of these about 100 were in the part of the area drained by Drinkwater Creek and the others were in the part drained by Bedwell River. A large number of the claims have been cancelled or have been allowed to lapse but at the end of 1940 about 300 of the recent locations remained in good standing.

Transportation in the area has been a serious problem, the known deposits tributary to Bedwell River are from 2 or 3 to 12 miles from the head of Bedwell Sound, and those tributary to Drinkwater Creek are 10 miles or more from the head of Great Central Lake. The first Bedwell River road, on which work was stopped in 1914, was a very costly undertaking. Beyond the end of the road supplies and equipment had to be taken in on pack-horses or back-packed and after the road deteriorated packing from the head of Bedwell Sound was necessary. In the Drinkwater Creek section it was necessary to pack from Great Central Lake. In spite of difficulties of transportation a good deal of work was done on some of the least accessible properties. Supplies needed for shallow workings were packed to the Della property. Supplies needed for about 350 feet of underground work and equipment for an experimental cyanide mill were packed to the You property.

From the summer of 1939 to the end of 1940, in addition to surface work in the area, more than 6400 lineal feet of underground work was done, mostly by hand, on three properties, with a possible additional 200 lineal feet on the others. With the exception of machinery dragged to the Muskateer on go-devils early in 1940, all the supplies, equipment and material used in this work had to be taken in by back-packing or on pack-horses.

Access

The Bedwell River part of the area is entered from the head of Bedwell Sound, about 20 miles by water from Clayoquot and Tofino. Clayoquot and Tofino, about 1 mile apart, are regular ports of call for the Canadian Pacific Steamship Company's west coast steamers which in summer sail from Victoria northbound every fifth day, and during the rest of the year every tenth day. Northbound passengers may find it convenient to board the steamer either at Victoria or about 24 hours later at Port Alberni. Busses and trains from Victoria and Nanaimo make connection with steamers at Port Alberni, and at Nanaimo connection is made with Vancouver steamers. Airplanes of Canadian Airways, Ltd., and Ginger Coote Airways, Ltd., fly regularly between Vancouver City Airport and points on the west coast of Vancouver Island, and will call at Tofino when business offers. It is expected that in 1941 airplanes will be able to land at an approved float at the head of Bedwell Sound. W. Knott of Tofino operates a gas-boat between Tofino and the head of Bedwell Sound, handling passengers and freight. Other boats can be hired at Tofino or Clayoquot. Small scows are available for handling heavier freight. The landing at the head of Bedwell Sound is on a slough and cannot be used at low tide.

Repairs to corduroyed parts of the old road and the construction of light bridges in 1938 and 1939 made it possible to take supplies up Bedwell River on horses. Construction of a truck-road, following approximately the route of the old wagon-road, started in the autumn of 1939 and reached a point about 2 1/2 miles from the head of Bedwell Sound. Work started again in August 1940, the program being to follow the old route and where necessary to use running plank on cross stringers, after the manner of logging roads. This road is to go far enough to serve the Buccaneer and Musketeer properties, and at the end of the year was reported to have reached a point between 5 and 6 miles from tidewater, leaving between 2 and 3 miles to be completed. Trails branching from this route serve various prospects, and an old trail continues up the main valley to the mouth of You Creek, where it branches, about 11 miles from the head of the sound. One branch continues northerly to the Casino camp close to the river. Pack-horses were taken to the Casino in 1939, but in 1940 could not travel beyond 8-Mile because wind-falls blocked the trail. The other branch goes up You Creek past the You property to the entrance of a canyon near the head of one of the forks of the creek. It is possible to continue by this route, called Bear Pass, to Della Lake, and thence via the Della Falls to Drinkwater Creek. The canyon section leading to the summit of Bear Pass is very rugged and no trail could be found there in July 1940. Pack-horses could be taken to near the head of You Creek if windfalls were cleared out, but it would be impracticable to build a pack-horse trail via Bear Pass and the Della Lake Route.

The easiest route to the eastern part of the map-area is by boat from Great Central, a saw-mill town at the foot of Great Central Lake, to the head of the lake, thence by logging railroad and trail to upper Drinkwater Creek. Busses run between Great Central and Port Alberni, about 10 miles by road. Power boats can be hired at Great Central and Messrs. Bloedel, Stewart and Welch, engaged in logging on lower Drinkwater Creek and in several other sections along Great Central Lake, operate tug-boats on the lake. By arrangements with the logging company, Pioneer Gold Mines of B. C., Limited had a large part of the material and men going to the Sherwood on upper Drinkwater Creek transported to Camp 6, near the western end of the lake, and thence to the end of the logging railroad, about 3 3/4 miles in an air line north-westerly from the outlet of Drinkwater Creek.

From the end of the logging railway a pack-trail leads about 4 1/2 miles to the Sherwood base camp, on the north-eastern side of Drinkwater Creek. A trail running to the Sherwood camp leaves the main trail a short distance southerly from the base camp. The old Drinkwater Creek trail from Great Central Lake was largely obliterated in building the railway. From the railway to the base camp the trail has been re-located in part and generally follows easy grades.

The trail crosses to the south-western side of the creek near the base camp. From the south-western side of the crossing the Della Falls trail leads to the Della group, and an old trail can be followed north-westerly up the valley for about two thirds of a mile from the crossing, or say 250 yards past the creek draining Della Lake. It is reported that a trail formerly led from upper Drinkwater Creek to the southern end of Buttle Lake, north of the area. Old cuttings, beyond a sharp bend in the valley, about 2 miles north-westerly from Della Falls, may indicate where the old trail climbed northerly out of Drinkwater Valley. The writer saw no other evidence of the old trail to Buttle Lake.

General Character of the Area

The area is rugged and mountainous, many peaks are more

Plate I. Big Interior Mountain looking south-easterly from Mount Tom Taylor.

(Courtesy Department of Lands)

than 4000 feet above sea level. The highest are in the north-eastern part of the area where the main peak of Big Interior Mountain is more than 6100 feet, and jagged peaks of Mount Septimus reach about 6400 feet elevation. Average slopes from peaks to valley-bottoms are commonly steeper than 1500 feet per mile and in several sections exceed 3000 feet per mile. Steep high bluffs are common; on the western side of Drinkwater Creek, above Della Falls, bluffs rise more than 2000 feet in a horizontal distance of less than half a mile. Above 3000 feet elevation the surfaces on which vegetation grows are less extensive than those of bare rock, scree and ice. The bare tops of many granitic ridges are rounded and there is open upland country north of upper Drinkwater Creek, but throughout the area mountains and ridges of Mesozoic volcanics are both steep and jagged. Great accumulations of talus are found at the foot of high bluffs; and the upper parts of the main valleys and branch canyons entering them contain great angular blocks of rock which make some parts almost impassible.

In their lower courses the main stream valley-bottoms are a quarter of a mile wide or wider, and the streams have moderate gradients. In the last 11 miles of its course Bedwell River has an average gradient of about 80 feet per mile and toward the mouth meanders in a narrow gravel flood plain. Many tributary streams rise in deep cirques or basins, flow through deep narrow canyons and cascade down the last steep slopes to the bottom of the valleys of the main streams.

A number of small glaciers in the area are indicated on (Fig. 1), many smaller snow masses last throughout the year. There are some beautiful lakes at high elevations. The waters from several of these lakes cascade more than 1500 feet to the floor of Drinkwater Valley and suggest the possibility of high-head water-power development. Most of the lakes are crystal clear, but the waters of Cream and Beauty Lakes, in the north-eastern part of the area, contain glacial rock-flour in suspension which from a distance gives them a curious opaque green appearance.

Red cedar, hemlock, balsam fir, spruce, Douglas fir, and yellow cedar, grow in the area. Hemlock and balsam fir trees of fair size continue to elevations of 2000 feet, and trees large enough for mining purposes are found locally to elevations of about 4000 feet. To elevations of 2000 feet or so there are patches with heavy undergrowth and below 1000 feet elevation underbrush is common. Yew thrives up to about 4000 feet elevation and on some steep slopes the matted growth is almost impenetrable. At high elevations heather grows where there is soil, and a few annuals are to be found blooming in high basins in August and early September.

Climatic records are not available for points within the area, but 37 years' records of precipitation, and mean minimum temperatures for the years 1931 to 1938 inclusive, at Clayoquot, 16 miles south-westerly from the head of Bedwell Sound are available. For Clayoquot, (a) the average annual precipitation exceeds 107 inches of water, for the 6 lowest months the average monthly precipitation in inches is: April, 7.63; May, 5.90; June, 3.75; July, 2.32; August, 3.17; and September, 6.37. For the other 6 months the monthly averages range from 10.22 to 16.12 inches. In average mean minimum temperature February at 36 degrees fahrenheit is the lowest month, and August at 52 degrees is the highest. Local report, confirmed by the writer's experience in the two field seasons, is that precipitation on lower Bedwell River is more than at Clayoquot. Precipitation throughout the area is heavy. At higher elevations many feet of snow fall each year, and much snow lasts well into the summer. Comparison of photographs taken in 1937 and 1940 with some published in 1906 and 1916 indicate that in the large cirque in Big Interior Mountain there has been a great decrease in the size of the snow mass.

In periods of lowest run-off, many branch-creeks are dry. Many of the beds of tributaries of the Bedwell River are dry crossing the floor of the main valley; and a considerable section of the bed of upper Drinkwater Creek is dry also, although there is a fair flow above and below the dry section. The steep slopes, and in the higher elevations the lack of soil and vegetation, make for very rapid run-off. Dry stream beds become torrents after a day's rain, the larger streams may increase their flow many fold and, in canyon sections, have risen more than 20 feet after prolonged rain.

Field Work and Acknowledgements

In 1939 the writer's party reached the head of Bedwell Sound on July 28th and spent until September 15th mapping the geology and examining prospects in part of the area drained by Bedwell River. E. P. Williams was employed as assistant. Bulletin No. 8, 1940, was based on this work. In 1940, assisted by J. H. Bennett, the writer spent from July 5th to August 20th mapping geology and examining prospects in the part of the area drained by Drinkwater Creek. The party then

(a) Data from, "Climate of British Columbia, Report for 1940, Province of British Columbia, Department of Agriculture."

went to the head of Bedwell Sound via Great Central Lake, Port Alberni, and Tofino, and thence as soon as possible to upper Bedwell River. This roundabout journey, of about 150 miles, took the party from the Sherwood base camp, east of Big Interior Mountain, to the You camp, on the western slopes of the mountain, less than 4 miles in a straight line. The long route was taken because it was impracticable to back-pack supplies and equipment up the Della Falls trail and through Bear Pass. As it happened heavy rain began on August 20th and continued until the 22nd so that little time usable for mapping was lost by the long move. Work in the Bedwell River part of the area was continued until September 17th. Additional mapping was done along the eastern contact of the Bedwell River batholith, and some other areal mapping was done farther west, but most of the time was devoted to mapping and sampling the new workings on the Musketeer and Buccaneer properties. In August 1939 weather was generally favorable for field-work, but from August 27th until field-work was stopped there were very few dry days. The 1940 season was wetter, of 75 days, 31 had almost continuous heavy rain, or rain with interludes of fog. Some traverses were made in drenching rains, but plane-table mapping and photography were impossible in such weather.

The current activity had its beginning so recently that prospecting and development were still in comparatively early stages, and trails and living accommodation were limited. Prospectors and mining companies were generous in supplying information and assistance. The writer is indebted to Messrs. Bloedel, Stewart and Welch, for transportation on the Drinkwater Creek railway and by steamer down Great Central Lake. The party lived for considerable periods in the Musketeer, Sherwood and Buccaneer camps and at Carl Noel's cabin at 3-Mile on the Bedwell River. Accommodation in these established camps was particularly welcome because of the wet weather. Plans and other information concerning the Buccaneer, Musketeer and Sherwood properties were made available by company officials, information concerning located claims was supplied by the Mining Recorders for the Alberni and Clayoquot Mining Divisions, and concerning Crown-granted claims by the Registrar, Land Registry Office, Victoria. The writer gratefully acknowledges his indebtedness for information, hospitality, and other kindnesses, without which the field-work could not have been done nor the information for this bulletin obtained.

References

Published information on the area is found in: Annual Report, Minister of Mines, British Columbia, 1898 to 1933; Bulletin No. 8, British Columbia Department of Mines, 1940;

Memoir 204, Geological Survey, Canada. published in 1937; and Map 196-A, Vancouver Sheet, Geological Survey, Canada, issued 1928. The Annual Reports, Minister of Mines, British Columbia, contain some general information concerning the area, progress notes, and some details concerning properties. In Memoir 204, M. F. Bancroft summarized geological information from other sources; and summarized references to properties in the area which had appeared in the Annual Reports of the Minister of Mines. So far as the writer knows Bulletin No. 8, 1940 contains the first published map showing geology of the area except "Map 196-A" which shows the geology immediately at the head of Bedwell Sound.

Bibliography

The following is a bibliography of publications dealing with Vancouver Island and of some interest in interpreting the geology of the map-area.

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18. Minister of Mines, British Columbia, Annual Reports - 1898 to 1938.

19. Sargent, H. - Preliminary Report on the Bedwell River Area, Vancouver Island, British Columbia - Bulletin No. 8, British Columbia Department of Mines, 1940.

20. Stevenson, John S. - Lode-Gold Deposits of the Zeballos Area, British Columbia Department of

Mines, 1938.

21. Young, G. A. and Uglow, W. L. - The Iron Ores of Canada, Vol. 1, B. C. and Yukon, Geol. Surv., Canada, Economic Geology Series No. 3, 1926.

In the following pages some specific references to these publications are indicated by the numbers corresponding with the publications in the foregoing list.

GENERAL GEOLOGY

Previous Geological Mapping in and near the Map-area.

Two maps, "Vancouver Sheet" (11) and "The Buttle Lake Map-area" (13), published by the Geological Survey, Canada, at eight miles to the inch, show geology adjoining or close to the Bedwell River-Drinkwater Creek map-area.

The Vancouver Sheet, issued in 1928 is a compilation of geological information concerning south-western British Columbia, and includes a narrow strip along the west coast of Vancouver Island. The rocks at the head of Bedwell Sound are indicated as belonging to an assemblage of volcanic and sedimentary rocks of Triassic and (?) Jurassic age.

The Buttle Lake map-area, mapped by Gunning in 1930, extends a little farther west and a good deal farther east than the Bedwell River-Drinkwater Lake map-area. The southern boundary of the Buttle Lake map-area, 49 degrees 30 minutes north latitude, is approximately the northern boundary of the Bedwell River-Drinkwater Creek area. Along the common boundary from west to east, Gunning mapped about 10 miles as "Jurassic and or Cretaceous, Coast Range Intrusives", thence easterly, "Palaeozoic and Mesozoic, Volcanics and Sediments", which continue for some miles past the eastern boundary of the Bedwell River-Drinkwater Creek area.

Units Mapped

In the Bedwell River-Drinkwater Creek area unconsolidated material has been mapped where it obscures the bed-rock over a considerable area, and bed-rock has been mapped as two major units one of which has been subdivided into three parts, as set forth in the following table:

Recent

Unconsolidated material

Mesozoic

Jurassic and, or, Cretaceous
(Coast Range), - granite rocks, chiefly quartz-diorite.

Palaeozoic and Mesozoic

Chiefly Lower Mesozoic
(Vancouver Group), - andesite, basalt, fine-grained impure tuffs, limestone.

Permian, - limestone, in part recrystallized, includes at some points overlying thin bedded siliceous and tuffaceous (?) argillites.

Complex stratigraphically below the Permian limestone; volcanics, tuffaceous and argillaceous sediments, of Palaeozoic age; basic instrusives, related to Lower Mesozoic volcanics; and granitic intrusives (Coast Range).

Distribution of Formations

Palaeozoic and Mesozoic

In the eastern part of the area Palaeozoic and Mesozoic rocks are continuous with Gunning's (13) Palaeozoic and Mesozoic, and confirmation of age was obtained in fossiliferous limestone which has been assigned to the Permian. Three subdivisions of the Palaeozoic and Mesozoic rocks will be discussed later.

The volcanic rocks at the head of Bedwell Sound in the south-western corner of the map-area, shown in the Vancouver Sheet as part of an assemblage of volcanic and sedimentary rocks assigned to the Triassic, are separated by drift-filled valley bottoms, the Penny Creek intrusive, and unmapped sections, from volcanics and sediments exposed to the north and east between river level and elevations well above 5000 feet, and extending north-easterly to the Bedwell River batholith. This assemblage is regarded as part of the youngest of the three subdivisions.

Coast Range Intrusives.

The Bedwell River batholith, chiefly quartz-diorite, from 4 to at least 6 miles wide, crosses the area and occupies about half of it. The contacts have been mapped for some distance northerly and south-easterly from Bedwell River in the western part of the area, and following a similar course in the eastern part. Extending from about the south-eastern corner of the area to a line running south-westerly from Bedwell Lake, the batholith, where not traversed closely, has been indicated by a pattern, and these parts may contain roof pendants. Continuing north-westerly the ground was not seen by the writer but is almost certainly occupied by the batholith, which may extend farther west than indicated. Gunning's mapping immediately to the north shows "Coast Range Intrusives" for some distance farther to the west.

In the western part of the area a smaller mass of quartz-diorite, through which Penny Creek cuts, will be called the Penny Creek intrusive. Heavy overburden prevented accurate mapping of the outline of the southern end of this intrusive west of Penny Creek. The intrusive continues north-westerly beyond the part which has been mapped.

Minor intrusives, too small to be represented on the map, include in the Palaeozoic and Lower Mesozoic rocks innumerable dykes and less regular masses of granitic rock, related to the larger intrusives. Later dykes intrude the larger masses of granitic rock, and also intrude the Palaeozoic and Lower Mesozoic rocks where they are less conspicuous. These later dykes, of which the age has not been determined, are provisionally included with "Coast Range Intrusives".

The Problem of Correlation Across the Batholith

The Bedwell River batholith forms an unbridged gap between rocks older than it in the eastern and in the western parts of the area, and there is no mapping which bridges it within 50 miles to the north-west of 30 miles to the south-east of the boundaries of the area. Correlation across the gap is further complicated by the following facts; the older rocks represent a series some thousands of feet thick, generally of fine-grained volcanic rock much of which is in intrusive relationship with the rest; the lithological differences are insufficient to differentiate the members definitely where the structure is complex; there is a great deal of fracturing, and where marker horizons are present there is evidence of faulting on a large scale.

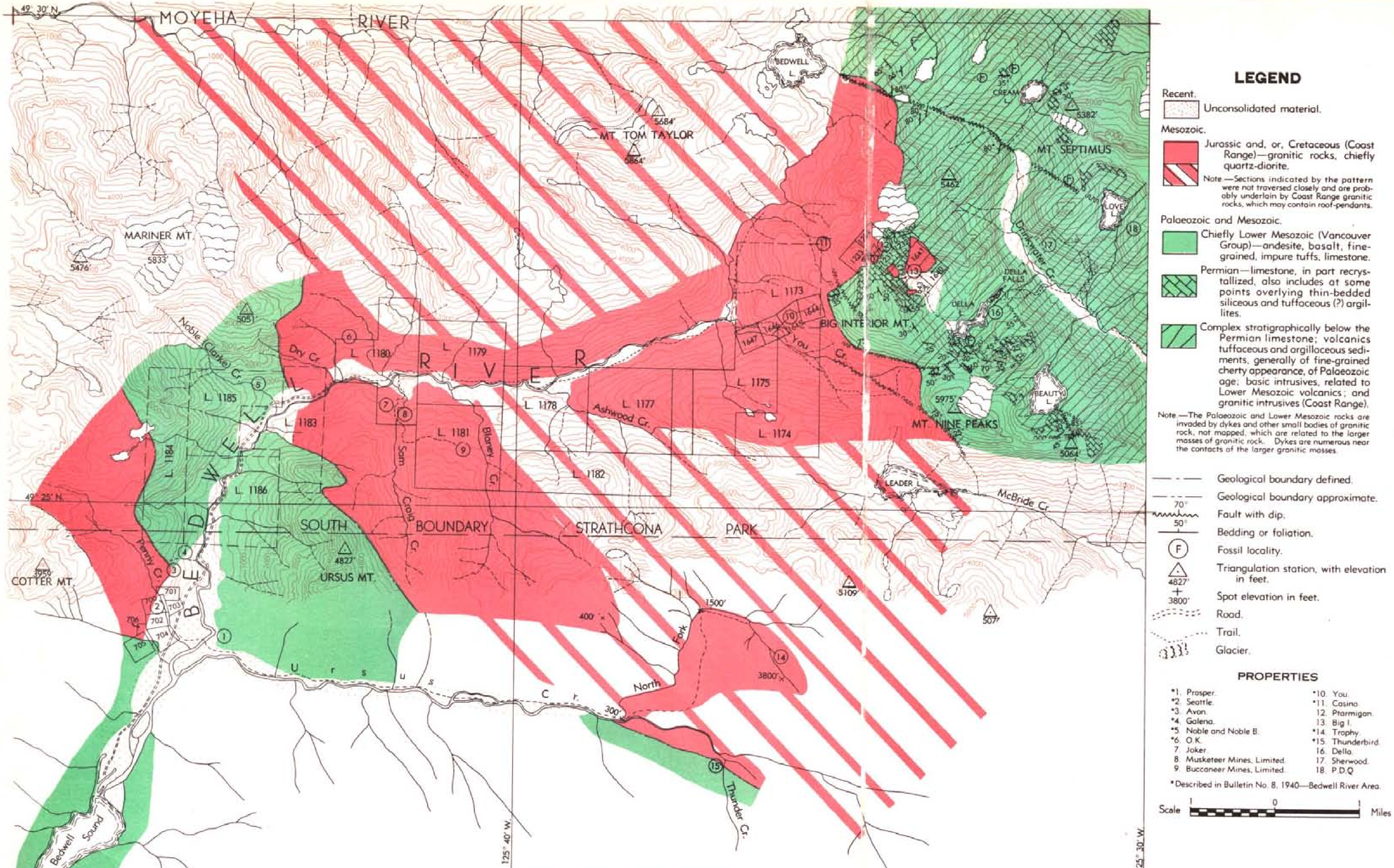


Fig. 1. Bedwell River-Drinkwater Creek Area.
(contour interval 200 feet)

Topography from British Columbia Department of Lands
Map 92 F/5.

BULLETIN #13

Subdivision of Palaeozoic and Mesozoic Assemblage

The thick assemblage of volcanic and sedimentary rocks mapped as "Palaeozoic and Mesozoic" has been subdivided into three units, indicated by patterns on (Fig. 1). The middle member is a limestone formation of which the age has been determined, on fossil evidence, as Permian. The rocks stratigraphically below the limestone are mapped as a complex of pre-lime volcanics and sediments, intrusives probably related to the Lower Mesozoic volcanics, and granitic rocks related to the Bedwell River batholith. These two units were found only in the eastern part of the area. Overlying the limestone horizon, volcanic rocks are mapped as Vancouver group chiefly Lower Mesozoic. The volcanic and sedimentary rocks found south-west of the Bedwell River batholith are also put in this unit. This appears to be justified by Gunning's work in the Buttle Lake area, to be referred to later, and by the previous mapping represented on the Vancouver Sheet.

Clapp (3, 4 and 5) differentiated the Vancouver group in southern Vancouver Island, but had not definitely established its relationship to a formation immediately underlying it. In the Buttle Lake area Gunning found Permian limestone and describes the series overlying it under the name Vancouver group, but on his map did not differentiate between the Palaeozoic and Lower Mesozoic rocks. Concerning subdivision of the Palaeozoic and Mesozoic assemblage he said, (13 pages 59A and 60A):

> "The quite definite statement by Miss Fritz places the fossiliferous limestone in the Permian. The considerable thickness of volcanic rocks and other sediments lying stratigraphically below the limestone and well exposed in the area may, however, be Pennsylvanian or older. It does not seem advisable as yet to give these Palaeozoic rocks a definite formational or group name. When their age, characteristics, etc., are more fully known, the name Buttle Lake group or formation for all or part of them is suggested. That they should be separated definitely from the overlying Vancouver group, even though possibly conformable with it, is self evident and it is interesting to note a remark Dawson made years ago in this connection (6), -- 'If this great mass of rocks (Vancouver series) should eventually prove separable into Triassic and Carboniferous portions, I would suggest the retention of the name Vancouver series for the former.'"

Palaeozoic and Mesozoic Complex

The rocks stratigraphically below the Permian limestone are exposed through a range in elevation of at least 2500 and probably 3500 feet. They include rocks older than the limestone, basic intrusives probably related to Lower Mesozoic volcanics, and grantic intrusives related to the Bedwell River batholith. As the relationships are involved and the elements are often small, this assemblage is therefore mapped as a complex; included within its boundaries, there are masses of Permian limestone too small to be shown on the map.

The complex consists largely of fine-grained cherty-looking greenish volcanic rock, of which a good deal may be altered siliceous tuff. Fine-grained argillaceous rocks, some of which are tuffaceous, are also to be found, and thin-bedded light-coloured siliceous sediments were found near the north-eastern end of Della Lake and near the pass at the head of Drinkwater Creek. In many instances the stratified rocks are in blocks which might be regarded as large elements in fragmental volcanics. At some points there are larger masses of sedimentary rock, which show small scale folding, but it was not possible to trace them more than a few hundred yards.

Basic volcanics form a minor part of the complex but close to the limestone they are much more abundant. They intrude the limestone, and are doubtless related to lavas which overlie it. East of the cirque in Big Interior Mountain, and on the southern side of the ridge between Della and Beauty Lakes, basaltic rock is present in large volume and appears to be in intrusive relationship. This rock shows marked changes in texture in distances of a few inches. It ranges from fine-grained to moderately coarsely granular; and in part consists of rounded cobbles in a matrix, both of which are essentially of the same material. This rock appears to be an intrusive breccia, and is probably related to the Mesozoic lavas. Clapp refers to a similar occurrence, as follows, (3 page 55):

> "A peculiar type, apparently related to the basalt porphyrite, is exposed on the east shore of Alberni Canal, a mile and a half north of Coleman Creek. It is an agglomerate with angular to rounded fragments of volcanic rocks ranging from aphanitic types to relatively coarse grained basalt porphyrites; and may represent an old volcanic neck."

Basic rocks are also found along the fault on the upper Drinkwater Creek; and easterly from the bend in the creek, on steep slopes rising from the fault-draw, some amygdaloidal types are found. It seems probable that the fault may have formed a channel for the ascending lavas, and it is noteworthy that amygdaloidal types are rather common in the Vancouver group and rare in the rocks older than the Permian limestone.

North and south of the divide at the head of Drinkwater Creek the rocks of the complex, including rock which appears to be sheared flow-breccia, are strongly foliated. The foliation generally strikes northerly and dips steeply westward. Granitic dykes and some dykes of diorite cut the foliation. Aplite from 1/2-inch to a few inches wide, apparently in the nature of lit-par-lit injections, is found in the foliated rock. Some of the aplite has a foliated appearance doubtless inherited from the schist, and some grades into quartz-diorite dykes.

In the complex, particularly near the contact with the Bedwell River batholith, there are many dykes and less regular masses ranging from quartz-diorite to feldspar-porphyry, some of which pass gradationally into dark dybrid types, difficult to identify by themselves. Rocks of the complex, more or less completely granitized, were found at several points, notably north of the glacier on Big Interior Mountain. Here the contact was drawn rather arbitrarily between granitic rock containing more or less altered xenoliths on the one hand and incompletely granitized rocks containing numerous granitic dykes on the other.

Permian Limestone

In the eastern part of the map-area isolated masses of limestone make up about 7 per cent of the triangular area in which they are found. From a point on the western side of Big Interior Mountain, the base of the triangle extends south-easterly about 3 3/4 miles to a point south-east of Beauty Lake; the apex, about 4 1/2 miles from the base, is on a mass of limestone north-east of Price Creek in the north-east corner of the map-area. The triangle has an area of about 8 1/2 square miles; within it 20 masses of limestone, with a combined area of about two thirds of a square mile, are shown on the map, and there are other masses too small to be shown.

Although accessible exposed margins are faulted or are contacts with basaltic or granitic intrusives, the isolated masses of limestone are believed to belong to one horizon. This conclusion is supported by the following facts: (1), fossils in the various masses appear to belong to the same group; (2), the same sequence of beds can be recognized in many of the outcrops; (3), aside from minor folds, the beds have a rather uniform attitude throughout the area in which the limestone is found; (4), wherever the rock overlying the limestone formation is exposed it consists of basalt much of which shows well marked pillow structure, this rock is markedly different from the major part of the rocks underlying the limestone. It therefore seems reasonable to take the top of the limestone horizon as the base of the overlying Vancouver group.

The Permian limestone is the only conspicuous horizon marker in the assemblage of Palaeozoic and Mesozoic rocks. It serves to indicate definitely faulting on large and on small scales. It is also important because it contains well preserved fossils which serve to date the formation. Economically it is of some interest, as on Big Interior Mountain some copper-bearing mineralization has been found at contacts between the limestone and basalt, near the Bedwell River batholith.

The limestone formation consists principally of thick light grey-buff or almost white beds, which have a faint purple cast, and much of it is recrystallized. In most of the exposures, thin-bedded, siliceous and probably tuffaceous, argillites were found, usually separated from the limestone by from 10 to 200 feet of black basalt which is intrusive into the limestone. The thin-bedded sediments, often folded or contorted and partly destroyed, are also dyked and overlain by the basalt. They were always found above the thick-bedded light-coloured limestone, below which in a number of instances dark grey to almost black limestone was the lowest part of the formation exposed. The thick-bedded dark lower beds and overlying light-coloured limestone contain fossils. Some beds are made up almost entirely of crinoid stems and discs; and a great deal of dark grey to almost white chert is found in the limestone.

Aside from recrystallization, accompanied by destruction of bedding-planes and fossils, the limestone shows very little effect of metamorphism. Some of the recrystallized limestone has undoubtedly flowed under stress. Garnets, epidote, amphibole, some magnetite, and also at a few points sulphides, are found, mostly near the main peak of Big Interior Mountain, where the limestone is in contact with basalt near the batholith, or in contact with the quartz-diorite batholith.

Fossils seen in the limestone were usually difficult to recover; but in a small mass shown about a quarter of a mile north-west of Cream Lake (Fig. 1), and in a smaller mass not shown lying a quarter of a mile farther west, weathering caused the fossils to stand out on the surface and they were quarried with less difficulty. These were in steep northern exposures of southward dipping beds. The smaller mass, measuring about 100 feet normal to the beds, almost entirely surrounded by snow, appeared to be a faulted remnant. The lower beds are of very dark limestone, succeeded upward by lighter grey-buff beds. The larger mass to the east has an exposed thickness of about 250 feet, normal to the beds, and is overlain by basalt. The lower beds here too are dark and it was found difficult to recover fossils from them, but the light-coloured overlying beds yielded a good collection. Fossils from the two masses were collected from beds, some of which have a sandy texture, in the 50 feet above the top of the dark lower measures. They included 3 varieties of corals, several brachiopods, also abundant crinoid stems and discs. A fourth coral "Syringopora" was found east of Drinkwater Creek on the north-eastern side of the fault-draw which runs to a divide between Drinkwater Creek and Love Lake. These fossils, with some from near the south-western corner of Della Lake, were sent to the office of the Geological Survey at Ottawa. Dr. Alice E. Wilson kindly classified them as follows:

Corals:

Zaphrentis species
Cyathophyllum species
Syringopora species
Michelinia species

Crinoid discs

Brachiopoda:

Productus species of the *Productus vishnu*-type
Orthothetes species close to a species on Timor Island
Reticularia species
Spirifer species of *Spirifer musakheylensis*-type
Spirifer species fragmentary but about *Spirifer rajah* Salter
Dielasma species about *Dielasma problematicum* Waagen

Dr. Wilson reported further:

"Though the corals are certainly of late Palaeozoic age, they in themselves are not sufficient to ascertain the exact age."

"The rocks of the brachiopod locality are of Permian age."

The best preserved brachiopods were quarried from the limestone north-west of Cream Lake, which is thus established as Permian. Limestone on the south-eastern side of Cream Lake contains similar fossils. This mass is separated by a distance of more than half a mile from the mass north-west of the lake and there is evidence of much faulting. However it is reasonable to assume that these masses belong to the same horizon. The mass on the south-eastern side of the lake is intruded and overlain by basalt, and above a considerable thickness of basalt, the thin-bedded siliceous sediments are exposed. From the lowest bed exposed, the limestone extends upward southerly to intrusive basalt, a distance estimated at 225 feet normal to the beds. The basalt measured in the same way is about 210 feet thick, and a remnant of recrystallized limestone on top of the basalt is about 50 feet thick. Thus limestone exposed in this section is 275 feet thick. Allowing for the missing dark lower beds and the thin siliceous beds at the top of the formation, it is safe to say that the original thickness cannot have been less than 350 feet.

On the western side of the cirque in Big Interior Mountain, limestone is exposed in inaccessible cliffs which rise to a maximum height of 700 or 800 feet. The limestone in the talus below the cliffs is lithologically similar to that observed elsewhere and some similar fossils were seen in it. Banding on the cliffs suggests bedding-planes of low dip. The exact attitude and therefore the thickness could not be determined. The thickness suggested by the exposure is greater than was seen elsewhere and this mass might belong to a lower horizon.

Not far outside the area limestone masses, probably belonging to the highest Permian formation, are found south-easterly from Love Lake; and farther to the south-east there is limestone well up the north side of Drinkwater Valley. References to limestone north of the area are contained in passages by Gunning quoted later. These include outcrops, which the writer saw from the distance, on the ridge north-east of Price Creek, north-westerly from the mass shown north-east of Price Creek, (Fig. 1).

The limestone on the north-eastern side of Price Creek was mapped from airplane and ground station photographs. It was not examined by the writer but was easily recognized from the south-western side of the creek. It terminates abruptly at its north-western margin. as is seen clearly in the field and on the photographs. The south-westerly projection of this margin follows the straight south-eastern side of Cream Lake, and continues down the steep side of Drinkwater Valley in a narrow draw. This seems definitely to mark a fault; and the limestone south-east of Cream Lake, which must be upthrown relative to the mass north-west of the lake, is on the south-eastern side of the same fault. The limestone indicated on the north-eastern side of Price Creek most probably belongs to the same horizon as the masses south-east and north-west of Cream Lake; and probably limestone farther northerly on the ridge north-east of Price Creek also belongs to the same horizon.

In the Buttle Lake area Gunning found limestone in the Palaeozoic rocks (13 page 59A) - -

> "The oldest known rocks within the area were found in the vicinity of Buttle Lake. They consist of a thick series of volcanic rocks including andesitic to basaltic flows, tuffs, and coarse volcanic breccias with at least two and probably three interbedded horizons of white, grey, or pink, crystalline limestone and minor amounts of argillite and quartzite. The uppermost horizon of limestone is the only one that is well exposed for any distance. In it, around the headwaters of Marble Creek, are many well-preserved fossils from which several collections were made."

The headwaters of Marble Creek are about 12 miles north-westerly from Cream Lake. Based on the fossil evidence this limestone was placed in the Permian. Concerning limestone elsewhere in the Buttle Lake area Gunning says, (13 page 60A) - -

> "This same uppermost limestone horizon is well exposed along the summits on the west side of the south fork of Wolf River dipping to the west, and extends to the north across the head of the north fork of that river. What is almost surely the same horizon is again exposed on the slopes on the east of Price Creek from the south end of Buttle Lake to the southern boundary of the sheet, dipping at low angles to the east."

In the Bedwell River-Drinkwater Creek area, the incomplete and isolated limestone exposures suggest a considerable range of thickness in the limestone as originally deposited, which in turn suggests deposition in local basins. It will be noted that the fossils found consisted of several corals, a number of brachiopods and abundant crinoid discs or stems. On Marble Creek in the Buttle Lake area Gunning found abundant bryozoa, some brachiopods and a few crinoid stems. Both collections have been classified as Permian. It seems probable that they were deposited within a limited range of time in local basins which may account for the differences in fauna which accumulated or were preserved.

Vancouver Group

Immediately above the Permian limestone on Mount Septimus, on the south peak of Big Interior Mountain, and on Mount Nine

Peaks, the rock is basalt some of which shows well-developed pillow structure. Lithologically this rock resembles the basalt found intruding and spreading out over the top of the limestone formation. It is thus the lowest and probably the oldest member of the Vancouver group, albeit the more granular basalt is usually remarkably fresh in appearance both in hand specimens and microscopically. It consists esentially of labradorite and augite, with a good deal of magnetite, and contains some chlorite and carbonate. Similar rocks are exposed in the peaks to elevations 1200 to 1500 feet higher than the limestone on the slopes. There has been so much faulting and granitic dykes are so numerous that the stratigraphic distances of the summits above the limestone are hard to estimate, probably they are of the order of 1000 to 2000 feet.

There can be little doubt that the thick assemblage of volcanic and sedimentary rocks, exposed from Bedwell River level to 4,800 feet elevation on Ursus Mountain, and to 5,800 feet elevation on Mariner Mountain, is part of the formation exposed along the shores of Bedwell Sound and mapped as Triassic and (?) Jurassic on the Vancouver Sheet. It resembles lithologically and most probably is the same age as the Vancouver group in the Buttle Lake area, in which Gunning found Triassic fossils, (13 pages 61A and 62A), and accordingly has been mapped as "Chiefly Lower Mesozoic, Vancouver group".

The stratigraphic position of these rocks cannot be worked out from available data, but it is probable that this assemblage represents a section considerably above the base of the formation exposed on the other side of the batholith in the eastern part of the area. On the south-western side of the batholith the rocks of the formation consist chiefly of rather fine-grained andesites, and black or dark-green basalts including amygdaloidal varieties with light-green amygdules standing out on the weathered surfaces. Float of volcanic breccia was found in the Bedwell River, but this rock was not observed in place. With the volcanics are included andesitic and basaltic dykes, resembling the normal volcanics, often difficult to distinguish from them and believed to be closely associated in origin with the volcanics. Some rocks observed on Mariner Mountain are probably greatly altered tuffs. In general the rocks of the Vancouver group are massive, fine-grained and so altered that the structure is obscured. Seen from a distance these rocks are of a very dark-brown colour. There are also some lenses of recrystallized limestone, more or less replaced by silicates, magnetite, and sulphides, near the Penny Creek intrusive on the Seattle and Avon properties. On the Seattle property basic volcanic rock may have been more completely replaced by garnet, epidote, magnetite, pyrite and chalcopyrite than has the limestone beside it.

Clapp (3 pages 44 to 94) gives a detailed description of the Vancouver group in southern Vancouver Island and Gunning (12 pages 100A to 106A) has described the group as found in northern Vancouver Island. Bancroft (1 page 11) refers to limestone beds outcropping at the head of Cotter Creek, which flows westerly into Herbert Arm; and Dolmage (10 page 15A) refers to thin beds of limestone on Bedwell Sound and Herbert Arm.

Coast Range Granitic Rocks

Granitic rocks in the Bedwell River batholith and in the Penny Creek intrusive, underlie a large part of the Bedwell River-Drinkwater Creek area. Innumerable dykes and less regular masses of granitic rock related to the larger masses cut the members of the Vancouver group and older rocks. These granitic rocks are themselves cut by andesite and dacite dykes and by at least one mass of peridotite.

In southern Vancouver Island, Clapp (4, 5 and 6) mapped various bodies of intrusive igneous rock which he regarded as all belonging to one general period of intrusion, -- "correlated with the irruption of the Upper Jurassic Coast Range batholith" -- (5 page 14). Minor intrusives later than the main batholiths were regarded as possibly extending into the Lower Cretaceous period. The Beale diorite and Saanich granodiorite and quartz-diorite, the most widespread types in the northern and western parts of southern Vancouver Island, were regarded as closely related to each other and also to the gneissic intrusives near the south end of the Island. In Northern Vancouver Island Gunning (12, 13, 14 and 15) mapped rocks of the same general types, as "Coast Range Intrusives," and assigned them to the Jurassic and/or Cretaceous periods.

The granitic intrusives in the Bedwell River-Drinkwater Creek area are doubtless of the same age and related to the Coast Range Intrusion. The most widespread varieties are light-coloured and often weather to a chalky-white. They show considerable differences in texture, but in general have feldspar grains not more than 2 or 3 millimeters across. Quartz ranges from small interstitial grains to phenocrysts which may be 7 or 8 millimeters across. The average rock of the Bedwell River batholith is quartz-diorite with quartz forming from 15 per cent. to 30 per cent. of the whole. The feldspars consist chiefly of oligoclase-andesine; alkali-feldspar, orthoclase and microcline, rarely forms as much as one third of the total feldspar. The Penny Creek intrusive is richer in orthoclase and approaches the composition of granodiorite in which, according to the classification used, the ratio of alkali-feldspar to soda-lime-feldspar is not less than three to five or more than five to three. The femic minerals are usually altered, hornblende is recognized in elongated laths and there is some biotite. Chlorite is found, apparently replacing biotite and hornblende, and with epidote and sericite replacing feldspar. Tiny grains of apatite are found usually as inclusions in the quartz grains, but in sections from some parts of the area apatite crystals are present as inclusions in feldspar. Normally, the rock has a pale-green cast, due to the altered femic minerals, but in some sections the surfaces are brown with iron oxide.

Along the eastern margin of the batholith, usually where it is in contact with basalt, a variety of quartz-diorite, much richer in femic minerals and therefore much darker than the main mass of the batholith, is observed. It contains 65 to 75 per cent. oligoclase-andesine, 10 to 25 per cent. quartz, and 10 to 15 per cent. femic minerals, consisting of hornblende, biotite and magnetite in varying proportions. This rock appears to be an early phase of the intrusive; it is found in irregular masses dyked by the usual variety of quartz-diorite, but the relationship of the two is often very much involved. Some of this dark quartz-diorite contains numerous fragments of basalt, but it is usually homogeneous

Rather fine-grained diorite outcrops at some points on the margin of the Penny Creek intrusive. Thin sections from two points consist essentially of oligoclase with abundant hornblende and some orthoclase. One section contained a little quartz and the other some titanite; both were altered, the feldspars and the hornblende being attacked by a carbonate mineral. Similar diorite was found on the western side of You Creek, south of the You group, near a small pendant or foundered mass of basic volcanic rock. The diorite may belong to an early phase of the intrusion.

In the older rocks near the margins of the batholith the numerous granitic dykes show a considerable range in composition and texture. Some closely resemble the facies of the main batholith in which quartz phenocrysts are conspicuous, and are thought to represent dykes connected with the early phase of the main intrusion. Similar rocks of more uniform texture are through to be later. Feldspar-porphyry dykes, including a facies marked by elongated laths of hornblende, cut the dykes with conspicuous quartz phenocrysts. The

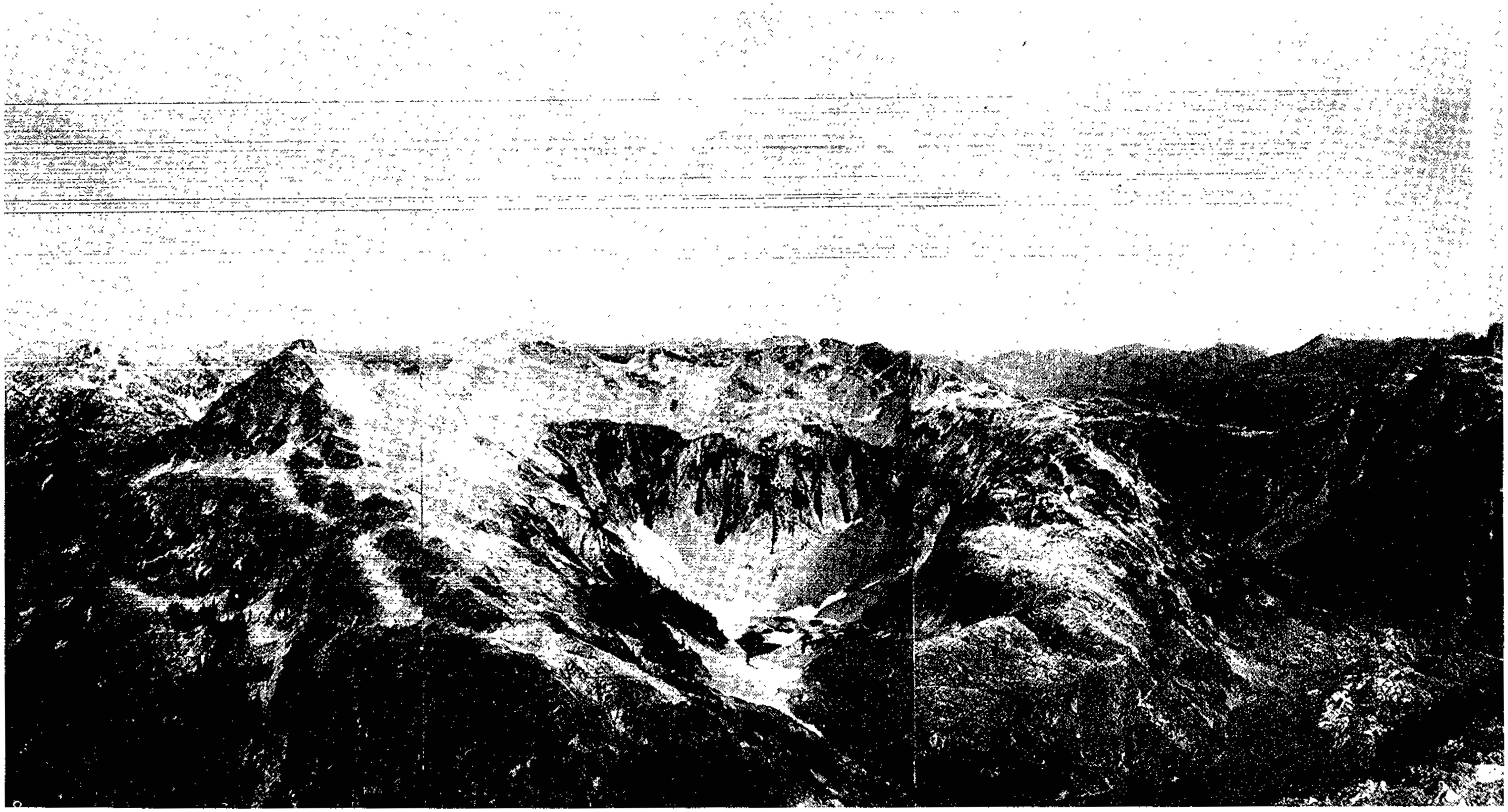


Plate II. Panorama looking northerly into cirque--
Big Interior Mountain.

(Courtesy Department of Lands)

feldspar-porphyry consists of phenocrysts of zoned plagioclase, about andesine or andesine-labradorite, up to 3 or 4 millimeters long, in a very fine-grained groundmass. Some of these dykes contain laths of hornblende, of these some have a brown or purple colour, which seems to be in the groundmass. The quartz-diorite dykes with conspicuous quartz crystals, and to some extent the other dykes, are found merging gradationally with the older rocks which they apparently replace. Passing from normal porphyritic quartz-diorite, the groundmass becomes very dark and the phenocrysts are unusually conspicuous by contrast, this rock grades to fine-grained material which is hard to identify unless it can be traced to the normal dyke type. Other porphyritic hybrid types resemble some of the porphyritic volcanics. These rocks are usually altered, and contain secondary minerals. Granitization, producing light types, at points on the eastern contact of the Bedwell River batholith has been mentioned under "Palaeozoic and Mesozoic Complex".

Later Dykes

A number of dykes of andesite and dacite are found cutting the Bedwell River batholith and the Penny Creek intrusive; and a dyke of peridotite, about 75 feet wide, cutting the batholith, is exposed in the bed of Sam Craig Creek about 1 2/3 miles from its confluence with Bedwell River. The dykes also cut the rocks older than the granitic intrusives, but are less conspicuous here and might easily be mistaken for some of the dykes related to the Mesozoic volcanics. These dykes are usually altered hydrothermally, and in the batholith are cut by veins. There appears to be no other information available that would fix the age of these dykes, which are later than the main granitic intrusion.

Structural Features

The relationships of the different members of the Palaeozoic and Mesozoic complex stratigraphically below the Permian limestone, and the Vancouver group above the limestone, are difficult to establish because of lithological similarities, intrusions, and the metamorphism of the rocks. The Permian limestone in the eastern part of the area is a conspicuous horizon marker and serves to indicate faulting on large and small scales. Unfortunately this rock is found in a small part of the area only, where it is in isolated masses separated by faulting, erosion, and intrusives.

Bodies of Permian limestone north-west and south-east of Cream Lake, in the north-eastern part of the area, are exposed at about the same elevations and have about the same attitudes, striking about east and dipping about 30 degrees southward. Faulting intervenes and points at the same elevation in the two masses are separated by about 1000 feet normal to the strike. The masses are 250 feet or more thick and no exact correlation has been made between corresponding beds. If the tops of the two exposures be taken as representating approximately the same horizon, the mass south-east of the lake has been uplifted 500 feet or more relative to the mass north-west of the lake. A short distance to the south-east a fault of large displacement trends south of west. It is readily followed from Bedwell Lake past Love Lake, marked by the deeply trenched valley of Drinkwater Creek and by several draws all in the same alignment. That there has been displacement is clearly indicated here as limestone is cut off abruptly at the fault. South-westerly from the fault limestone is found on the ridge between Della and Beauty Lakes, and near the summit of Big Interior Mountain. Between these masses of limestone and the fault just mentioned it seems probable that there is another fault following a slightly more southerly course from Bedwell Lake and not so deeply trenched until it reaches the valley of Drinkwater Creek, which it then controls for about 3 miles extending south-easterly beyond the boundary of the map-area. The structure is complicated by other breaks striking east of north. Faulting has produced a substantial uplift of the limestone to the south-west relative to the limestone found at and north-easterly from the fault first mentioned. The fact that north-easterly from the first fault the limestone consists of a few small masses makes it difficult to work out the actual displacement.

Extending south-easterly from the head of Della Lake the limestone and the overlying thin-bedded sediments are folded in an open syncline of which the axis trends north-westerly. One limb of the syncline is exposed at the north-eastern edge of the glacier on Mount Nine Peaks, the other limb is exposed not far to the north-east on the northern side and crest of the ridge between Della and Beauty Lakes. Aside from such minor structures, where the beds are preserved, the limestone strikes within 30 degrees of due east and dips from 10 to 40 degrees southward. On the western side of Big Interior Mountain the dips are in a direction west of south, farther east the direction is nearly due south, and near the most south-easterly exposures the dips are in a direction east of south. These might be taken as indicating the nose of a fold plunging southward; but there has been so much faulting, the limestone has been so greatly affected by intrusives, and is in so many separate masses, that the existence of such a structure cannot be regarded as established.

Deeply entrenched valleys following straight courses, or draws in alignment on both sides of one or more summits, are common in the area. They appear to indicate rapid erosion along faults or fractures. Steep escarpments found along the trenches support this theory. The topographic features are very noticeable, many such trenches are conspicuous in the airplane photographs, and the topographic mapping also indicates them clearly.

Extending from the older rocks well into or across the batholith, deeply trenched valleys appear to mark a system of strong fractures or faults striking from north-west to west; and another system striking east of north. That they were in existence early in the period of granitic intrusion is indicated by early-phase granitic dykes along them. Other dykes suggest that previously some of the breaks served as channels through which Lower Mesozoic volcanics ascended. The fractures control parts of the contacts of the main intrusives. Continuations in the batholith are marked by late dykes and by hydrothermal alteration of the rocks along the trenches, indicating that opening of these breaks continued after the main granitic masses had consolidated.

ECONOMIC GEOLOGY

Introductory Notes

Early interest in mineral deposits in the area had to do with placer-mining on Bedwell River. This was followed by a period in which copper-bearing replacement deposits received attention. In the past few years the interest has been in veins carrying values in gold and some silver. After the writer left that part of the area in 1940, some work was done on silver-bearing mineralization discovered near Cream Lake in the north-eastern part of the area.

In the following paragraphs some general observations are made concerning "Gold-Bearing Veins", "Copper-Bearing Replacement Deposits", and "Placer-Mining". This is followed by a section headed "Properties and Mineral Deposits", which contains detailed descriptions of mineral deposits on several properties in the area. Descriptions of a number of properties, not found in this bulletin, will be found in a similar section of Bulletin No. 8 published in 1940.

In examining the various mineral deposits many samples were taken, to indicate the range of values and the values associated with certain types of mineralization. To delimit ore and to determine average values of gold-bearing veins which may return assays of several ounces per ton, would require much closer spacing of samples.

Mineral deposits are described under the names of the properties on which the writer believes they occur. When the properties were examined, few recently staked claims had been surveyed and therefore the exact boundaries were not marked; and it was impossible to find the corner posts of some claims surveyed years ago.

Gold-Bearing Veins

Fractures containing gold-bearing mineralization have been found in many parts of the area, in granitic and in volcanic rocks. Some of the more promising veins which have been discovered strike within a few degrees of north 20 degrees east, or north 65 degrees east. In the western part of the area veins of the first group are found standing almost vertically, or dipping steeply eastward; in the eastern part they are found dipping less steeply westward. Of the veins striking approximately north 65 degrees east almost all seen by the writer, dip from 45 to 70 degrees northward, but one dips steeply southward. Other veins in the area have diverse attitudes. In the Bedwell River batholith veins belonging to both groups are found following or cutting dykes of andesite or dacite, which in turn cut the batholith.

Most of the veins are fractures filled principally with quartz, some carbonate, and varying amounts of sulphides. Fragments of wall-rock, more or less replaced, may make up a minor part of the gangue, and commonly there is some gouge at the walls. Many of the veins have branches which diverge at small angles from the main fractures. Often the vein-mineralization is wider than average where a branch leaves the main fracture. Several of the veins have sections in which the width exceeds one foot, and in a few cases vein-filling reaches a width of 20 inches. The Sherwood vein consists of mineralization developed as vein-like or lenticular masses in a shear-zone, and the mineralization reaches greater widths than it does in the other veins. Some veins on which a little work has been done, consist of sheeted zones, in which vein-mineralization is developed along closely spaced branching, nearly parallel, fractures.

In the general part of this bulletin "vein" is used in a broad sense meaning a fracture or sheeted-zone, which may or may not show evidence of shearing, and which is filled essentially with introduced quartz, carbonate, or other gangue minerals, sulphides, and more or less sheared wall-rock. This broad sense includes fractures filled largely with vein-mineralization, or fractures filled largely with sheared wall-rock but containing vein-mineralization. In the section, "Properties and Mineral Deposits", "vein" usually has a narrower sense, meaning a fracture, filled largely with introduced vein-minerals, which may also contain a minor proportion of sheared wall-rock. "Shear" is used for a fracture filled essentially with sheared wall-rock, and "shear-zone" for a wider break in which the filling consists of masses of wall-rock separated by shears, except where the amount of vein-mineralization in shears and shear-zones is referred to specifically.

Experience so far shows that the gold is confined to vein-mineralization. The veins which contain gold, contain sulphides ranging from a fraction of one per cent. to a substantial part of the total vein-matter. Free gold is occasionally seen in many veins, but most of the gold is of microscopic size. Under the microscope gold is usually seen at the margins of sulphides, veining or replacing sulphides, or in the gangue near the sulphides. The relationship of gold to sulphides is discussed rather fully in the reports on the Buccaneer and Musketeer properties later in this bulletin. Although the gold is associated with the sulphides, between pieces of vein-matter which give the same gold assays there may be a marked difference in sulphide content; this statement applies to mineralization from the same vein but the difference is more striking when mineralization from certain nearby veins is compared.

The vein-mineralization consists of quartz, some carbonate, and sulphides. In many veins the gangue is ribboned by closely spaced fractures parallel with the walls. These fractures may be healed with later mineralization. The quartz is frequently well-crystallized. Sulphides may form a large part of the vein-filling, or may be in small masses between quartz crystals or in the ribbon-fractures. Of the sulphides pyrite is often in well-formed crystals, and crystals of sphalerite are found. Some pyrite crystals have been cut into slices by ribbon-fractures. Pyrite, sphalerite, chalcopyrite and galena are the sulphides usually found. Pyrrhotite and marcasite derived from it were recognized in specimens from several veins. Arsenopyrite was found in a vein in the quartz-diorite near the eastern contact of the Bedwell River batholith, and was reported from a vein near the western contact. Vein-matter from the Sherwood and P. D. Q. properties, seen by the writer, was greatly altered by weathering; it contained pyrrhotite and may contain other minerals less common elsewhere in the area.

Copper-bearing Replacement Deposits

Limestone lenses more or less replaced by silicates and metallic minerals, near the Penny Creek intrusive, have already been mentioned. At one point on the Avon group, limestone, found in contact with granitic rocks, is partly replaced by disseminated grains of pyrite, chalcopyrite and magnetite. At another point the metallic minerals have almost completely replaced the limestone. Elsewhere on this property green silicates with some magnetite are found in the limestone at and near the contacts; the main mass of the limestone, however, contains but little introduced material. On the Seattle group, andradite garnet, epidote and magnetite with more or less pyrite and chalcopyrite completely replace limestone and possibly some volcanic rock, and at one point disseminated mineralization consisting of magnetite, pyrite, chalcopyrite and sphalerite was observed in the limestone. On the Galena group magnetite, pyrite and chalcopyrite replace fine-grained volcanic rock. On the old Bedwell River road, a little more than a mile north-easterly from the bridge at 3-mile, there is an exposure of chalcopyrite filling joints and to some extent replacing the volcanics in the walls of the joints. This occurrence was described under "Empress" in the Annual Reports, Minister of Mines, British Columbia, 1917 and 1918, at which time the surface was stripped.

The Avon, Seattle and Galena properties were described in Bulletin No. 8, 1940. The Ptarmigan and Big I properties, near the eastern contact of the Bedwell River batholith, are described fully in the present bulletin. The copper-bearing mineralization is found principally replacing volcanic rocks and limestone. The work done on these deposits has not developed commercial ore bodies.

Chalcopyrite appears to be the primary copper mineral; pyrite, pyrrhotite, and some molybdenite are found, but except for minor amounts of sphalerite at one point the writer saw no other primary sulphides in these deposits. Samples of typical mineralization usually assayed a trace or nil in gold. One sample of selected sulphides assayed: Gold, 0.14 oz. per ton; silver, 3.0 oz. per ton; copper, 11.1 per cent; another assayed; Gold, trace; silver, 2.0 oz. per ton; copper, 8.3 per cent. On the Seattle property some disseminated mineralization in limestone contained magnetite, pyrite, chalcopyrite and some sphalerite. A sample of selected material, containing sphalerite and a moderate amount of chalcopyrite, assayed: Gold, 0.10 oz. per ton; silver, 0.1 oz. per ton. Some of these deposits are definitely younger than the large granitic intrusives, and it is probable that all are younger. It is an interesting fact

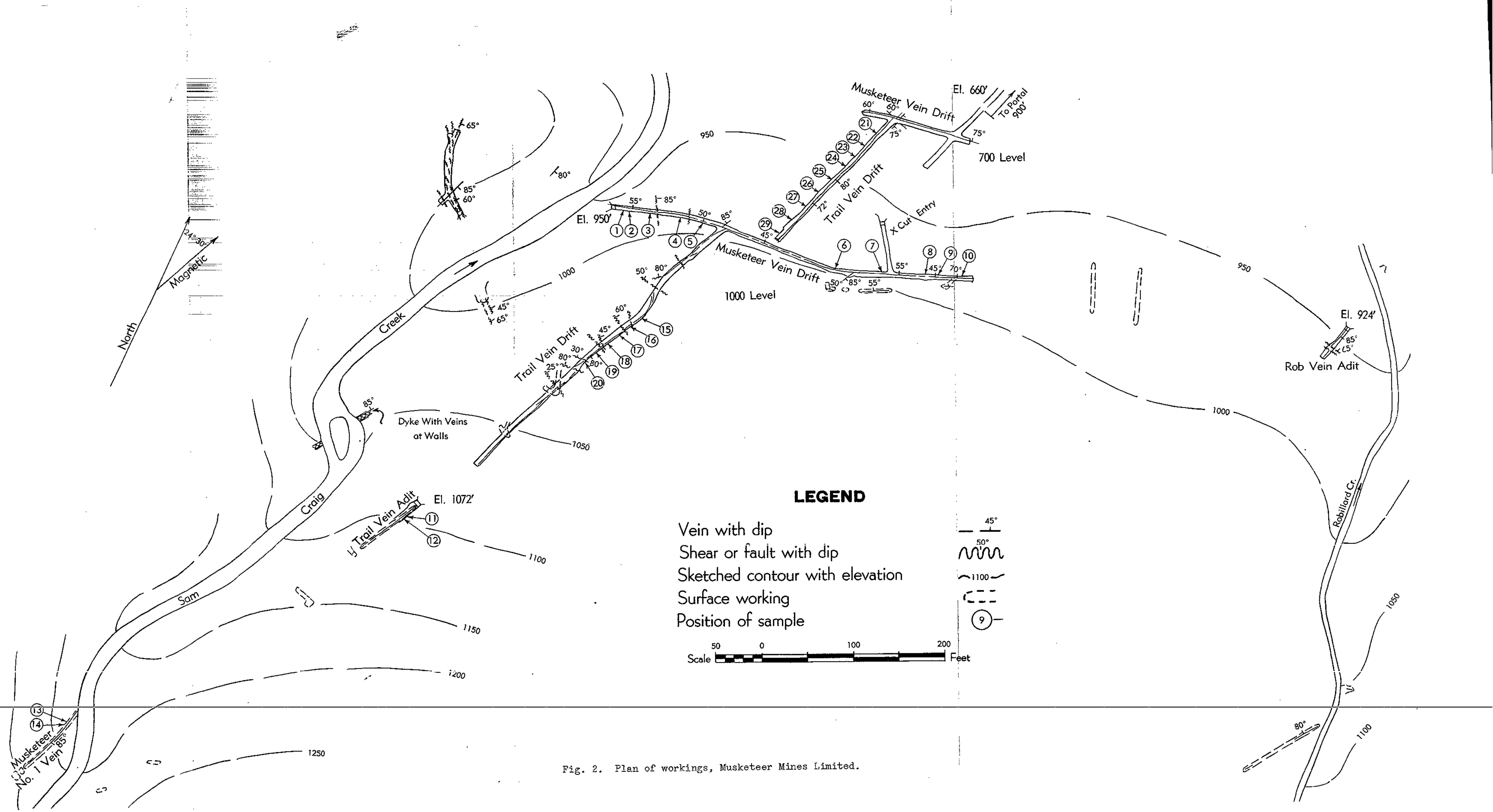


Fig. 2. Plan of workings, Musketeer Mines Limited.

that almost all the gold-bearing veins in the area contain pyrite, sphalerite, chalcopyrite and galena in about that order of deposition. The chalcopyrite content is usually small. and is often microscopic. The gold appears to have been deposited later than, or with the late sulphides. It does not appear that the gold-bearing mineralization can be closely related to the copper-bearing replacement deposits. Some gold-bearing veins have been found near but not immediately at copper-bearing replacement deposits.

Placer-Mining

Early reports on the Bedwell River area refer to placer-mining. The scenes of principal activity are believed to have been on the north-western side of the river about five miles from the mouth, and just above a canyon-section of which the up-stream end is about 6 1/2 miles from the mouth. In the spring of 1939 an effort was made to recover gold from the river gravel below the lowest canyon-section approximately 3 miles from the mouth of the river. From this point to the mouth, the river-bed is wide, bed-rock exposures are known to the writer at two points only, and there are extensive flats principally on the north-western side of the river. The placer operation attempted in the spring of 1939 was on ground understood to be included in the Agnes placer-claim registered in the name of J. W. Lamb. Two wing-dams were constructed and it is reported that some gold was recovered before high water made it necessary to cease operations. Some test pits were sunk a few feet on the flat west of the river, near the wing-dams. It is reported that gold was recovered at the wing-dams, in the test pits, and from testing and panning along the river. So far as the writer known, testing has not been sufficiently extensive to determine fully the nature of the gravel, depth to bed-rock, or average values. Gold recovered in testing is reported to be rather fine, but not flour gold. Large boulders might be expected in a country of such rugged topography but very few were seen in the river-channel by the writer. Four placer-leases, extending downstream for a total distance of approximately 2 miles from the Agnes, were granted on January 23rd, 1940, to Frank A. Noel (Lease 143), W. A. Noel (Lease 144), H. Noel (Lease 145) and Carl Noel (Lease 146).

MUSKETEER MINES, LTD.
(No. 8 Fig. 1)

The eight claims of the Musketeer group and five claims of the Shamrock group were recorded in September, 1938, in the name of Patrick McCrory. A registered agreement covers the sale of the claims by McCrory to Musketeer Mines, Limited (N.P.L.), a company with head offices in Vancouver. The company is the registered owner of the A, B, C and D fractional mineral claims staked and recorded in the latter part of 1939. These fractional claims lie between or adjoin claims of the Musketeer and Shamrock groups. The company is the recorded owner of the F mineral claim and the H fractional claim, staked and recorded early in 1941, lying north of the other ground; and of the claims Broken Chain Nos. 1, 2 and 3 north of the river, recorded in July, 1939. The company is also interested in an option to purchase the claims Joker Nos. 5, 6, 7 and 8, Trail No. 1 and Trail No. 2, of which the recorded owners are S. D. Craig and G. H. Patton. These claims lie generally north-westerly from the claims of the Musketeer group. Excepting the three Broken Chain claims, which lie across the river, the ground held by the company is south of Bedwell River on lower Sam Craig Creek.

Work on the property has been done from a tent-camp, at about 950 feet elevation, on the western side of Sam Craig Creek. A branch trail running southerly from the river near the mouth of Sam Craig Creek, crosses from the eastern to the western side of the creek, about a third of a mile from the river, near the portal of the 700 level, and climbs 300 feet to the camp, about three-quarters of a mile by trail from the river. The river can be forded by horses, and an old log jam half a mile upstream from the mouth of Sam Craig Creek, can be crossed by men at all stages of the water. A branch-road is to be built to the property from the Bedwell River road, now under construction, and it is reported that work has started on a bridge to cross the river below Sam Craig Creek.

On both sides of lower Sam Craig Creek the surface is irregular. Rocky knolls and ridges are separated by swampy depressions and narrow draws. The average slope is steeply northward to a small flat along the river. Overburden is deep in the flatter areas, surface cuts have gone down as much as 10 feet without reaching bedrock. Tree-growth is fairly heavy on the flat and on the lower slopes where the rock is covered by drift.

The discovery in August 1938 of the Musketeer Vein on the eastern side of Sam Craig Creek did much to stimulate the present activity in the Bedwell River Area. The same autumn, the property, consisting of the Musketeer and Shamrock, was optioned to a group including Pioneer Gold Mines of B. C., Limited, of Vancouver, and Anglo-Huronian Limited, of Toronto. The option was later transferred to Musketeer Mines, Limited, (N.P.L.), incorporated on June 21, 1939.

Development work on the property started in the autumn of 1938. Underground work was carried on by hand until late in March 1940. Work done in this period consisted of surface workings, four short adit drifts, the 1000 level, including some 375 feet of drifting southerly on the Trail Vein, and the outer part of the crosscut-entry to the 700 level. In August and September 1939 six diamond-drill holes were bored totalling 1100 feet. Preliminary work on a proposed water-power development was done during the same autumn. Work on this project was suspended when it became apparent that construction of a road up the Bedwell River would not be carried through that year.

The following spring a gasoline-powered compressor was brought in and from a date late in March 1940 drilling on the 700 level was done with compressed air rock-drills. Late in 1940 operation of the compressor was suspended for the winter, and a small crew resumed work on the 1000 level, advancing the Trail Vein drift southerly by hand.

Figure 2 accompanying this report shows the relative positions of most of the workings on the property at the end of August 1940. This is based on compass surveys by the writer, except that the position of the 700 level relative to the 1000 level is based on information supplied by the company engineer. The datum on which elevations were based was obtained from a number of barometer readings. Relative elevations of points in the surveys were computed from the survey data. The datum used for company surveys is about 60 feet higher than that used on (Figure 2). The veins on which substantial work had been done at the time of the examination are described in this report, with the exception of one or two showings indicated on Fig. 2. The 700 level starts as a crosscut driven southerly and intersects the Musketeer Vein some 945 feet from the portal. Of this crosscut-entry, the inner end only is represented on Fig. 2.

Since the examination the drifts on the Trail Vein on the 700 and 1000 levels have advanced southerly, and the drifts on the Musketeer Vein on the 700 level have advanced easterly and westerly, beyond the points shown.

The approximate positions from which the writer took samples have been indicated on Fig. 2. The sampling data are tabulated later in this report. This data gives an indication of the range of widths and values, but samples would need to be more closely spaced to permit accurate estimates of average widths and values.

The writer wishes to express his thanks to F. A. Joubin, engineer for Muskateer Mines, Limited, to J. Merritt, foreman in 1939. to John Swanson, foreman and Ivan Thompson, account-

ant at the mine in 1940, who generously supplied information concerning the property, and also made available facilities for work.

The property is about a mile from the western margin of the Bedwell River batholith, and is underlain by igneous rock which shows some range in texture and composition but consists principally of quartz-diorite. Some finer grained granitic rock, outcropping along the trail west of Sam Craig Creek, is probably intrusive into the quartz-diorite. Several dykes on the property are andesite and some others, too altered for definite determination, are probably andesitic. The granitic rocks and the dykes have been altered hydrothermally near shears and fractures.

The veins so far discovered are in fractures along which there has been more or less shearing and which on their attitudes may be divided into two groups. The one group consists of fractures which strike from 10 to 30 degrees east of north and range in dip from 85 degrees westward to about 75 degrees eastward. Some of these fractures follow the walls of andesitic dykes of the same general attitude. The other group consists of fractures striking from about north-east to almost due east and dipping north-westward or northward at angles from 45 degrees to 75 degrees. The Musketeer Vein, belonging to the second group, cuts and appears to offset slightly the Trail Vein, which belongs to the first group. The veins are cut by shears which strike from 30 to 80 degrees west of north and dip northward or north-eastward at angles from 45 to 85 degrees. There is some faulting of veins by the shears, the horizontal displacements observed are of the order of a few feet or inches. The Trail Vein cuts some masses of altered andesite but for most of the length of this vein in the walls are of quartz-diorite which is also the wall-rock of the other veins on which extensive work has been done.

Most of the veins have sections which are ribboned by fracturing in the vein-filling parallel with the walls. In the easterly-striking veins the ribbon fracture-surfaces and the walls of the veins are marked by fine grooves or striations which are nearly horizontal. In the Musketeer Vein the striations observed have a low pitch to the east. The walls of a shear which faults the vein are also marked by grooving which pitches about 55 degrees north-westward.

The vein-fractures usually contain gouge along the walls. Introduced vein-matter consists of quartz with more or less white carbonate and varying proportions of sulphides. The widths of vein-matter observed range from a fraction of an inch to more than a foot. In the Musketeer Vein the maximum width observed is 8 inches, but in the Trail Vein widths of 8 or 10 inches are common and locally widths exceed a foot. Usually the greatest widths are found where a split converges with the main fracture. The quartz is often notably well-crystallized. The sulphides consist of pyrite, sphalerite, galena and chalcopyrite. The pyrite is frequently in coarse crystals. Some good crystals of sphalerite were found in one vein. The sulphides occur following the ribbon-planes in some ribboned parts of the veins and as irregular masses which may form a large part of some unbanded parts of the veins. Free gold, generally quite fine, has been found in several of the veins.

The sulphides are distributed irregularly in the veins and the sulphide content varies greatly from point to point. In a general way it has been observed that the gold tends to occur in the parts of the veins carrying appreciable percentages of sulphides. As a measure of the sulphide content, the total sulphur content was determined in a number of samples from this property. In the samples from the Musketeer vein, the sulphur ranged from a fraction of 1 per cent. to 7 per cent. The higher figure is probably equivalent to more than 15 per cent. combined sulphides. Samples containing much sulphide mineralization gave high assays in gold; and generally vein-matter moderately well-mineralized with sulphides gave better values than material poor in sulphides. A closer study was made of the relationship of gold and sulphides in the Trail vein on the 700 and 1,000 levels. Assay-pulps from the samples taken on each level were grouped within moderate ranges of gold assays. Equal quantities from each assay-pulp in a group were combined to form a composite sample for the group. The results from assaying five composite samples and a single sample unusually high in gold are set forth in the following Table.

Inspection of the table shows that for the composite-pulps, the assays in gold, silver, lead, zinc and sulphur all increase in the same order but not in the same ratio. The single sample unusually high in gold, is not proportionately as rich in the other constituents, but is notably richer than average in all of them. All the pulps except the two which assayed highest in gold, assayed nil in copper. The sample which assayed lowest in gold, assayed nil in copper, lead and zinc; but assayed 1.8 per cent sulphur, equivalent to a pyrite content of 3.4 per cent. This confirms the observations that pyrite alone is not a reliable indicator of gold. Galena and perhaps sphalerite are usually observed with pyrite in vein-matter which assays well in gold.

Composite Samples Trail Vein

Gold oz. per ton	Silver oz. per ton	Copper Per Cent.	Lead Per Cent.	Zinc Per Cent.	Sulphur Per Cent.	*Total Sulphides Per Cent.	
Trace	0.2	Nil	Nil	Nil	1.8	3.4	From 700 Level.
0.58	0.4	Nil	0.24	0.3	1.9	3.9	From 700 Level.
0.86	1.0	Nil	0.57	0.5	2.8	6.0	From 1000 Level.
3.56	1.5	Nil	0.84	0.9	3.6	7.0	From 700 Level.
4.20	2.5	0.08	1.42	1.0	5.9	12.9	From 1000 Level.
17.90	5.6	0.08	1.02	0.9	4.7	10.4	From 1000 Level. Single sample.

* Total metallic minerals calculated as sulphides.

The information obtained from chemical analysis augments and confirms data obtained from microscopic study of polished ore specimens. In the microscopic work, free gold was found usually veining or replacing sulphides, at the margins of sulphide grains or in the gangue near sulphides, and no tellurides or other gold compounds were observed. The sections studied microscopically were generally of vein-matter richer than average in sulphides, but some were of ribboned vein-matter more sparingly mineralized. The metallic minerals identified in these sections are pyrite, galena, sphalerite, chalcopyrite and gold. Some pyrite crystals have been cut into thin slices by the ribbon fracturing of the veins. Chalcopyrite occurs separately from sphalerite and tiny blebs or blades of chalcopyrite are to be seen in most grains of sphalerite. The chalcopyrite content is decidedly small, usually it is too small for the copper to be determined by routine quantitative assaying methods. The microscopic study indicates that sulphides were developed between quartz crystals and in fractures in the gangue, and that pyrite is the oldest sulphide. Galena and chalcopyrite vein and replace sphalerite and are therefore later than sphalerite. Gold is as late as the latest sulphides and possibly later.

The coincidence of the gold and sulphides may be explained by the theory that sulphides, in their order, and gold, with or subsequent to the latest sulphides, were deposited in the parts of the veins most subject to successive re-opening by fracturing. The later fracturing may have failed to open channels in some parts of the vein moderately well-mineralized with early sulphides, and may have opened channels to some poorly-mineralized parts. Thus moderately well-mineralized vein-matter may assay well in gold, although generally the well-mineralized vein-matter is richer. Since the gold occurs largely as grains of free metal, it is not to be expected that the ratio with the total sulphide content or with an individual sulphide would be constant. The microscopic study suggests that as an indicator of gold values galena would be better than pyrite.

Musketeer Vein

Surface cuts in deep overburden expose this vein for part of its known length. Because of the depth of overburden, the vein was explored by an adit-drift on the 1000 level, at rather shallow depth. This drift follows the vein easterly from Sam Craig Creek for 407 feet. About 125 feet from the Sam Craig Creek portal a branch drift has been driven southerly following the Trail Vein; and 317 feet from the Sam Craig Creek portal a crosscut entry, driven from a point about 60 feet north-westerly, makes connection with the Musketeer Vein drift. The portal of this entry is on the eastern side of a low ridge on the eastern side of Sam Craig Creek. The crosscut entry to the 700 level intersected a vein, believed to be the Musketeer Vein, about 945 feet from the portal and about 285 feet below the drift on the 1000 level. When the property was examined the vein had been followed on this level for 122 feet. The average dip indicated by the relative positions of the drifts on the two levels is between 55 and 60 degrees northward.

1000 Level

The strike of the vein changes markedly at two points in this drift. In the western section the strike is about north 73 degrees east. At 85 feet from the western portal the vein is cut by a shear which strikes west of north; in the middle section, easterly from this shear, the vein strikes about north 85 degrees east. About 255 feet from the western portal the vein swings to the left and continues thence on a strike of north 68 degrees east. For most of the exposed length the vein dips from 45 to 55 degrees northward but it steepens toward the eastern end of the drift, and 90 feet easterly from the crosscut entry dips 75 degrees northward. Approximately 50 feet from the western portal the vein is cut by a northwesterly striking shear. At the shear the eastern segment of the vein is displaced about a foot to the south, relative to the western segment.

Through most of the length of the drift on the 1000 level, the Musketeer Vein is 1 1/2 to 7 inches wide with gouge along the walls. The vein-matter consists of quartz, a little calcite and irregularly distributed sulphide minerals. Much of the vein is ribboned or banded by fractures parallel to the walls and, in parts of the ribboned vein, sulphides are developed along the ribbon-fractures. Some parts of the vein show no banding and may contain little sulphide mineralization or may be well-mineralized with sulphides in irregular masses. The sulphides include pyrite, sphalerite, galena and a minor amount of chalcopyrite. It is reported that fine free gold has been found at a number of points in the vein.

At the western portal the vein is from 3 to 5 inches wide. About 15 feet north-easterly, it has widened to 7 inches where for 2 feet the vein, consisting of white quartz with a little sulphide mineralization, is completely crushed. This narrows to solid well-mineralized quartz 4 1/2 inches wide, thence to the shear at 50 feet the vein is from 3 to 4 1/2 inches wide. Thence easterly to the next shear, a distance of about 35 feet, the vein-matter consists of ribboned well-mineralized quartz 3 to 5 1/2 inches wide. Thence easterly for about 70 feet to a point past the Trail Vein drift, the vein-matter is from 1 1/2 to 4 1/2 inches wide. In part it consists of rusty gouge, but for most of this section it is principally ribboned quartz. Some high assays in gold are reported from sampling of this section of the vein.

About 30 feet easterly from the Trail vein drifts, the Musketeer vein passes into a shear from 1 1/2 to 2 1/2 feet wide, which continues for about 70 feet on a strike north 85 degrees east and dip about 45 degrees northward. At several points, gouge-filled fractures branch off into the walls at small angles with the main shear. Narrow stringers or lenses of quartz with some sulphides are found along the sides of the main shear. It is reported that regular sampling across the width of the shear yielded assays of a few hundredths of an ounce of gold per ton.

At the eastern end of this section, continuing on the same strike for 30 feet, the usual type of vein comes in again. It is 1 1/2 to 3 1/2 inches wide and is quite well-mineralized with sulphides. In the next 20 feet the strike changes to about north 68 degrees east, the dip steepens to 55 degrees northward, and the vein-matter widens to a maximum of about 7 inches near the middle of the section, diminishing to 3 inches at the eastern end. Approximately at this point a narrow fracture branches in a southerly direction and the drift has been widened at the southern side. This fracture strikes about north 30 degrees east and dips 85 degrees south-eastward. It contains quartz 1/4- to 1/2-inch wide mineralized with sulphides. It is reported that fine free gold was found in the main vein near this point.

The cross-cut entry is about 42 feet easterly from the narrow fracture and at the time of the examination the drift continued easterly 90 feet past the cross-cut. In this section, about 132 feet long, the vein is less than 2 inches wide for the first 15 feet; in the next 107 feet the vein-matter ranges from 2 1/2 to 8 inches and averages between 5 and 6 inches in width. Sulphides probably form less than 3 per cent. of the vein-matter except where there are local concentrations; one such concentration occurs at a point 10 feet westerly from the crosscut-entry. The last part of the drift was driven through badly shattered ground and in the last 10 feet the vein ranges from 1 1/2 to 3 inches wide. The dip here is 70 degrees northward.

Ten samples taken from the Musketeer vein on the 1,000 level, at positions indicated on (Fig. 2), were principally from the parts of the vein regarded as most apt to contain substantial values in gold. This excludes the part of the drift following the wide shear. The data from this sampling are shown in the following table:

Musketeer Vein - 1000 level

Sample No.	Width Inches	Description	Gold oz.per ton	Silver oz.per ton
1	7	White crumbly vein-matter, little sulphide mineralization.	0.14	Trace
2	$4\frac{1}{2}$	Quartz with sulphides.	4.95	4.1
3	$4\frac{1}{2}$	Banded vein with some sulphides and gouge.	2.34	1.6
4	3	Banded vein-matter with sulphides.	2.64	1.2
5	4	Rusty quartz, some sulphides.	1.64	0.6
6	$6\frac{1}{2}$	Banded quartz, well-mineralized with sulphides.	3.00	2.8
7	$5\frac{3}{4}$	Banded quartz with sulphides.	1.56	1.2
8	$6\frac{1}{2}$	Quartz with some sulphides.	0.56	0.6
9	$6\frac{1}{2}$	Crushed vein-matter, quartz with some sulphides.	0.96	1.0
10	6	Quartz with some pyrite.	0.30	0.1

700 Level

When the writer examined the property at the end of August 1940, the Musketeer Vein had been followed for a total distance of about 122 feet by drifts which extended approximately 20 feet easterly and 102 feet westerly from the center line of the 700 level crosscut-entry. Timbering hid the vein in parts of this length. The fracture is well-marked, ranges from 3 to 8 inches wide and contains quartz from 1/2 to 6 inches wide. The sulphide content is small. The writer did not sample the vein in this working. Company sampling is understood to have indicated values in gold, but not of commercial grade for vein-matter of such width. Since the examination the drift has been advanced westerly to a point 373 feet from the center line of the crosscut-entry. Between approximately 210 and 310 feet, company sampling indicated commercial values in vein-matter averaging about 2 inches wide. At the face of the drift, vein-matter is reported to be 7 or 8 inches wide and to have given assays approaching commercial grade. The drift easterly has been advanced to a point 175 feet from the center line of the crosscut-entry. The vein has a width averaging about 5 inches, but no part of this work was regarded as developing commercial mineralization.

Trail Vein

The Trail vein has been explored in an adit, in surface cuts extending southerly from the adit, and in branch-drifts which run southerly from the Musketeer Vein drifts on the 1000 and 700 levels. The average strike of the vein is 15 to 20 degrees east of north, and the average dip is about 80 degrees eastward. The mineralization does not occur in a simple fracture. At some points, there are several roughly parallel fractures which may range from a fraction of an inch to several inches in width. The greater part of the vein consists of a fracture containing two or three inches to a foot of quartz, which may be separated by a horse of wall-rock from another fracture containing a lesser width of quartz. The fractures tend to branch, and at the point of branching the width of vein-mineralization is often greater than average. Much of the vein-matter is ribboned. Parts of the vein are abundantly mineralized. Some parts contain 5 to 10 per cent sulphides. In the adit sulphides were even more abundant. Other parts are poorer in sulphides. The sulphides include pyrite, galena, sphalerite and a little chalcopyrite. The quartz is well-crystallized, as are the sulphides in general. Some pyrite crystals are more than 1/2 an inch across. Beautifully formed crystals of sphalerite were found in a vug in the Trail Vein adit. Gold values bear a rather close relation to the sulphide mineralization as indicated by a table earlier in this report. The best values are usually obtained from parts of the vein containing sphalerite and galena, as well as pyrite. The walls are of quartz-diorite, often greatly altered. The vein is cut by a number of cross-shears, few of which offset it markedly.

On the two levels drifts follow the Trail Vein southerly from the Musketeer Vein, but there has been no drifting northerly. On the 1,000 level a narrow vein-filled fracture is exposed on the northern side of the Musketeer Vein drift, 2 feet west of the projection of the vein followed in the Trail Vein drift. On the 700 level there are several narrow vein-filled fractures on the northern wall of the Musketeer Vein drift, about opposite the entrance of the Trail vein drift.

From the portal of the Trail Vein adit, about 122 feet higher than, and 400 feet southerly from, the Sam Craig Creek portal of the 1,000 level, a trench extending southerly up the slope exposes the vein for about 80 feet. The vein is from 2 1/2 inches to 8 inches wide and contains much sulphide mineralization. About 65 feet from the lower end of the trench, quartz striking about south 10 degrees west diverges from the vein when followed southerly. It is 2 to 8 inches wide and contains little or no sulphide mineralization, but contains sericite and some ankeritic carbonate. It is white in contrast with the rusty filling in the principal fracture. Southerly from this trench cuts in deep overburden expose vein-mineralization at two points.

The Trail Vein adit driven about 33 feet when the writer examined it, was timbered for about 20 feet from the portal. Where not concealed by timber, the vein ranges from 1 1/2 to 12 inches in width; it has very irregular walls and in part is frozen to one wall. The wall-rock is greatly altered. Much of the exposed vein is heavily mineralized with sulphides. Pyrite, sphalerite, galena and a little chalcopyrite are arranged in bands parallel with the walls of the vein, and form from 2 to 3 to perhaps 40 per cent of the vein-matter. The writer took two samples toward the inner end of the working.

Sample No.	Width Inches	Description	Assay	
			Gold oz.per ton	Silver oz.per ton
11	$8\frac{1}{2}$	Heavily-mineralized vein-matter.	9.34	6.4
12	7	Quartz with much less sulphides, near heavily-mineralized section.	12.04	6.0

On the 1000 level, the Trail Vein drift extended 375 feet southerly from the Musketeer Vein drift when the property was examined.

To a point 123 feet southerly from the entrance of the drift the Trail Vein is represented by fractures containing from 1/2 inch to 4 inches, and usually not more than 2 inches, of vein-matter. At some points, the fractures contain gouge only. This part of the vein was not sampled by the writer. At 123 feet, the drift is crossed by a shear striking a little south of east and dipping 50 degrees northward. From the shear southerly for 127 feet, the vein is generally wider. It is cut by numerous shears spaced at short intervals which strike from approximately due east to about south 60 degrees east and dip northward or north-eastward at angles from 25 to 85 degrees. At most of them there is no apparent offsetting of the vein. At a number of the shears, the width of vein-matter increases markedly. Between 123 and 235 feet from the drift entrance, the vein is of fair width and is more abundantly mineralized than other sections of comparable width. The inner 25 feet of this section is 3 to 4 inches wide and is much broken. The writer took six samples across the vein in the section between 123 and 210 feet from the entrance of the drift, the data from which are tabulated below. The width of the vein changes in short distances as will be seen in notes in the table.

Trail Vein, 1000 level

Sample No.	Width Inches	Description	Assay	
			Gold Oz. per ton	Silver Oz. per ton
15	5	Quartz moderately mineralized.	0.66	0.7
16	9	4 inches abundantly mineralized, rest sparingly.	0.84	1.0
17	$6\frac{1}{2}$	Well-mineralized.	1.92	1.1
18	$4\frac{1}{2}$	Well-mineralized - Note: 2 feet to south the vein is 9 inches wide, sparingly mineralized, it narrows to 2 inches 8 feet south widening to 6 inches 10 feet south	6.80	5.2
19	6	Banded vein, well-mineralized.	17.90	5.6
20	$3\frac{1}{2}$	Vein well-mineralized. In 25 feet to south, vein of about this width is much broken.	3.62	3.4

Between 235 and 255 feet from its entrance, the drift is timbered and lagged. In the remaining 120 feet of the working to the face, as of August 31, 1940, the quartz-filled vein is continuously exposed, ranging from a narrow stringer to a width of a little more than 12 inches. Much of this section is from 5 to 10 inches wide. Sulphide mineralization is sparingly developed. This part of the vein was reported to be non-commercial and was not sampled by the writer. It is reported that the drift has since advanced a further 60 feet or so and that for the last few feet width and grade are regarded as commercial.

The Trail Vein drift on the 700 level had reached a point 178 feet southerly from the Musketeer Vein drift when the writer examined this working on August 28, 1940. In this distance, the vein-fracturing is generally strong. In several sections splits run approximately parallel with the main fracture for considerable distances. Within the fracture-zone there is a good deal of wall-rock, in some sections as a horse separating two veins of quartz. The width of quartz ranges from about 3 inches near the intersection with the Musketeer Vein, to a maximum of 17 inches, and is usually from 6 to 12 inches wide. The writer took samples at 9 points along the vein in this draft. At two points, altered wall-rock within the fracture zone was sampled, and was found barren.

Data from the writer's sampling are given in the following table:

Trail Vein, 700 Level.

Sample No.	Width Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
21	8	Quartz moderately mineralized, wider just to south.	2.86	1.9
22	10 1/2	Quartz sparingly mineralized.	0.56	Trace
23	8	Quartz sparingly mineralized (vein narrows to 5 inches, 5 feet south.)	0.78	0.2
24	11	Quartz sparingly mineralized.	0.52	0.3
25	10	Quartz well-mineralized.	4.86	3.1
26	8	0 to 8 inches from hanging-wall, horse of altered wall-rock.	Trace	Trace
	14 1/2	8 to 22 1/2 inches from hanging-wall, well-mineralized quartz. (Split from north converges with main vein here.)	3.72	2.1
27	17	White quartz, little sulphide mineralization, at local swell.	0.22	0.2
28	9 1/2	Quartz plus altered wall-rock, little sulphide mineralization.	Trace	Trace
29	6	0 to 6 inches from hanging-wall, altered wall-rock, some quartz and pyrite.	Trace	0.2
	8	6 to 14 inches from hanging-wall, quartz sparingly mineralized.	0.68	0.3
	5	14 to 19 inches from hanging-wall, altered wall-rock some pyrite.	Nil	Nil

It is reported that when work was suspended in December 1940 the face of this drift was 504 feet southerly from the Musketeer Vein. Of this length company sampling indicates that about 55 per cent is of commercial width and values, in shoots ranging from 25 to more than 100 feet in length.

Rob Vein

Some surface workings and a 45-foot adit on the western side of Robillard Creek, indicated near the right hand side of Figure 2, expose vein-mineralization in a narrow fracture which strikes about north 15 degrees east and dips about 85 degrees south eastward. The vein-mineralization from 2 1/2 to 8 inches wide, consists of quartz with more or less sulphides. Parallel shears. striking north 70 degrees west and dipping 65 to 70 degrees south-westward, cut the vein. In the adit the shears were encountered between 28 and 33 feet from the portal. The vein is faulted by the shears and on the southern side is offset 3 1/2 feet toward the east, relative to the segment on the northern side. The vein, from 3 to 8 inches wide for 25 feet from the portal, is abundantly-mineralized with sulphides at the portal and well-mineralized for the rest of the distance. Beyond 25 feet from the portal it narrows, and at the southern side of the shears it consists of quartz 3 to 5 inches wide containing 2 or 3 per cent pyrite and some chlorite. Sampling indicated high values in gold for the abundantly-mineralized material and low values for the sparingly-mineralized material on the southern side of the shears. A cut on the eastern side of the creek exposed shearing but no vein-mineralization.

Musketeer No. 1 Vein

This vein can be seen under the water for about 50 feet along the western side of Sam Craig Creek, at about 1,250 feet elevation. It has been exposed by stripping extending southerly up the slope on the western side of the creek. Two cuts, in deep overburden, short distances southerly from the end of the stripping, did not expose the vein. These workings, indicated in the lower left hand corner of (Fig. 2), expose a sheeted zone 2 to 3 feet wide in which closely spaced subparallel joints or fractures strike about north 15 degrees east and dip about 85 degrees south-eastward. Along the eastern side of the sheeted zone there are some narrow stringers of quartz. Along the western side, vein-mineralization consisting of quartz and some calcite irregularly mineralized with sulphides, ranges from 3 to 8 inches in width, pinching or swelling in short distances. The sulphides, pyrite, sphalerite, galena and chalcopyrite, in small aggregates irregularly

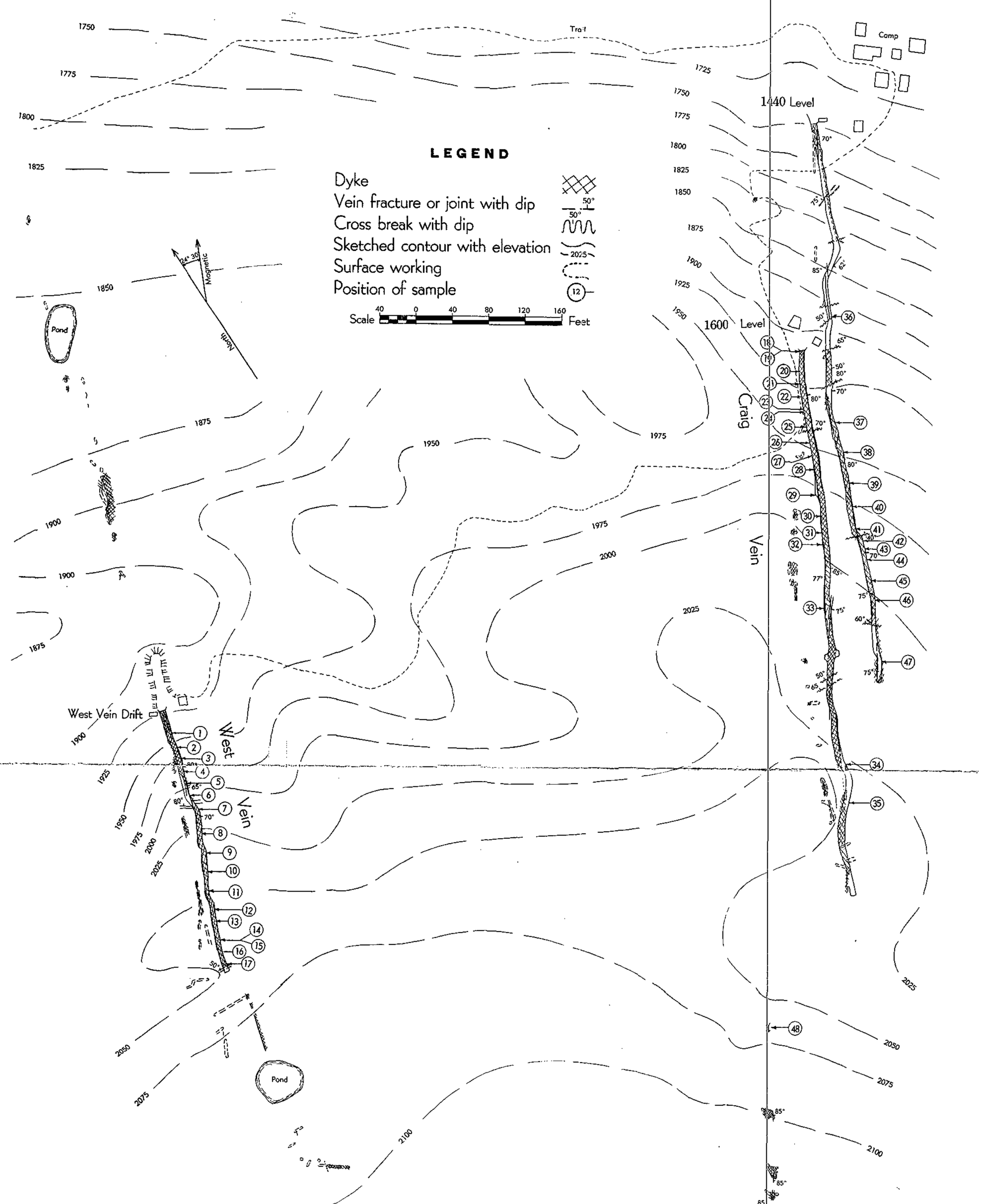


Fig. 3. Plan of workings, Buccaneer Mines Limited.

distributed through the gangue, form roughly 1 to 15 per cent of the vein matter. Two samples were taken from this vein.

Sample No.	Width Inches	Description	Assay	
			Gold oz. per ton	Silver oz. per ton
13	$7\frac{1}{2}$	Well-mineralized quartz, 10 feet above creek.	4.54	3.0
14	5	Quartz with some pyrite, 14 feet above creek.	1.28	0.6

Note: Sulphides formed roughly 15 per cent of sample No. 13, and 3 per cent of sample No. 14.

Bonus Vein

An adit-drift on this vein is situated about 1,500 feet almost due west from the Trail Vein adit. The Bonus adit is at approximately 1,400 feet elevation on the north-western side of a north-easterly-trending draw. At intervals in the draw, for about 800 feet down-stream from the adit, there are exposures of shearing in the quartz-diorite. The shearing trends north-easterly and dips steeply south-eastward. The wall-rock is greatly altered and at some points quartz and some pyrite are developed in the shear. South-westerly from the adit-portal, at higher elevations, there are indications of the shear, and at about 175 feet ribboned-quartz 5 inches wide is exposed. The adit follows the shear south-westerly for about 100 feet. At the portal quartz 4 to 6 inches wide contains very little sulphide mineralization. The wall-rock is greatly altered on both sides of the shear for a total width of about 5 feet. This vein was not sampled by the writer.

BUCCANEER MINES LTD. (No. 9, Fig. 1)

Buccaneer Mines, Limited, N.P.L. with head office in Vancouver, is the recorded owner of the claims Dictator, Nos. 2 to 8, Ruff Nos. 1 and 2, and Gold Mint, recorded in 1938; Grace Fractional, recorded in 1939; Buccaneer Nos. 1 to 9, and Ruff Nos. 3, 4, and 5, recorded in 1940. The original locations were made by S. D. Craig and were later transferred to the company. The claims are south of the Bedwell River on ground extending across Blaney Creek but most of which lies west of Blaney Creek. Work on the property is under the direction of the exploration staff of Bralorne Mines, Limited, which company is reported to hold an option on a controlling interest in Buccaneer Mines Limited.

The writer wishes to express his gratitude for accommodation provided at the camp, and for information, very useful in the preparation of this report, which Henry C. Hill, exploration engineer for Bralorne Mines, kindly made available.

The property is reached by an extension of the branch-trail which serves the Musketeer Mines Limited property. From the Musketeer camp the trail runs southerly on the east side of Sam Craig Creek climbing steeply to about 1600 feet elevation, and thence turns easterly following an uneven grade to the Buccaneer camp at about 1625 feet elevation. The total distance by branch-trail from the river, near the mouth of Sam Craig Creek, to the camp is about 2 miles. The camp consists of frame and log buildings capable of accommodating 20 men.

The country is rugged and on the property the surface in general slopes steeply either toward the river or toward tributary creeks. The camp and the principal workings are west of Blaney Creek in an area where rock hummocks rise between cross draws and swampy depressions, and locally the general slope is less than average. Overburden is thin or wanting at some points; at others it is more than 4 or 5 feet deep. In general tree cover is not heavy, but conifers in various parts of the property are sufficient in size and number to provide fuel and mining timber.

The property is entirely within the area occupied by the Bedwell River batholith. The principal workings, consisting of three adits and numerous surface workings exploring the Craig Vein and the West Vein, are about 1 1/2 miles easterly from the western margin of the batholith.

Between the fall of 1939 and early summer of 1940, three adits were driven. On the Craig Vein, an adit called the 1600 level was driven about 590 feet southerly and an adit called the 1440 level, 160 feet lower, was driven about 610 feet southerly from a point near the camp. The West vein-drift, an adit on a vein discovered early in 1940, was driven 250 feet or so southerly. This vein is roughly parallel with and 725 feet westerly from the Craig Vein. Work was stopped during the summer of 1940 but about September 1st a small crew, working two shifts per day resumed work in the West vein-drift. On September 15th, when the writer completed his examination, the face was about 300 feet from the portal. It is reported that this working has been advanced to a point about 475 feet from the portal, and that between 30 and 40 feet from the portal a winze has been sunk 31 feet on the vein. The underground work, totalling about 1700 lineal feet, has been done by hand; the only power used has been for driving ventilating fans. The adits and the surface workings on the two veins as at September 13th, 1940 are indicated on (Fig. 3) on which the topography is indicated approximately by sketched contours at 25-foot intervals. This plan is based on a Brunton compass survey by the writer, and on some information obtained from company's surveys. The base elevation was determined by barometer readings, but the relative elevations of points on the map were obtained from the Brunton survey. In addition to the workings shown on Fig. 3, strippings and surface cuts have been made on several other veins, two of which are east of Blaney Creek.

Most of the work on the property has been done in two zones in which vein-mineralization occurs in branching fractures, which for much of the indicated length are in or at the sides of altered green andesite dykes. The dykes, incompletely exposed in the surface and underground workings, strike about north 25 degrees east and dip steeply southeastward. The exposed widths of dyke-rock range from a few inches to about 25 feet, and generally range from 6 to 10 feet. The dykes pinch to narrow widths or disappear altogether; they split into irregular branches and at some points curve markedly. It seems probable that the dyke-rock was intruded along lines of rupture, as masses which varied considerably in width and were not continuous in straight lines for long distances. However, an individual mass may have the same width and attitude for several hundred feet. It is not clear whether certain apparent displacements of dyke-masses are due to curving, original emplacement as off-strike masses, or to faulting.

A dyke-mass is exposed on the surface about 100 feet south-westerly from the 1,440 level portal. The level follows another dyke-mass underground, which 130 feet southerly from the portal has diminished to a width of 3 or 4 inches. Dyke-rock, probably emplaced as a separate mass, is encountered 245 feet from the portal, and is about 25 feet westerly from the projection of the one followed in the first 130 feet of the working. The most southerly surface cuts in this section are separated by 200 feet across a swampy depression from the cuts to the north. If the most southerly cuts are on the continuation of the same zone (Craig), the dyke and the vein-fracturing have been offset about 100 feet to the west either by curving of the zone or by faulting, neither of which can be entirely dismissed at present, but it seems more probable that the most southerly cuts expose dyke-rock emplaced as a separate mass.

Surface workings which expose dyke-rock southerly from the best defined part of the West vein-zone lie east of the southerly projection of the best defined part of the zone, and here, too, the relationship had not been definitely established at the time of the examination. At the portal of the West vein-drift the vein-fracture is in dyke-rock. Followed southwesterly, the vein crosses to the western contact, and from that point follows approximately along the contact as far as the working had advanced. It is reported that, in the extension of the drift since the examination, the vein crosses again to the eastern side of the dyke-mass, which it then leaves and continuing southerly cut another dyke-mass, some distance east of the projection of the first.

In the underground workings, frequently both walls follow smooth slips representing two fractures or joints, both of which may be tight and barren, or either or both may contain vein-matter. At some points several parallel fractures are exposed in the roofs of the workings. Vein-filling is usually largely in one fracture which may be from two to 20 inches wide. Although the vein-filling is seen to pinch in one fracture and to make in another, the workings do not expose parallel fractures both containing important widths of vein-filling. On the 1440 level, vein-mineralization which has been principally in a fracture on the west side of the drift pinches in that fracture and begins to swell in a fracture about 4 feet to the east. In this section, several southerly-striking stringers cross from the one fracture to the other. The principal vein-filled fracture may have both walls of dyke-rock, or may follow the contact between the dyke and quartz-diorite. In some sections the vein-filled fracture crosses from one wall of the dyke to the other. At some points the fractures pass completely into the quartz-diorite. At many points fractures branch at small angles from the main-fractures, and at such points the vein-filling in the main-fractures may be wider than average. In the West vein-zone one branch-fracture has been traced on the surface between 40 and 50 feet southerly from its junction with the main-fracture. In general, the fracturing strikes east of north and dips steeply south-eastward, but vertical dips, and dips westward, are observed. Fracturing in the quartz-diorite is less regular than that observed in the dyke-rock.

At some points, usually in the quartz-diorite, quartz replacing sheared wall-rock forms the greater part of a lenticular mass, and at others quartz in irregular stringers forms the greater part of an irregular mass of rock. These bodies may be from 1 foot to 3 or 4 feet wide. So far as is known, appreciable values in gold have not been found in such bodies. Usually, the vein-filling consists almost entirely of quartz, from 2 to 20 inches wide. There is usually some gouge at the walls, but at some points the vein-matter is frozen to the walls. The vein-filling includes fragments of wall-rock usually in part replaced by ankeritic carbonate and chlorite. Small angular masses of light-buff ankeritic carbonate, which sometimes have a little chlorite on slips, doubtless represent completely replaced fragments of wall-rock. The quartz is often well-crystallized and shows the outlines of individual crystals. A little white carbonate occurs with the quartz. Some of the vein-matter is ribboned by closely spaced fractures parallel with the walls.

The primary sulphides, chalcopyrite, pyrite, galena and sphalerite, occur as scattered grains filling openings between quartz crystals, and along fractures in the gangue in some ribboned parts of the veins. Locally, sulphides may constitute several per cent of parts of the veins, rarely more than a few feet long; but the average sulphide content would probably be a fraction of one per cent. Some evidence of secondary alteration is seen at almost all points where the workings have exposed metallic minerals. The primary sulphides are partly replaced by secondary minerals. Malachite and a black mineral, probably chalcocite, also occur in cracks and small openings in the gangue, where probably there had been no primary sulphide minerals. Rusty stains may have been derived from the iron content of decomposed pyrite, chalcopyrite or sphalerite. Under the microscope a good deal of alteration of the primary sulphides becomes apparent. Chalcopyrite is in part replaced by covellite and malachite derived from the chalcopyrite. The secondary minerals are also deposited at other points, as is the black mineral. Sphalerite is seen to be partly decomposed and galena is partly replaced by anglesite.

Gold is occasionally recognized with the naked eye, and under the microscope it is seen as small grains. Grains about 20 microns in length are not unusual and some are 100 microns long. The distribution of gold is irregular; it occurs in the gangue, and in contact with or close to sulphides. The age relationships of the sulphides are in part obscured by secondary minerals which have attacked the margins of the grains. Pyrite is the oldest sulphide and gold is found at the margins and in veins cutting pyrite grains. Gold is found in similar relationship with galena. Chalcopyrite is found as separate grains in gangue, and also replaces pyrite, but the chalcopyrite and sphalerite are usually so much altered that their relationship with each other and with the other sulphides is not clearly indicated.

Quantitative information on the metallic mineral content of the veins was obtained in the following manner.

Samples taken in the West vein-drift were grouped within limited ranges of gold assays. For each group a composite sample was prepared by combining equal weights from the assay pulp for each sample in the group. The composite samples were assayed for gold, silver, copper, lead, zinc and sulphur. The same procedure was followed for the samples from the 1600 level and from the 1440 level on the Craig Vein. The results of these analyses are listed in the table on the following page.

In the analyses of the composite samples, the highest quantity of any of the elements, copper, lead, zinc and sulphur, is 0.3 per cent; therefore the percentage error may be high although the actual error in a determination is less than 0.1 per cent. Further, although it seems probable that the metal content of the vein-matter has not been greatly changed by secondary alteration, the fact that evidence of secondary alteration is so commonly observed in the veins from which the samples were taken casts some doubt on the relation of the analyses to those which might be anticipated from unaltered vein-matter. Therefore, generalizations regarding unaltered vein-matter, based on the available data, are by no means indisputable. The generalizations offered seem reasonable in the light of data from this and from other properties, and may be of some use in considering the relationship of gold in unaltered vein-matter.

Copper was detected in one composite sample, lead and zinc were detected in the same sample and in another. Nil assays in these metals were returned from the remaining samples. All samples contained some sulphur, which however is a small percentage in all cases. The iron content of the ore is low, and as iron is introduced in the grinding of the samples, determinations of iron in the composite samples are of doubtful use. The total sulphur content of the samples is probably considerably below that of the primary ore. Pyrite appears to be the least altered sulphide. If all the sulphur is attributed to pyrite, and if the copper, lead and zinc are attributed to chalcopyrite, galena and sphalerite, the total content of sulphide minerals computed from analyses of the composite samples in one case approximates 2 per cent, and in the others is a fraction of one per cent.

Composite Samples

West Vein

Gold oz. per ton	Silver oz. per ton	Copper Per Cent.	Lead Per Cent.	Zinc Per Cent.	Sulphur Per Cent.	*Total Sulphides Per Cent.
Trace	Trace	Nil	Nil	Nil	0.06	0.11
0.82	0.2	Nil	Nil	Nil	0.10	0.19
10.54	2.0	0.22	0.22	0.3	0.29	1.9 plus
			Craig Vein			
			1600 Level			
Trace	Trace	Nil	Nil	Nil	0.05	0.09
0.54	0.2	Nil	Nil	Nil	0.09	0.17
3.90	0.9	Trace	0.01	0.1	0.09	0.33
			1440 Level			
Trace	Trace	Nil	Nil	Nil	0.13	0.24
0.96	0.2	Nil	Nil	Nil	0.06	0.11
3.82	0.7	Nil	Nil	Nil	0.05	0.09

* Total metallic minerals calculated as sulphides.

It is significant that the sample in which copper, lead and zinc were detected, and which according to calculation represents the highest sulphide mineral content, returned the highest assay in gold; and that the sample in which lead and zinc were detected, and which is second in sulphide mineral content, is also second in gold; but it must be noted that in the sample third in gold, and very little below second place in regard to that metal, none of the metals copper, lead and zinc was detected, and the calculated total sulphide mineral content is as low as in the sample which assayed lowest in gold. In the case of the three composite samples from the Craig Vein 1440 level, the order in gold assays is the inverse of the order of the calculated sulphide contents. Of the three samples, the lowest in gold is a composite made up from samples which included some taken across sheared wall-rock, containing a few quartz stringers and some disseminated fine grains of pyrite. This disseminated pyrite, from mineralized sheared sections rather than from the more usual vein quartz, may account for the sulphur content which, low as it is, is still well above the average. In the case of the samples from the Craig Vein 1600 level, although the base metal contents and the calculated contents of sulphide minerals are very low, their order is the same as the order of gold and silver assays, the same condition obtains for the samples from the West vein-drift, and in this group the quantities are larger. In view of the not infrequent occurrence of visible free gold, and of the very low metallic mineral content of these veins, the relation of gold to sulphides as shown by the analyses, might be said to be remarkably consistent. The writer believes that pyrite was deposited before the other sulphides; that the other sulphides were introduced into the vein, reopened by subsequent fracturing; and that the gold was introduced either with or subsequent to the latest sulphides; and therefore that the later sulphides are apt to be more reliable indicators of gold than is pyrite. Accordingly unaltered parts of the veins containing more sulphides than the average should be found to contain more gold than average, particularly if the sulphides include sulphides other than pyrite.

Widths of vein-mineralization range from a fraction of an inch to an observed maximum of 21 inches. In the Craig Vein, widths greater than 6 or 8 inches usually represent a local swell. In the West vein-drift, the average width is greater, but widths exceeding 10 inches or so usually represent local swells. At one point the width swells from 7 inches at the floor to 21 inches at the roof. Similar changes in width take place in distances of a few feet measured horizontally.

Plate III. Mount Nine Peaks viewed looking northerly across the valley of Leader Lake and McBride Creek.

(Courtesy of Department of Lands)

With rapid fluctuations in width and in values, close sampling is necessary to determine average width and grade and the limits of commercial mineralization. In parts of the workings company sampling has been spaced at about two-foot intervals. Elsewhere sampling has been less closely spaced. In the West vein-drift and in some sections of the other adits the vein has been left standing at the side of the workings and has been sampled in holes, cut through the vein, about breast high. This avoids the need of storing broken ore until the property is brought into production and may preserve some ore which would probably be mixed with waste and lost if broken during development. Where the vein is left standing at the side of a drift, the width is not continuously exposed and as the one wall is hidden, complete information is not available.

The positions from which the writer took 48 samples are indicated on Fig. 3, and the data concerning the samples are given in tables in this report. These samples serve to indicate the range in width and values, but would need to be more closely spaced to delimit commercial mineralization and to permit close estimates of average widths and values. Except in a few instances the writer did not sample parts of the vein known to be essentially barren. Results of company sampling of the West Vein were not available when the writer sampled the West Vein-drift.

Craig Vein

The 1600 and 1440 adits incompletely explore the Craig Vein for 800 feet along the strike. Surface-cuts give additional information concerning this section of the vein. Surface-cuts and strippings at four points in a length of 310 feet, expose incompletely what may be the southerly extension of the same Craig zone, offset about 100 feet west of the projected strike of the 800-foot section. In the 310-foot section fracturing is rather irregular. Widths of vein-matter are less than in the better parts of the 800-foot section, and values are understood to be sub-marginal.

In the 800-foot section, in the better parts, vein-matter is usually from 3 to about 8 inches wide, with occasional swells to 10 or 15 inches. On the 1600 level a swell about 12 feet long reaches a maximum width of 20 inches, from widths of 7 to 9 inches at the ends. A sample consisting of channels across the central part of this mass gave good values in gold. In the poorer parts vein-matter may be thin or absent; but some sections, in which the quartz is wider than average, contain low values in gold.

Within the 800-foot length, the sections showing the most attractive values occur in that part of the vein opened by the outer 300 feet of the 1600 level, and the downward projection of this part of the zone on the 1440 level. Farther south on the 1600 level the values are sub-commercial but company sampling indicates some improvement in the last 30 feet of the working. On the 1440 level vein-mineralization occurs irregularly, and in part consists of incompletely-replaced sheared wall-rock, to a point about 245 feet from the portal, below the portal of the 1600 level. In the remaining part of the working quartz vein-filling is more continuous, and assays of an ounce of gold per ton or better are obtained in several short sections of which the first begins about 80 feet southerly from the point corresponding with the 1600 level portal.

Craig Vein

Sample No.	Width Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
		1600 Level		
18	3	Face at portal, August 1939, breast high, quartz.	1.70	0.4
19	10	Face at portal, August 1939, 15 inches below No. 18, quartz.	0.60	Trace
20	4	East wall, banded quartz.	1.82	0.4
21	$4\frac{1}{2}$	East wall, quartz.	3.10	0.7
22	11	East wall, quartz with inclusions of dyke-rock.	0.38	0.2
23	5	Floor east side, quartz with some sulphides.	4.02	0.4
24	4	East wall, quartz.	1.68	0.7
25	$3\frac{1}{4}$	East wall, quartz.	0.54	0.1
26	4	Roof east side, quartz.	3.42	0.6
27	9	Roof east side, quartz and 3 inch horse of dyke-rock.	0.62	0.4

Craig Vein Cont'd

Sample No.	Width Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
		1600 Level		
28	$4\frac{1}{2}$	Roof east side, quartz with inclusions of dyke-rock.	Trace	0.2
29	12	Roof west side, local swell, quartz and some sulphides	2.30	0.1
30	6	Roof west side, quartz with sulphides.	6.48	1.3
31	5	Roof west side, quartz, some malachite.	6.20	1.4
32	18	Roof west side, quartz with sulphides midway along lenticular swell, 12 feet long, 7 to 9 inches wide at ends.	9.22	2.2
33	$9\frac{1}{2}$	Roof west side, quartz.	Trace	0.2
34	24	Roof, quartz and sheared quartz-diorite.	Trace	Trace
35	$11\frac{1}{2}$	Middle of roof, quartz and sheared quartz-diorite.	Nil	Nil
		1440 Level		
36	26	Roof, sheared quartz-diorite with much vein quartz.	Nil	Nil
37	$6\frac{1}{2}$	Roof, quartz and inclusions of yellow carbonate.	0.20	Trace
38	$5\frac{1}{2}$	West wall, quartz.	0.80	Trace
39	4	West wall, quartz.	1.00	Trace

Craig Vein (Cont'd)

Sample No.	Width Inches	Description	Assay Gold oz. per ton	Silver oz. per ton
		1440 Level		
40	7	Floor, east side, quartz and carbonate replacing dyke-rock.	0.82	Trace
41	$7\frac{1}{2}$	East wall, quartz with inclusions of dyke-rock.	0.14	Trace
42	9	West wall, quartz and 1 inch of dyke from foot-wall.	1.90	0.5
43	$7\frac{1}{2}$	West wall, quartz with some green stain.	6.36	1.2
44	$9\frac{1}{2}$	West wall, quartz with inclusions of dyke-rock.	Nil	Nil
45	9	West wall, quartz.	0.90	Trace
46	15	Roof, west side, local swell, quartz with some chlorite.	1.10	0.3
47	10	Roof, west side, quartz with inclusions of dyke-rock	Nil	Nil
		Surface		
48	$3\frac{3}{4}$	Quartz vein.	2.60	0.8

West Vein

In this zone there are surface-workings at intervals over a length of about 900 feet, from a point at about 1845 feet elevation, near the north-west corner of (Fig. 3), to a point at approximately 2085 feet elevation about 400 feet southerly from the portal of the West vein-drift. In the section extending northerly from the portal the fracturing is rather irregular. Company sampling indicated that values in gold are generally below commercial grade. In the cuts immediately southerly from the portal, high values were obtained. Southerly from a point a little more than 200 feet from the portal the fracturing shows a tendency to split and the continuity of the main fracture is not definitely indicated. Company sampling of the branch, traced between 40 and 50 feet southerly from its junction with the principal fracture, is reported to have indicated values slightly below profitable grade. Farther to the south across a small pond there are several surface workings some of which do not reach bedrock. The farthest, a trench, exposed dyke-rock, but the writer did not see any vein-filled fracturing.

When the writer examined it, the West vein-drift had reached a point about 300 feet south-westerly from the portal. At the portal the vein-fracture is in dyke-rock. About 75 feet south-westerly the fracture reaches the western contact of the dyke-mass and from that point follows southerly approximately along the contact. The fracture is strong throughout the working including below the section below where the tendency to split was observed on the surface. Near the face the adit cut a cross-break striking a little south of east and dipping 50 degrees northward. The ground is sheared and crushed for several feet, but south across the break the vein was found without apparent displacement. The usual range in width is from 4 or 5 inches to 9 or 10 inches but there are frequent swells to 12 or 16 inches, and occasionally to greater widths. The widest section observed is about 225 feet from the portal, here the vein, 21 inches wide at the roof, was immediately above a section 7 inches wide at the floor.

West Vein

Sample No.	Width Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
1	$6\frac{3}{4}$	East wall, platy quartz vein with sulphides.	15.70	2.9
2	$10\frac{1}{2}$	East wall, quartz with much chalcopyrite.	6.38	1.4
3	4	East wall, quartz, pinches out three feet to north.	Trace	0.2

West Vein (Cont'd)

Sample No.	Width Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
4	6	East wall, quartz and inclusions of dyke-rock.	0.24	0.4
5	11	East wall, quartz and inclusions of dyke-rock.	Trace	0.2
6	9	Roof east side, quartz.	Trace	0.4
7	12	West wall, quartz.	Nil	Nil
8	15	West wall, vein is split, contains some dyke-rock.	0.08	1.1
9	10	West wall, quartz some sulphides.	Trace	0.2
10	18	West wall, quartz.	Trace	0.2
11	11	West wall, quartz, and altered fragments of wall-rock.	Nil	Nil
12	10	West wall, quartz and some carbonate.	Nil	Nil
13	$7\frac{1}{2}$	Roof, west side quartz, narrows to north.	1.20	0.3
14	21	Roof, west side, quartz and some carbonate.	0.66	Trace
15	7	Floor below No. 14, quartz.	1.08	0.4
16	6	West wall, quartz some sulphides.	8.48	2.5
17	9	West wall, banded quartz some carbonate.	0.54	0.3

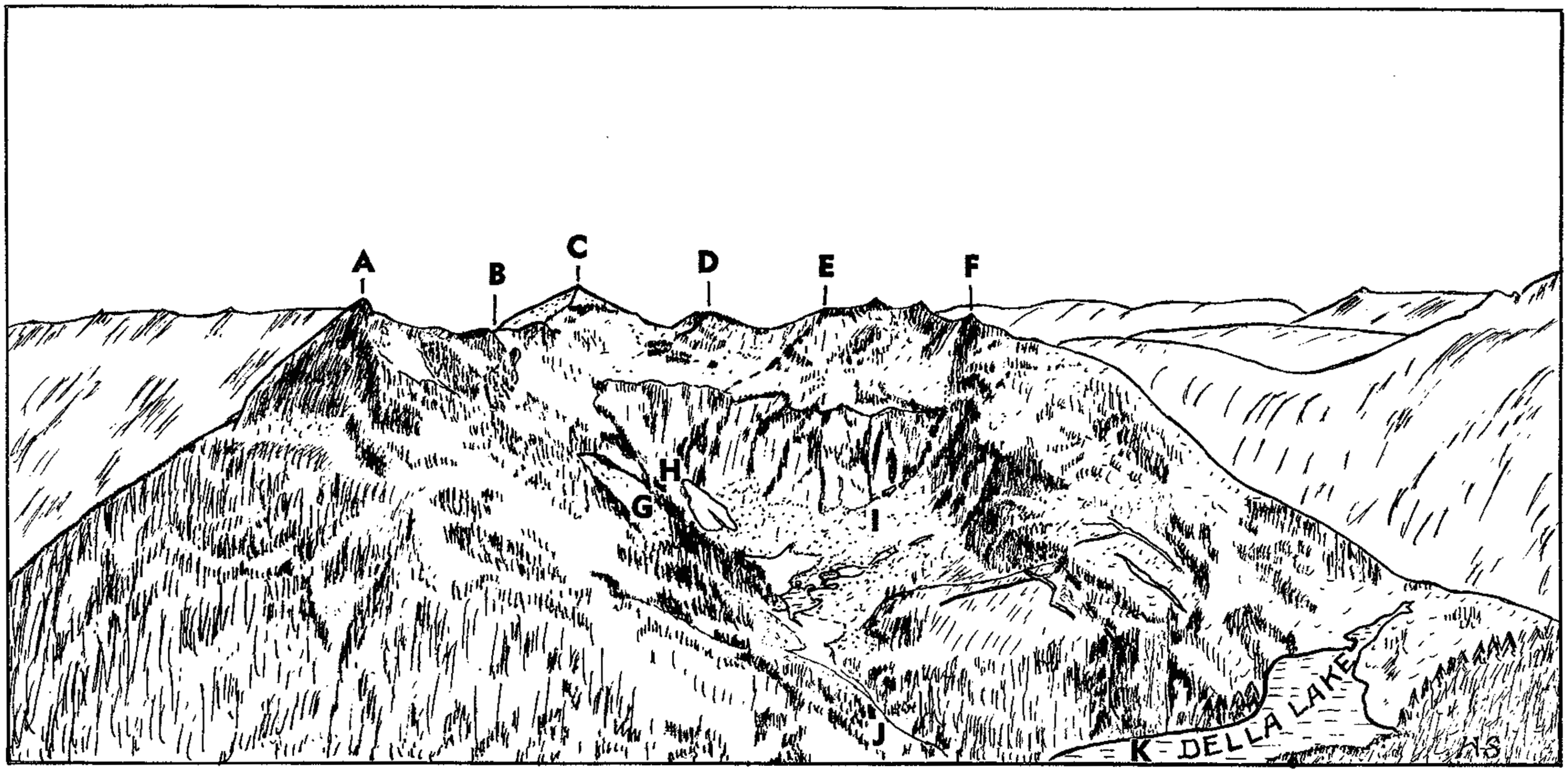
Work was continuing in this drift at the time of the examination. It is reported that when work was suspended, the face of the working had reached a point 475 feet southerly from the portal, and that between 30 and 40 feet from the portal, a winze had been sunk to a depth of 31 feet. Further it is reported that company sampling indicated commercial widths and values in the winze, and in the drift in five sections, ranging from 30 to 80 feet long.

PTARMIGAN (NO. 12-Fig. 1)
BIG I (NO. 13-Fig. 1)

Four Crown-granted claims known as the Ptarmigan group, and adjoining them to the south-east, four Crown-granted claims known as the Big I, or sometimes as the Big Interior group, cover ground which includes the highest peak of Big Interior Mountain and the north-western part of a deep cirque south-east of the peak. The claims are in part in the Alberni and in part in the Clayoquot Mining Divisions. The main peak is approximately 8 1/2 miles north-westerly from the head of Great Central Lake and 11 1/2 miles north-easterly from the head of Bedwell Sound. The claims: Big I No. 6, Lot 1231; Big I No. 7, Lot 1232; Great Central No. 6, Lot 1233; and Great Central No. 5, Lot 1234; Crown-granted in 1913, have been called the Ptarmigan group and are owned by Ptarmigan Mines, Limited, an English company with a representative in Vancouver. The claims: Big I No. 1, Lot 1640; Big I No. 2, Lot 1641; Big I No. 3, Lot 1642; and Big I No. 4, Lot 1644; Crown-granted in 1926, have been called Big I group and are registered as owned by Joseph A. Drinkwater and Michael Tebo of Alberni.

A cirque in the heart of Big Interior Mountain is enclosed by a series of high peaks and connecting ridges except where it opens into the hanging-valley occupied by Della Lake, described in the note on the Della. The cirque and the rugged ridges and peaks enclosing it are shown on Plate II, a panorama composed of three photographs looking in northerly directions from the top of Mount Nine Peaks, elevation 5975 feet. On the drawing, (Fig. 4), based on the panorama, a number of reference points are indicated by letters. These letters with the names given in the following paragraph will be used throughout the report.

The term cirque will be restricted to the inner steep-walled part and the outer section connecting it with the valley of Della Lake. The slopes extending from the tops of the steep walls to the peaks and the crests of the surrounding ridges will be called the rim of the cirque. From the main peak "C" a great ridge extends southerly to a second peak, the south peak "A", and thence south-easterly to a pass between Della Lake and a



A. South Peak—elevation 5,900 feet.
B. Southern margin of limestone, on south spur.
C. Main Peak, Triangulation station—elevation 6,107 feet.
D. Knob of limestone.
E. Eastern margin of limestone on ridge.
F. Fracture on western side of peak.
G. Draw.
H. Top of snow mass in north-west corner of cirque.
I. Eastern end of quartz-diorite.
J. Outlet of cirque.
K. Fracture at Della Lake—elevation 3,525 feet, approximately.

Fig. 4. Looking northerly into cirque, Big Interior Mountain, copied from panoramic photograph
Plate II.

branch of You Creek. This ridge will be called the south spur. From the main peak a ridge extends north-easterly for about a quarter of a mile to a knob "D" and thence easterly for half a mile to "F" the most easterly of several jagged peaks. From "F" a ridge extends southerly sloping down to bluffs which tower more than 500 feet above the shore of Della Lake. Continuing south-westerly with axis paralleling the lake, a spur slopes down to "J", the entrance to the cirque. A snow mass at "H", in the inner corner of the cirque, and a draw "G", of which the head is in the rim on the south spur, will serve as further points for reference. Some other points marked with letters will be defined in the geological descriptions.

The floor of the inner cirque is between 3700 and 3800 feet in elevation. Some snow masses, about as in Plate II, remained in August 1940 and the several shallow lakes were exposed. Pictures published in the Annual Reports, Minister of Mines, British Columbia, probably taken in August 1906, show a very much greater accumulation of snow, which was then referred to as a glacier. From the floor talus slopes rise several hundreds of feet to steep cliffs which wall the inner cirque. An embayment at "H" in the north-western corner has walls which are less steep. Extending southerly from the embayment on the western side of the cirque steep cliffs of quartz-diorite and limestone rise as much as 700 feet above the talus. High rusty bluffs extend south-easterly from the embayment to an escarpment which forms the eastern wall of the inner cirque. The inner cirque has a maximum width of almost half a mile. The width narrows toward the south-east and the stream from the cirque flows through a shallow narrow canyon at "J" into the valley of Della Lake. The distance from the cliffs at the head of the cirque to Della Lake is about three quarters of a mile.

Above the precipitous walls of the cirque the rim rises steeply to the crest and to the several peaks of which the south peak "A" has an altitude of approximately 5900 feet, the main peak "C", of 6107 feet and a peak about three quarters of a mile to the east has an altitude of about 6000 feet. The outer slopes of Big Interior Mountain are steep on all sides. The main peak stands more than 5000 feet higher than the floor of Bedwell River Valley at the mouth of You Creek, less than 2 miles to the south-west. From the same peak, north-westerly to a point on upper Bedwell River, the drop is more than 4200 feet in about 1 1/4 miles. The highest peak between "E" and "F", (Fig. 4), is about 3400 feet higher than the floor of Drinkwater Creek Valley, three quarters of a mile to the east. A glacier of which the head is in the saddle between "C" and "D", (Fig. 4), extends northerly to the head of one of the sources of Bedwell River. There is also a small glacier in a northerly-facing cirque, in the south peak, "A".

The general geology is indicated on (Fig. 1). Trending south-westerly the contact of the Bedwell River batholith crosses the crest in the saddle between the main peak "C", and a knob of limestone "D", and crosses the crest of the south spur not far south of "C". The main batholith is not exposed elsewhere within the area encircled by the crests surrounding the cirque; but a mass of quartz-diorite, three eighths of a mile from north to south, is exposed between "I" and "H" in the northern wall of the cirque; a second and smaller mass is exposed in the bluffs, westerly from "H", in the north-western corner of the cirque; and a third mass about the size of the second is exposed in the bluffs about 1100 feet to the south. Dykes of quartz-diorite up to 50 feet wide are exposed on the spur on the south-eastern side of the cirque, and numerous smaller dykes of quartz-diorite and of feldspar-porphyry are found in and around the cirque. Dykes of feldspar-porphyry, including a facies rich in hornblende, cut the quartz-diorite.

Limestone outcrops on the crests of the ridge north-easterly and southerly from "C" and extends almost to the foot of steep cliffs between the two smaller masses of quartz-diorite, on the western side of the cirque. On the south spur limestone and overlying thin bedded siliceous and argillaceous sediments are intruded by basalt, doubtless related to the overlying lavas which form the south peak "A", and are important in Mount Nine Peaks to the south and Mount Septimus to the east. The limestone is believed to belong to the same horizon as other faulted masses found in this part of the area. Fossils collected from two limestone masses north-east of upper Drinkwater Creek have been identified and placed in the Permian.

The rocks stratigraphically below the limestone are mapped as a "Palaeozoic and Mesozoic complex". They include fine-grained cherty volcanics and impure tuffs older than the limestone, small bodies of intrusive basalt, and at the eastern side of the cirque a large mass of basaltic rock in intrusive relationship, as well as numerous granitic intrusives. Much of the large mass of basaltic rock consists of rounded cobbles in a matrix of very similar material which grades from fine-grained to a moderately coarse granular texture. This rock passes gradationally to one of more uniformly gabbroic appearance and is believed, like the basalt intruding the sediments on the south spur, to be related to the Lower Mesozoic volcanics.

Much faulting has occurred in this part of the area as indicated clearly where there are limestone masses to serve as markers. Probably there has been movement along some fractures which are indicated by scarps and other topographic features. A fracture cuts through the spur on the eastern side of the cirque and is clearly exposed from "K" on the shore of Della Lake, for almost 1 mile northerly to the peak "F". This fracture strikes west of north, dips steeply westward and for some distance controls the scarp at the eastern side of the cirque. Other fractures control parts of the south-western wall of the cirque.

A good deal of limestone is recrystallized but most of it is unmineralized. At some points, notably near the main peak, garnet, epidote, amphibole, and other silicates replace basalt and limestone. Some of the resulting silicate rock contains a little magnetite. Sulphides are found at a number of points in the silicate rock and, close to contacts with limestone, in the basalt which has been less completely metamorphosed. The sulphides include chalcopyrite, pyrrhotite, and at a few points, molybdenite. In the talus on the upper slopes near the main peak some banded material containing a good deal of malachite is found. Patches green with malachite are to be seen at a number of points. The andesite and fine-grained sediments older than the limestone contain disseminated sulphides and some magnetite at several points. On the rim and in the cirque sulphide mineralization was found in the basalt and in the older volcanic rocks more commonly than in the limestone.

Some of the granitic dykes contain chalcopyrite and pyrrhotite in tiny fractures. Fine grains of pyrite, pyrrhotite and some chalcopyrite are disseminated in some of the granitic rock, particularly near the contacts. Great rusty bluffs at the northern side of the cirque consist of quartz-diorite containing disseminated sulphides. Rusty bluffs on the peaks facing Drinkwater Creek consist of fine-grained rocks of Palaeozoic age, cut by granitic dykes. Grains of pyrite are disseminated through the dykes and the older rocks.

Local concentrations of copper-bearing mineralization and larger masses containing scattered grains of chalcopyrite, in or close to the ground covered by the Crown-granted claims, will be described later in more detail. A little chalcopyrite and some molybdenite were found near a dyke in the escarpment on the eastern side of the cirque. Elsewhere on Big Interior Mountain the writer found little evidence of copper-bearing mineralization.

History

The Annual Report, Minister of Mines, British Columbia, for various years from 1903 to 1933 refer to the Ptarmigan and Big I. The Annual Report, Minister of Mines, 1906 is based on an examination made in August of that year by H. Carmichael and the Annual Report, Minister of Mines, 1916 is based on an examination made in October of that year by W. M. Brewer. The other reports contain the current news of the properties and some of them reproduce information contained in 1906 and 1916.

From the reports it appears that the first claims were located about 1899 by J. A. Drinkwater and D. Nichols, and that at different times other staking was done nearby. Of the various claims staked the eight mentioned in the first paragraph of this report are probably the only ones held for long. Apparently little actual work was done on the ground, although a rather costly campaign of road construction was begun by Ptarmigan Mines, Ltd., and a serious effort was made to take a diamond-drill to the Big I group.

In the Annual Report, Minister of Mines, British Columbia, 1906, Carmichael mentions a 31-foot adit; this appears to be the only reference to any working on either property seen by an officer of the Department. The adit is in the north-western corner of the cirque toward the north-western boundary of the Big I group. Carmichael does not mention any workings farther to the north-west on the ground later acquired by Ptarmigan Mines, Limited; and it is probable that in 1906 there were no workings on this ground. In the Annual Report, Minister of Mines, 1916, Brewer says that in October he was unable to visit the 31-foot adit on the Big I property because the rock was slippery from frost. He says also that for the same reason he was unable to examine three short adits driven on the Ptarmigan property after Carmichael's examination. The present writer found the 31-foot adit; and on the Ptarmigan property found a 15-foot rock-cut from the end of which an adit had been driven 3 feet; but found no other workings within the area covered by Crown-granted claims.

The 1912 and 1913 Annual Reports, Minister of Mines, British Columbia, record that Ptarmigan Mines, Limited, had taken up claims and in 1913 obtained Crown-grants of the claims listed as Ptarmigan group in the first paragraph of this report. The 1913 Report mentions a "tunnel entry of 10 feet" on the property of Ptarmigan Mines, Limited, and the expenditure of $47,000, principally on road construction. The 1914 Annual Report, Minister of Mines, British Columbia, says that the company suspended work because of the outbreak of war.

Apparently Ptarmigan Mines, Limited, intended to build a wagon-road up Bedwell River, to a point from which an aerial tramway would be built to the claims near the summit of Big Interior Mountain. The exact location of the proposed tramway is not mentioned in the reports. It seems probable that the site proposed for the lower terminal of the tramway must have been at least as far up the river as the mouth of You Creek, and possibly farther; that is at least 11 miles by road from the head of Bedwell Sound and possibly 12 or 13 miles.

It is reported that when work was suspended in the autumn of 1914, supplies and equipment, including cables for the proposed tramway, were left at the head of Bedwell Sound. Road construction, involving the building of many bridges, had reached the 7-mile post. This was a difficult and costly project requiring the building of many bridges and of much corduroyed road. Powder left at the head of the sound had later to be destroyed. The Annual Report, Minister of Mines, British Columbia, 1919, reports that the company engineer inspected the material, and the road, and found that they had deteriorated greatly. The company does not seem to have attempted further work on the project. In 1939 the wooden bridges and the corduroyed parts of the road had deteriorated so much that they were no longer useful even for pack-horses.

The Annual Reports mention examinations of the Big I property, made by engineers representing one or more mining companies; but there is no statement of any specific work done at the property after the 31-foot adit, which was driven before Carmichael's examination in 1906. In 1916, Brewer says that early in October of that year a diamond-drill was taken in and that a light aerial tramway had been built for taking supplies up the mountain from the river camp on Drinkwater Creek. The tramway, still standing in 1940, extends from the bottom of Drinkwater Creek Valley to the top of the escarpment just north-west of Della Falls. The writer saw a quantity of equipment including pumps, parts of a diamond-drill, pipes and tools still lying near the foot of the tramway. Possibly this equipment was never taken any nearer the Big I property. An electric generator, the remains of which are in an old cabin on the north-eastern side of Drinkwater Creek, and copper transmission wire now used for hand-holds along the Della Falls trail, were probably taken in at the same time as the diamond-drill.

Access

The head of the cirque can be reached from the top of the Della Falls trail by a route along either side of Della Lake, vestiges of a trail remain through timber on the north-western side of the lake. The distance is about 1 1/2 miles by either route. At a few points it is possible to climb well up the cliffs from the cirque, and it may be possible to reach the rim above the cliffs this way. A safer and much easier course to follow, leads south-westerly from the southerly corner of Della Lake to the summit of the pass, a distance of about a quarter of a mile in a straight line, thence the south spur can be followed northerly. Most of the mineralization exposed on the upper slopes is close to the main peak of Big Interior Mountain, about 1 mile west of north from the pass.

The upper slopes can also be reached conveniently from the Bedwell River side by making use of the trail which leads from a camp-site, about 13 1/2 miles by road and trail from the head of Bedwell Sound, to the Casino workings. The camp is at about 1400 feet elevation, a short distance south-east of the river. From it the trail climbs, in about 0.8 miles, to a point at 2600 feet elevation, south-east of the camp. The trail forks here; the left hand fork leads to the mine-camp and to the most extensive workings on the Casino property. The right hand fork of the trail is steep, rough, rather circuitous, and may be hard to follow, but it indicates a route up the very steep north-western side of the mountain to the open upper slopes. This branch of the trail reaches a point, at about 3900 feet elevation, on the western side of a northerly-flowing creek, about 1 1/4 miles from the river-camp. One of the Casino veins is exposed at intervals along the eastern side of this creek. The ridge on the western side can be followed southerly to a small lake at about 4400 feet elevation, and 1 3/4 miles from the river-camp by this route. The lake is a little more than half a mile south-westerly from the main peak. North-easterly from the lake there are high bluffs of quartz-diorite and of limestone. By circling to the south, the crest of the south spur, a short distance south of the peak, can be reached with little difficulty. The writer and his assistant climbed from the river-camp to the little lake in just over two hours. It is possible to go from the little lake to the crest of the main ridge near the best showing in not more than an hour and a half.

Examination in 1940

With two assistants the writer devoted a large part of the 1940 field season to geological mapping and examination of mineral deposits on Big Interior Mountain, and on Mount Nine Peaks, immediately south of it. By far the greater part of the effort was devoted to Big Interior Mountain. This work included mapping with a plane-table, for which a system of triangulation stations was laid out, and additional information was recorded in photographs taken from several camera stations. Traverses were run on which positions were determined by pacing and compass bearings, and by rough triangulation.

Most of the time the Sherwood base-camp on upper Drinkwater Creek was used as the base. Later, the western parts of the mountains were attacked from the Bedwell River side, using the old You mine-camp and the Casino river-camp as bases. Excluding time spent travelling between the outside and bases, and time spent at the Sherwood base-camp, 32 days in July, August and September were devoted to this work. During this time there were many rainy days and much fog. For plane-table mapping fair visibility and freedom from actual rain were required. Other work was frequently done in the rain. Climatic conditions of this kind are usual in this area.

The rugged and often precipitous slopes of Big Interior Mountain are hazardous when visibility is poor. Large parts of the upper slopes were still snow-covered in mid-August. Talus covers the bed-rock in considerable area on the rim and in the cirque. The difficulty of access, rugged nature of the country and unfavorable climatic conditions, greatly increase the difficulty of examining mineral deposits in this part of the area. Rust-stained rock exposures cover large sections and some copper mineralization is indicated in a very large volume of rock. To sample such a volume of material would be a large task, and to take the samples out for assay would be another.

The principal copper-bearing mineral found in these deposits is chalcopyrite. The pure mineral contains 34.5 per cent copper and has a specific gravity from 4.1 to 4.3. If we take the specific gravity of the average rock as about 2.7, it is apparent that chalcopyrite must make up about 2 per cent of the volume of such rock, in order for the rock to contain 1 per cent copper by weight. Chalcopyrite is a rather conspicuous mineral, and is usually seen readily if present even in small amounts. Therefore the writer feels that careful observation will give a fair indication of whether or not chalcopyrite mineralization approaches commercial grade. The writer took samples representing any material which contained chalcopyrite including material obviously poor in that mineral. These "indicator" samples were designed to support and make more definite careful observations of the chalcopyrite content. The assays of these samples are given in the following more detailed notes.

Erosion is proceeding rapidly, snow lasts more than half the year, and therefore most material exposed at the surface shows little evidence of secondary alteration. Chalcopyrite, pyrrhotite and pyrite, found in the cliffs, in pieces of talus and in other exposures, show little evidence of alteration. On the other hand malachite, doubtless derived from chalcopyrite, is found at a number of points; and some pieces of talus, near the crest of the "South Spur" northerly from "B", consist of banded material obviously deposited by surface waters, and contain a good deal of malachite. It may be that, from shattered rock where erosion is less rapid, chalcopyrite has been leached out almost entirely, leaving perhaps a little malachite. Masses of shattered silicate rock, consisting largely of garnet, found northerly from "B" on the crest of the "South Spur", and south-easterly from "B" along the contact between limestone and basalt, contain a little malachite at the surface and might be found to contain sulphides a few feet below the surface.

Notes on occurrences of mineralization.

The position of the claims in relation to the topography is indicated on (Fig. 1) copied from Map 92 F/5, published by the Department of Lands in 1939, at a scale of 2 inches to 1 mile, and 100 foot contour interval. The topographic features are conspicuous and the triangulation station on the summit of the main peak of Big Interior Mountain consists of a cairn visible for miles. On the ground the writer found only one indication of the claim boundaries, a point witnessing for one claim post. It is therefore impossible to describe all the occurrences of mineralization in relation to the boundaries of the two properties, much less in relation to the boundaries of the individual claims. For this reason the mineral occurrences are described in relation to topographic features indicated on (Fig. 1) and shown in Plate I, specific references are made to letters in (Fig. 4), a sketch based on Plate II. Based on the boundaries as given on Map 92 F/5 it can be said that the occurrences described in the following notes are almost entirely within the ground covered by the eight claims of the Ptarmigan and Big I properties.

Mineralization exposed in the cliffs on the northern side of the cirque, from "I" to "H", is described first. Reference is then made to disseminated mineralization in the corner near "H" and along the western side of the inner cirque. The next exposures described are in the draw "G", which may be outside the ground covered by the two properties. The mineralization described next is exposed near the south-western margin of the limestone on the upper slopes of the eastern side of the south spur. Mineralization exposed on the inner slopes not far below the main peak is then described, followed by reference to masses of silicates found in the saddle just north-east of the main peak, and at the eastern edge of the glacier just north of the saddle.

Great rusty cliffs, extending for about 2000 feet westerly and north-westerly, form the northern wall of the cirque. For about 1500 feet, from "I" almost to "H", the cliffs consist of rather fine-grained quartz-diorite which contains inclusions of altered rock. At some points slabs of altered andesite or basalt form a veneer on the face of the cliffs, which are about at the southern boundary of the largest mass of quartz-diorite in the cirque. It appeared to the writer that the contact dipped toward the south and that the cirque advancing northerly has not gone far into this mass. The quartz-diorite belongs to a facies rich in biotite and hornblende and contains grains of magnetite recognized under the microscope. In the cliffs this rock contains tiny scattered grains of pyrite, pyrrhotite and some chalcopyrite. In the inclusions and in the slabs of altered rock exposed in the cliffs there is more-concentrated chalcopyrite mineralization. At some inaccessible points on these cliffs there are small areas of green stain, probably malachite. The most noticeable of these is toward the north-western end, where the face of the cliffs bends from a westerly to north-westerly course.

It seems unlikely that the accessible mineralization in these cliffs approached commercial grade. The amount of chalcopyrite to be seen is definitely small, and there is nothing to suggest that primary copper-bearing sulphides have been leached out. There is more sulphide mineralization in and around inclusions and in the slabs on the face of the cliffs but this material is present in small units, the largest seen by the writer might contain a few hundred tons which certainly would not average 2 per cent copper. A large sample consisting of chips knocked off at intervals in 40 feet was taken along the base of the cliffs, in what appeared to be a fairly representative section of the mineralized quartz-diorite. This sample assayed: Gold, nil; silver, nil; copper, trace.

The talus contains a great volume of rock broken from the cliffs and also contains rock carried down from the rim above. Particularly toward the north-western corner below the cliffs, the talus contains high temperature silicates which may have come from the zone near the main peak where such silicates are found in place. Mineralization richer in copper is also found near the main peak. It seems probable that scattered pieces of material, much richer in chalcopyrite than is the rock in the cliffs, have contributed to the idea that the talus might be regarded as low grade ore. The present writer does not believe that the talus contains enough copper per ton to cover the costs of extracting it even if the operation were on a large scale.

The second and smaller mass of quartz-diorite is exposed on the western side of the north-western corner of the cirque, north-westerly from "H", about due west of the southern boundary of the mass of quartz-diorite mentioned in the preceding paragraphs. Between the two masses of quartz-diorite, the rock consists of fine-grained dark volcanics and possibly some limestone cut by dykes and less regular granitic bodies. The granitic rocks include quartz-diorite and hornblende-feldspar-porphyry. At some points they have absorbed material from the older rocks producing dark hybrid types which are difficult to identify. The older rocks have been materially altered and frequently consist of fine-grained mottled rocks of indeterminate character. Some of these rocks have been bleached and altered hydrothermally. In these rocks there are many joints containing quartz with a maximum width of 1/2-inch. Three systems of intersecting joints were observed, individual joints are separated from the nearest members of the same series by distances of 1 foot to 4 feet. Some of the joints contain a little chalcopyrite. Fine grains of pyrrhotite, pyrite and chalcopyrite are found in minute irregular fractures particularly in the granitic and hybrid rocks. Small aggregates of magnetite were observed at some points in the altered volcanic rocks.

The writer climbed to a point near "H", at about 4200 feet elevation, near the top of the snow mass on the western side, and then circling to the north-east climbed the bluffs. At about 4625 feet elevation dark quartz-diorite containing pyrite, pyrrhotite and chalcopyrite in minute irregular fractures, was sampled across 5 feet from west to east. It assayed: Gold, trace; silver, 1.0 oz. per ton; copper, trace. The 31-foot adit is a short distance to the east at about 4525 feet elevation, on the eastern side of a small creek which cascades southerly to the head of the snow mass. In front of the portal a dyke of hornblende-feldspar-porphyry, 10 feet wide, strikes north 40 degrees east and dips 85 degrees north-westward. The dyke contains pyrrhotite and chalcopyrite in minute fractures. North-west of the dyke, above the adit and for some distance west of the creek, the rock is bleached to a light-buff colour. White mica in small flakes appears to be the principal constituent of the rock. Above the adit there are patches stained green with malachite. The adit is driven about north 20 degrees west, in rock that contains some pyrite. On the western wall, 12 feet from the portal, a sample was taken, combining two vertical channels cut from the curve of the roof to the floor. It assayed: Gold, nil; silver, nil; copper, trace. Another sample was cut from the face of the adit. It combined two channels cut from the roof to the top of the muck, a distance of 4 1/2 feet; and assayed; Gold, nil; silver, nil; copper trace.

Continuing north-easterly and easterly across several creeks and climbing to about 4800 feet elevation, little sulphide mineralization was seen. Much of the rock traversed consists of quartz-diorite and hornblende-feldspar-porphyry.

On the western side of the north-western corner cliffs of limestone tower above the floor of the cirque. They have a maximum height of about 700 feet, and extend southerly for more than 1000 feet from the small mass of quartz-diorite in the north-western corner to the third mass of quartz-diorite, which is also small, and is exposed in high cliffs. From the foot of the limestone cliffs dark fine-grained volcanic rocks cut by granitic dykes slope steeply to the top of the talus. The limestone high in the cliffs is apparently cavernous, and from operings toward the top streams pour down the face of the cliffs to the narrow strip of volcanic rock at the base. The cliffs are dark grey in colour and are banded suggesting bedding-planes of low dip. Fragments in the talus contain fossils resembling those obtained from other limestone masses in the area but nowhere else in the area did the writer see massive limestone of a thickness comparable with that indicated here. This limestone does not appear to be mineralized. In part of the narrow strip of volcanics below the cliffs there are small cavities from which nests of sulphides have been dissolved by surface waters. A number of hornblende-feldspar-porphyry dykes in this section contain chalcopyrite and pyrrhotite in tiny fractures.

The cliffs continue southerly or south-easterly to about the end of the third mass of quartz-diorite, beyond which a timbered spur projects east of north into the cirque. At "E", (Fig. 4), the eastern boundary of the limestone crosses the crest. From this point a plane of weakness extends west of south, dipping westward, and at the top of the escarpment, above "H", marks the boundary of the largest of the three masses of quartz-diorite. This plane projected southerly crosses the cirque to a bluff which is the continuation of the main wall of the cirque. The bluff, extending upward to the rim, is of limestone and from it the spur extends easterly. The southern limit of the spur is the draw "G". From its head to the bluff the deep steep-walled draw cuts through limestone. Easterly from the bluff the southern slope of the spur is covered with unconsolidated material. The spur appears to be composed chiefly of volcanic rocks.

On the southern side of the draw there are good exposures of fine-grained volcanics and impure argillaceous rocks, generally much altered and cut by many granitic dykes. At about 4200 feet elevation the rock is mottled by alteration. A width of 3 feet with ill-defined boundaries is cut by many joints and is mineralized with pyrrhotite and chalcopyrite. A sample of this material assayed: Gold, trace; silver, trace; copper, 0.1 per cent. At 4350 feet elevation on the northern side of the draw a strong shear is exposed striking north 60 degrees west and dipping 60 degrees north-eastward. The sheared rock across a width of 5 feet is sparingly mineralized with sulphides. To the north above this exposure there is dyke of quartz-diorite which the shear cuts a little farther to the west. In the dyke the shear narrows to 10 inches and contains less mineralization.

Westerly up the draw at about 4525 feet elevation, 250 feet from the point where the shear was found, a fracture strikes north-easterly and dips about 80 degrees north-westward. This is at the bluff of limestone previously mentioned. From the fracture to the head of the draw the northern wall is limestone. The elevation of the top of the bluff is approximately 4850 feet. In the bottom of the draw a shear strikes about due west and dips 45 degrees northward. There is a dyke of quartz-diorite immediately below the shear, and on the southern side of the draw, below the dyke, fine-grained volcanics extend for 25 feet west of the north-easterly striking fracture. Westerly from this point the south wall of the draw also is of limestone. In the volcanic rock on the south side, the fracture contains a dyke of hornblende-feldspar-porphyry. Close to this dyke, at creek level, there is an irregular mass of pyrrhotite 3 feet wide. It is not exposed north of the creek, is not traceable far to the south, and appears to die out upward. The pyrrhotite is cut by veinlets from the thickness of a pencil line to 1/16-inch. They are spaced 1/2-inch or more apart and contain chalcopyrite and some quartz. A sample across the width of 3 feet assayed: Gold, trace; silver, trace; copper, 0.4 per cent.

The draw "G" cuts well into the rim of the cirque. Southerly from the draw the limestone is broken and intruded by basalt. From a point a short distance west of the head of the draw the contact of the main limestone mass, with overlying basalt, follows an irregular course north-westerly to "B" on the crest of the south spur. The course of the contact is marked by a depression with volcanic rocks to the south-west and limestone to the north-east. The depression was partly filled with snow on August 14th, 1940. The contact roughly follows the limestone beds, strike about north 50 degrees west, dip 50 to 60 degrees south-westward, but the basalt is intrusive into the limestone at many points. Cherty and argillaceous beds at the top of the limestone horizon have been largely destroyed as have some of the upper beds of limestone. Much of the limestone is recrystallized, but along most of the contact there is little other evidence of metamorphism.

Following the contact north-westerly sulphide mineralization was found, at 5300 feet elevation, about halfway between the head of the draw "G" and the crest at "B". For about 40 feet north-westerly along the contact and 15 to 20 feet south-westerly rock, which projected through the snow, contains sulphides in irregular masses from an inch to 20 inches wide. This rock, largely fine-grained and basic, contains some garnet and possibly some fragments of limestone. The masses containing sulphides consist of chalcopyrite, garnet, some quartz. and unreplaced rock. Possibly 20 per cent of the area consisted of such material. A selected sample of this sulphide-rich material assayed: Gold, 0.14 oz. per ton; silver, 3.0 oz. per ton; copper, 11.1 per cent. The limestone just north-east of the contact dips 75 degrees westward. A little malachite stain at the margins of cherty nodules was the only evidence of mineralization in the limestone.

Between this point and the crest of the south spur occasional exposures of garnet and epidote were found near the contact, but there was little to indicate sulphide mineralization. On the western slope, about 400 feet west of south from the crest of the south spur, the writer found some garnet and a little malachite stain in a small area near the contact. This was the only copper-bearing mineralization found by the writer on the western side of the south spur.

The contact of the limestone with basalt to the south crosses the crest of the south spur at "B", elevation about 5700 feet, and about 1600 feet southerly from the triangulation station on the top of the main peak. Northerly along the crest the limestone is intruded by basalt and by granitic dykes. Between 350 and 375 feet along the crest the rock consists largely of garnet and shows a moderate amount of malachite stain. Thence northerly for another 350 feet the rock on the crest is basalt which extends for 100 feet or so down the slope to the west, but on the eastern side of the spur limestone is just below the crest. On the eastern side, a short distance below the crest and about 700 feet from the southern margin of the limestone, an adit has been driven for 3 feet from the end of a 15-foot rock-cut. Just past this point the main contact of the batholith crosses the crest. From the contact northerly the crest of the spur is quartz-diorite, as is the main peak about 900 feet to the north. On the western slope the contact runs westerly for some distance, but on the eastern slope of the spur, limestone continues a short distance below the crest for 400 feet northerly. From this point the crest rises steeply to the top of the main peak, about 500 feet farther to the north and nearly 300 feet higher. The side facing south-easterly into the cirque is very steep down to a small snow mass 300 to 400 feet below the peak. Immediately above the snow for 100 to 200 feet there are almost vertical cliffs. On this steep surface the contact is exposed extending north-easterly to the saddle between "C" and "D". The quartz-diorite in the ridge and in the peak contains fragments of basalt, is cut by many open joints, and is very rusty. The contact is irregular, its dip could not be determined but it is probably steep. Below the contact limestone, of low to moderate dip north-westward, is cut by dykes and thick irregular masses of basalt. The limestone and the basalt are cut by numerous dykes of quartz-diorite and hornblende-feldspar-porphyry which strike north-westerly. Relationships clearly marked elsewhere on Big Interior Mountain indicate that the hornblende-feldspar-porphyry is younger than the quartz-diorite.

At several points in a limited section along the contact of the batholith copper mineralization was seen a good deal richer than found elsewhere, with the exception of the occurrence halfway between the head of the draw "G" and the crest of the south spur at "B". The section extends from the cut and adit on the south spur, north-easterly below the main peak, almost to the saddle between "C" and "D", or about a quarter of a mile. Mineralization was found at several points within a vertical range of less than 150 feet and not more than 200 feet south-easterly from the contact. Farther to the south-east snow and talus masked the bed-rock as they did in considerable parts of the area outlined. The almost vertical cliffs below the peak are inaccessible. The examination was therefore limited to the base of the cliffs and to the ends where the cliffs merge with the inner slopes of the south spur and the saddle between "C" and "D". It was difficult to examine the base of the cliffs as the only footing available was the sharp top of the snow 2 or 3 feet from the face of the cliffs. Between the snow and the cliffs an opening extended down 6 to 10 feet. On the other side of the sharp top, the hard snow sloped only less steeply. Involuntarily the writer travelled by this route to the talus 150 feet below.

The cut at about 5775 feet elevation is a short distance east of the crest of the south spur. For 15 feet it follows a fracture westerly and from the end of the cut an adit continues a further 3 feet westerly. The rock here is basalt, but white limestone is exposed to the east, about 40 feet below the floor of the cut. The fracture strikes north 65 degrees west and dips 85 degrees north-eastward, and is at the northern side of the cut and adit. The rock has been silicified and sulphides are disseminated through it. Along the fracture for a width of a few inches there is abundant sulphide mineralization, some garnet replaces the wall-rock and quartz occurs with the sulphides. Molybdenite is present here in addition to chalcopyrite and a little pyrrhotite. A sample was taken at the widest part of the concentrated mineralization, 12 feet from the eastern end of the cut. This sample, 8 inches wide, assayed: Gold, trace; silver, 2.0 oz. per ton; copper, 8.3 per cent; molybdenite, 3.3 per cent.

In the zone outlined, north-easterly from the cut, most of the rock exposed is unmineralized limestone; masses of basalt, also unmineralized, and wide dykes of quartz-diorite, containing little sulphide mineralization, make up most of the remaining rocks exposed. There are several rusty patches of garnetized rocks showing areas of malachite stain. Several basalt dykes strike east of north and pinch down northerly as they approach the batholith. Some of these are largely replaced by the garnet and show malachite stain. One basalt dyke, followed northerly for about 100 feet, pinches from 3 feet to 6 inches in width. The narrowed dyke continuing northerly is greatly altered and contains a good deal of malachite. About a third of the way along the zone a 3-foot vein, consisting largely of garnet, contains malachite and some chalcopyrite. It strikes north 10 degrees east and dips steeply westward. A sample across the width of 3 feet assayed: Gold, trace; silver, trace; copper, 1.4 per cent. Followed northerly the width diminishes to 8 inches, in a distance of 60 feet or so. At about 5675 feet elevation, toward the north-eastern end of the zone, a sill-like mass, 20 feet thick, is exposed. It consists of fragments of

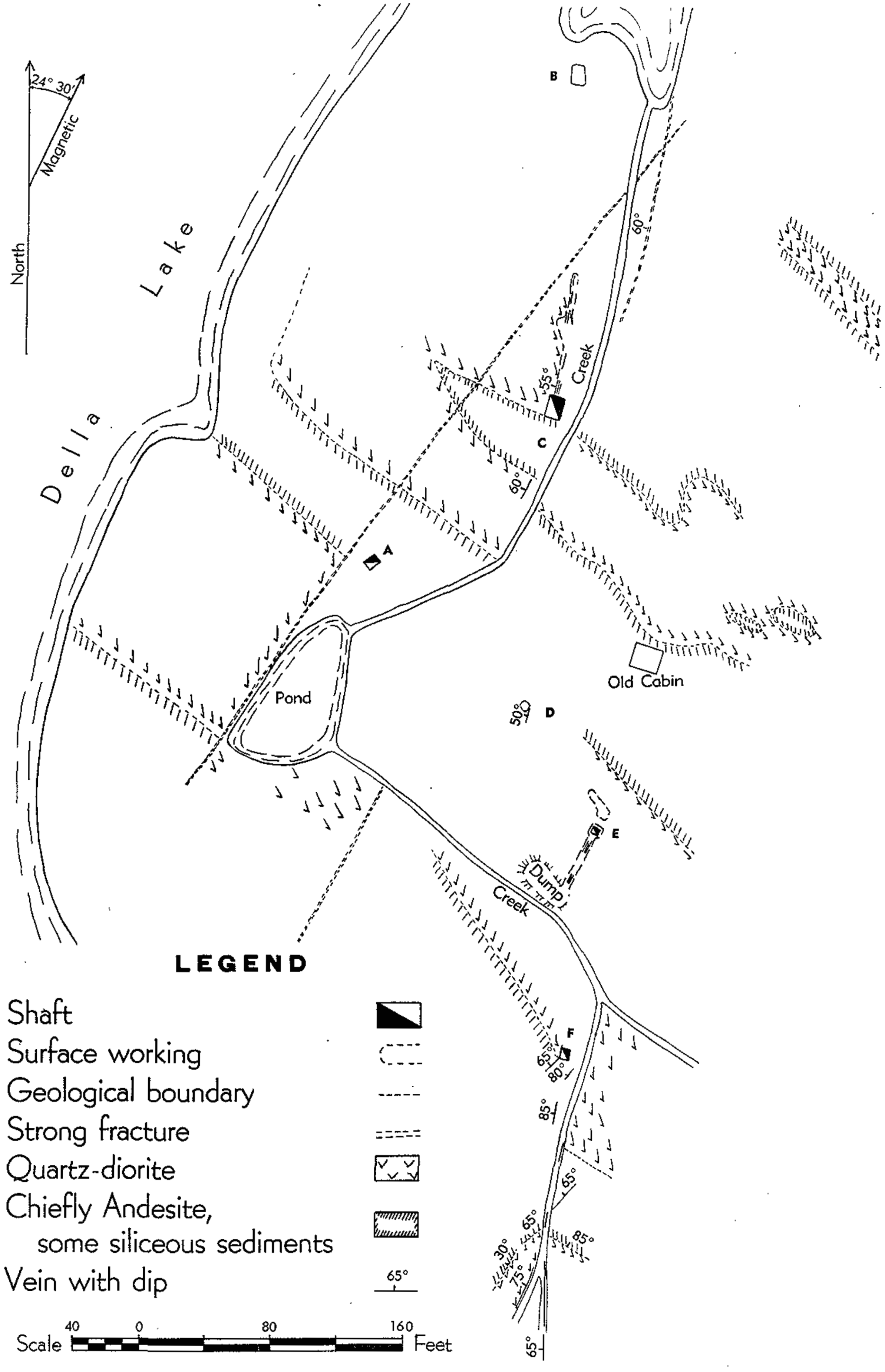


Fig. 5. Plan of workings, Della Property.

other rock in a ground-mass of quartz-diorite, strikes north 30 degrees east, and dips 55 degrees north-westward. Below the sill the rock is white limestone and above it there are small masses of limestone. The contact of the batholith is about 60 feet to the north-west up the steep slope. From 125 to 150 feet north-easterly from this exposure there is a band of garnet rock, thence for about 150 feet a mass of rock 10 feet thick contains a good deal of sulphide mineralization. This appears to be basalt replaced in part by garnet and otherwise altered. A sample from what seemed to be a fairly representative section of this rock assayed: Gold, trace; silver, trace; copper, 0.6 per cent. Quartz-diorite immediately above this rock contained very little sulphide mineralization. From this point to the saddle north-east of the main peak, a distance estimated at 500 feet, little bed-rock was exposed.

Limestone is exposed on the eastern side of the saddle, forming the knob "D" and extending easterly along the crest of the ridge for about three eighths of a mile to "E". From the saddle the limestone extends northerly for 800 or 900 feet, rising above the eastern edge of the glacier. Quartz-diorite outcrops in the saddle and continues westerly. On the south-eastern slope, just below the saddle, a considerable mass of basalt outcrops. Immediately above, there is a mass of rock composed almost entirely of bright green amphibole. No sulphide mineralization was observed here. At the eastern edge of the glacier, north of the saddle, the limestone is invaded from below by dykes of quartz-diorite. Beautifully crystallized garnet, epidote, and other silicates replace the limestone for a short distance from the contacts. With these silicates there is a little magnetite and a small quantity of sulphide minerals.

DELLA
(NO. 16 FIG. 1)

Ground which includes the north-eastern end of Della Lake and the adjoining south-western side of Drinkwater Creek Valley, is covered by nine contiguous Crown-granted claims of which the names and ownership are as follows:

Claim	Owner
Lot 591, "Della" M.C.	John David McLeod
Lot 592, "Bessie" M.C.	James Leo Rice
Lot 593, "Kate" M.C.	Herbert George Cummings
Lot 594, "Mamie" M.C.	Good Hope Mines Limited (NPL).
Lot 595, "Marie" M.C.	James Leo Rice
Lot 601, "Della Fraction" M.C.	Good Hope Mines Limited (NPL).

Lot 602,	"Minnie" M.C.	John David McLeod
Lot 603,	"Kendrick" M.C.	William Raymond Hancock
Lot 604,	"Engvick" M.C.	William Raymond Hancock

These claims are reported to have been located by Joe Drinkwater and Alvin Engvick about 1900. The Annual Report, Minister of Mines, British Columbia, 1917, lists the claims as Crown-granted that year, the grantee for all was Big Interior Gold Mines, Limited. Later the claims reverted to the Crown. The present Crown-grants were issued in the years 1930, 1934, 1935 and 1938.

The principal workings, believed to be on the Della were described in the Annual Report, Minister of Mines, British Columbia, 1916, and apparently were not new at that time. The reports mention efforts to save free gold which could be panned from the vein outcrops. The Annual Report Minister of Mines, 1906, states that an arrastra had just been completed at the property in August of that year. It seems probable that the workings were made at about the time the arrastra was built. Pictures of the arrastra appeared in the Annual Reports, Minister of Mines, 1906, 1916. Apparently it was built near the outlet at the north-eastern end of Della Lake and was driven by water from the lake under low head. In 1940 the writer's assistant found a circular pit lined with stones, doubtless the remains of the arrastra. A light aerial tramway, probably built about 1916 in connection with proposed development of copper mineralization on Big Interior Mountain, was standing in 1940; the upper terminal is not far from the outlet of Della Lake. The site of a cabin, near the principal workings at the Della, is still marked by the side logs.

Della Lake, trending north-easterly, occupies a deep hanging-valley, which opens to the east into the valley of Drinkwater Creek. The floor of the hanging-valley terminates abruptly at the top of an escarpment overlooking Drinkwater Creek. The lake elevation is approximately 3,525 feet and is about 1,700 feet higher than the bottom of the valley of Drinkwater Creek. The lake is more than three quarters of a mile long and has its greatest width, about a quarter of a mile, near the south-western end. It narrows to about 20 yards, less than a quarter of a mile from the north-eastern end. North-easterly from the narrows it does not widen greatly. A spur of Big Interior Mountain rises steeply on the north-western side of the lake, another spur forms the south-western wall of the hanging-valley. Between these spurs a stream flows south-easterly from a deep cirque in the heart of Big Interior Mountain and enters the lake near the south-western end. A stream from the glacier on

Mount Nine Peaks enters the lake at the southern corner. Thence south-easterly a steep spur of Mount Nine Peaks forms the wall of the valley. From near the narrows in the lake the valley widens out to the east and south-east and more moderate slopes prevail to the top of the precipitous south-western side of the valley of Drinkwater Creek. Bare rocks are exposed in most of this section but heather and clumps of trees grow in depressions and crevices where soil has accumulated. The principal workings are close to the south-eastern shore of the lake immediately south of the narrows. Most of the larger trees have been cut near the workings and near the camp-site, about a quarter of a mile southerly from the north-eastern end of the lake.

Della Lake discharges north-easterly in several streams which pour down the escarpment in a series of spectacular cascades, known as Della Falls. From the falls the water flows principally in two streams reaching Drinkwater Creek less than half a mile from the lake outlet and about 1,700 feet lower than the lake. These streams join Drinkwater Creek about 9 1/2 miles north-easterly from its mouth, which is near the western end of Great Central Lake.

The Drinkwater Creek trail crosses to the south-western side of the creek near the Sherwood base camp. From the crossing a branch-trail to Della Lake follows an irregular course to the foot of bluffs just south-east of Della Falls. The trail climbs 1,400 feet up the bluffs by a series of switchbacks. Wires strung along the trail and occasional overhanging branches make the ascent easier. From the top of the bluffs the trail follows a moderate grade to the camp-site within the hanging-valley. The distance by trail from the crossing to the camp-site is a little more than 1 mile. In a straight line the horizontal distance is about half a mile and the difference in elevation is about 1,750 feet. By using wires, strung along parts of the trail, and occasional overhanging branches as hand holds, it is possible to back-pack moderate loads up this very steep trail.

The rocks exposed along the trail up the bluffs are largely fine-grained volcanics. The north-eastern part of the floor of the hanging-valley consists of andesite, siliceous and tuffaceous sediments and small bodies of granitic rock. Nearby there are considerable masses of intrusive basaltic rock believed to be related to the volcanics of Lower Mesozoic age. The andesite and sediments are believed to be among the oldest rocks in the area, considerably older than Permian limestone which outcrops near the summit of Big Interior Mountain, and south of Della Lake, on the spur of Mount Nine Peaks. The granitic rocks are later than the basaltic ones and are related to the Bedwell River batholith assigned to the Jurassic and, or, Cretaceous. The main contact of the batholith is exposed a little more than 1 mile from the workings. It is probable that the roof of the batholith is considerably nearer the floor of the valley. Near the workings numerous granitic dykes and less regular bodies are developed along the breaks, some of which are strong and others rather indefinite. The resulting pattern is complex and the rock units are small. Vein-mineralization, carrying values in gold, is developed along several fractures which strike east of north and generally dip 50 to 70 degrees north-westward. These fractures are found following the contacts, or cutting across small rock units. They show marked changes in width, and have been traced for limited lengths only. In view of the small rock units and the irregular nature of the fractures it is unwise to project these veins beyond their known limits.

When the writer examined the property in July 1940, shafts and pits were full of water and unconsolidated material had sloughed into some of the workings. J. MacDonald and A. H. Rowan, both of Alberni, have been interested in the property recently and in some claims located nearby. They arranged to have some prospecting done in 1940. This work was being started when the writer left that part of the area late in August. It is reported that the prospecting was done principally low on the bluffs on the south-western side of Drinkwater Valley.

The workings and the local geological features including veins and fractures are represented on (Fig. 5). Numerous shallow draws trench the surface which is very hummocky. These trenches generally follow fractures or contacts between bodies of granitic and andesitic rock. For convenience in identification various workings have been marked with letters on (Fig. 5). A shaft marked "A" was sunk in andesite. No evidence of mineralization is to be seen in the broken rock at the collar of this shaft. The other workings were apparently made on fractures which probably contained some vein-mineralization, although such mineralization may not now be well exposed.

The vein-mineralization, consisting of quartz and sulphide minerals, occurs with sheared wall-rock in fractures which range from 1/2-inch to about 4 feet wide. Introduced vein-matter rarely forms more than a small part of the wider sections. Quartz 16 inches wide, measured normal to the walls, was observed at one point. The other exposures ranged from a fraction of an inch to 7 inches in width. Pyrite, chalcopyrite, galena and sphalerite at some points form important percentages of quartz stringers from 3/4-inch to 3 inches wide. These stringers may occur in wider zones showing evidence of mineralization. Some of the vein-matter is rusty and decomposed and possibly sulphides have been leached out. Sampling indicated better values in gold where sulphides were observed than elsewhere.

From the extent of the workings it does not appear that any substantial quantity of mineralized material had been mined and taken to the arrastra. Near several workings there are small piles of rock containing rusty vein-matter. Two small piles of vein-matter near the lake shore were apparently roasted in the hope that the roasted material would be more amenable to treatment; however it was not taken down the lake to the arrastra.

The most westerly workings in which mineralization was seen consist of, a pit "B" near the southern end of a narrow bay, stripping between a point 125 feet southerly from "B" and a shaft "C" 200 feet southerly from "B", and a narrow vein exposed from 44 to 58 feet southerly from shaft "C". These workings and exposures are in a natural trench through which a small stream flows northerly into the bay. It seems probable that the mineralization occurs along one fracture, striking east of north and dipping 55 to 60 degrees westward, which for most of the length controls the western wall of the natural trench. The pit "B" was full of water, and unconsolidated material concealed solid rock at the surface, but material in the dump indicates that the pit followed vein-mineralization. Thence southerly to the beginning of the stripping unconsolidated material covers the bed-rock. For approximately 85 feet from the beginning of the stripping to the southern side of the shaft "C", vein-mineralization is exposed at short intervals. Part of the filling of the fracture consists of decomposed black dyke-rock. The filling also includes sheared wall-rock, more or less silicified, and lenses or stringers of quartz, and sulphides. Sulphides occur with the quartz and with the silicified wall-rock. In a cut 52 feet northerly from shaft "C" the section exposed is indicated by the following samples:

Width Inches	Distance from hanging-wall Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
9	0 - 9	Compact silicified material containing some pyrite; much pyrite in width of 1 1/2 inches near hanging-wall.	0.30	0.1
5	9 - 14	Platy rusty quartz.	0.38	0.2
6	14 - 20	Light altered dyke, no mineralization, not sampled.	--	--
6	20 - 26	3/4 inches at hanging wall contains pyrite, rest is altered dyke rock.	0.14	0.1
17	26 - 43	Black decomposed dyke.	Nil	Nil

The section at the northern side of shaft "C" is indicated by the following samples:

Width Inches	Distance from hanging-wall Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
12	0 - 12	Black dyke, including 2 to 3 inches of quartz with pyrite and sphalerite.	1.30	0.3
22	12 - 34	Black dyke, including mineralized irregular quartz stringer.	0.30	0.1

The mineralization in this zone exposed southerly from shaft "C" consists of irregular quartz stringers 2 or 3 inches wide.

A pit marked "D", (Fig. 5), has been made at an isolated exposure of banded quartz containing altered wall-rock and some sulphides. The pit was full of water but the quartz was exposed for a length of 4 or 5 feet at the eastern side of the pit. It appears to be an irregular mass, striking north 10 degrees east, dipping 50 degrees westward, and about 16 inches thick, measured normal to the dip. A sample across the full thickness assayed: Gold, 0.36 oz. per ton; silver, trace.

The most extensive group of workings consists of a trench, 40 feet long, at the north-eastern end of which is a shaft "E", northerly from which there is a trench which does not expose bed-rock. The shaft was full of water and the trench was partly caved but south-westerly from the shaft a fair width of vein-matter was exposed in the trench. About 8 feet south-westerly from the shaft the writer took the following samples, across vein-matter and altered granitic rock, probably representing the full width of the fracture.

Width Inches	Distance from hanging-wall Inches	Description	Assay	
			Gold oz. per ton	Silver oz. per ton
5	0 - 5	Altered rusty wall-rock.	0.01	Nil
7	5 - 12	Quartz crystals in decomposed rusty mass.	0.10	Nil
15	12 - 27	Rusty horse of quartz-diorite.	Nil	Nil
22	27 - 29	Rusty decomposed quartz-diorite.	0.16	Nil

The strike of the fracture is about north 30 degrees east and the dip about 70 degrees north-westward. Across a small creek, there is a good exposure of fine granular volcanic rock in an escarpment about 50 feet south-westerly from the end of the cut. Neither fracture nor mineralization were observed on the projection of the strike in this direction.

The remaining workings and exposures are found at intervals for about 160 feet southerly from shaft "F" along the western side of a branch of the creek. The shaft was full of water and a number of the exposures were under water in the creekbed. These exposures consist of irregular branching fractures, containing gouge and at some points quartz. The quartz is in discontinuous stringers and lenses the widest of which is 6 inches.

SHERWOOD (NO. 17 - Fig. 1)
P.D.Q. (NO. 18 - Fig. 1)

The Sherwood and P.D.Q. properties adjoin, are served by the same trail, and both have been under development by Pioneer Gold Mines of B.C., Limited. The general information in this report is applicable to both properties. The report describes the work done on each property separately; but so far the two properties have been developed by one staff, essentially as a unit.

The properties include some 51 claims, 31 in the Sherwood and 20 in the P.D.Q. Nine of the claims were staked as fractions and it is understood that overlapping reduces the area of the others. Of the claims 8 were recorded in 1938, 12 in 1939, and 31 in 1940; 29 are recorded in the name of Pioneer Gold Mines of B. C. Limited, and the company is understood to have agreements or options to purchase the other claims. Some of the agreements provide that the vendor or vendors shall retain an interest in claims. Most of the ground covered is on the north-eastern side of the valley of Drinkwater Creek near Love Lake, but the Sherwood ground crosses the valley, north-westerly from Della Falls, and extends for some distance up the north-western side. The P.D.Q. ground adjoins the Sherwood to the east and south-east.

W. J. Sherwood is reported to have discovered the Sherwood Vein, a mineralized shear-zone in July 1939, and is or has been interested in many of the claims. The P. D. Q. ground consists of claims recorded in 1940, staked originally in the names of W. R. Ross, D. E. Lethbridge and Pioneer Gold Mines of B. C., Limited.

Supplies are brought up Great Central Lake, and to the end of the logging railway on Drinkwater Creek, on steamers and rolling stock operated by the logging company, Messrs. Bloedel, Stewart and Welch. From the railway to the property, about 6 1/2 miles by trail, supplies are taken on packhorses.

An examination of surface exposures and a few cuts on the Sherwood Vein was made in November 1939 for Pioneer Gold Mines of B. C., Limited. It was impossible to begin to do

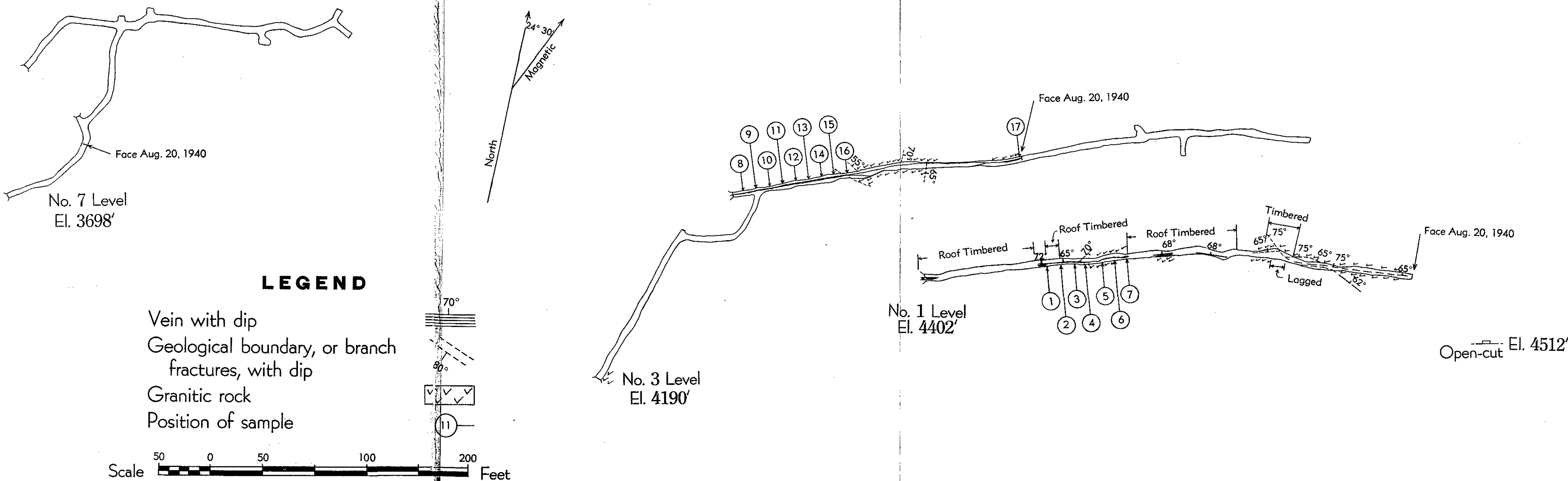


Fig. 6. Plan of workings, Sherwood property, after company plan.

more than preliminary work that year because of heavy snow. In 1940 a start was made as soon as snow conditions permitted. A warehouse was built at the railway, and necessary work was done on the Drinkwater Creek trail as far as the site of a base-camp, at approximately 1800 feet elevation, 4 1/2 miles by trail from the end of the logging-railway. The base-camp, built of logs. is on the north-eastern side about where the main trail crosses Drinkwater Creek, and is less than 100 yards from a log cabin built years ago and used in connection with work on the Della and Big I properties.

A branch-trail was built on the steep north-eastern side of Drinkwater valley just north-west of the creek draining Love Lake. It leaves the main trail about a quarter of a mile south-easterly from the base-camp, and climbs by a series of switch-backs, which in the first mile are built on a ridge between Love Lake Creek and a parallel creek 500 to 700 feet to the north-west. In about 2 miles the trail climbs approximately 2,400 feet to the mine-camp, at 4,200 feet elevation. By late in June trail construction had gone far enough to permit taking supplies on pack-horses from the railway to the mine-camp.

From this camp, consisting of tents, most of the work on the Sherwood Vein and on the No. 1 and No. 2 veins of the P. D. Q. property has been done. Underground work on the Sherwood Vein was carried on vigorously and three levels were driven. During the summer a second temporary camp was built for use in driving No. 7, the lowest level. When work was suspended for the winter in December, it is reported that work on the three levels (No. 1, No. 3 and No. 7) amounted to 1707 lineal feet, all driven by hand. The No. 1 and No. 2 veins on the P. D. Q. property, discovered during the season, were prospected by numerous surface workings.

Love Lake, at about 4,150 feet elevation, occupies a cirque, walled on the north by the main ridge of Mount Septimus and on the east and west by spurs which extend southerly from the main ridge. In this report the spur west of the lake will be called "Sherwood Spur", and the spur on the eastern side will be called "P. D. Q. Spur". The cirque opens to the south on a small area of low relief between the lake and the top of very steep slopes which extend down almost to the floor of the valley of Drinkwater Creek. The upper mine-camp is about at the outer side of the section of low relief, less than a quarter of a mile south-westerly from the south-western corner of Love Lake.

In the north-eastern part of the map-area (Fig. 1) a strong fault, marked by deep valleys or draws trenched along it, strikes about north 60 degrees west. This fault extends from Bedwell Lake south-easterly to a pass at the head of a creek flowing into the lake. On the other side of the pass the fault is marked by the valley of Drinkwater Creek for about 1 1/2 miles to a point where the creek-valley turns almost due south. The fault continues south-easterly and is marked by a draw on the western side of "Sherwood Spur", and by a shallower draw extending down to Love Lake on the eastern side of the spur. These draws cut deeply into the spur leaving a knob at the end which will be called "Sherwood Knob". The fault continues south-easterly across the lake and is as well-marked on the "P. D. Q. Spur", likewise leaving a knob at the end of that spur. This spur forms the western side of a basin in which there are several lakes drained by a creek which joins Drinkwater Creek down-stream from the creek draining Love Lake.

The slopes toward Drinkwater Creek from the two spurs and from the edge of the area of low relief between them, are very steep. The curving western and south-western sides of the "Sherwood Knob" consist of a series of steep bluffs connected by short sections which slope less steeply. The creek draining Love Lake and the creek to the south-east have very steep gradients and discharge substantial volumes of water. There is a good growth of coniferous trees at the bottom of the valley and up the steep slopes, the trees become shorter as the higher elevations are reached.

To the south-west of the fault south-westerly the ground included in the properties is mapped as "Palaeozoic and Mesozoic complex". It includes fine-grained volcanic and sedimentary rocks believed to be of Palaeozoic age, older than Permian limestone which is found at the north-eastern side of the fault on "Sherwood Spur" and at several other points north-east of the fault. The complex also includes a good deal of dark, generally fine-grained rock, in intrusive relationship. This rock is believed to be related to basaltic and andesitic volcanics younger than the limestone. The complex also includes many dykes and less regular masses of quartz-diorite and related rocks, associated with the Bedwell River batholith. At the nearest point the eastern contact of the batholith is about 2 miles from the top of "Sherwood Knob". Dykes of quartz-diorite, related to the batholith, are found along the course of the fault, in the complex to the south-west, and in the upper slopes of Mount Septimus, north-easterly from the fault, where they contrast conspicuously with the thick series of dark volcanic rocks extending upward to the jagged summits.

The relationships of the rocks in the complex are involved, a large part of the rock consists of intrusives, related to the volcanics and related to the batholith, in irregular masses which in general are small. Hybrid types resulting from absorption of older rocks by the granitic rocks are often difficult to identify. There is also evidence that some of the rocks have been modified by granitization, particularly in the section from the summit of "Sherwood Knob" to the area of lower relief south-westerly from Love Lake. In the same section there are many open fractures from a few inches to two feet wide. Pieces of rock dropped into some of the wider fractures could be heard hitting the walls at distances estimated at 50 or 60 feet below the surface.

The topography is so rugged, and the relationship of the various elements in the rock-complex is involved. The writer had the benefit of company plans showing the No. 1 and No. 3 levels on the Sherwood property. (Fig. 6), based on the company plan, shows the three Sherwood levels when work was suspended in December 1940. Some granitic rock cut by the workings and the traces of the vein as far as the faces, at August 20th, 1940, are indicated on (Fig. 6). The positions of samples taken by the writer are also indicated.

Information concerning the two properties was made available freely by the company officials. The writer and his assistants were boarded at the Sherwood camps and supplies and equipment were brought from the railway on the company pack-train. These accommodations assisted greatly in the examination of the two properties and in work done in the part of the map-area tributary to Drinkwater Creek. The writer wishes to record his gratitude to E. H. Lovitt, exploration engineer for Pioneer Gold Mines of B. C. Limited, and to R. P. Mason in charge at the properties, for the courtesies and assistance received.

Sherwood Vein

This vein consists of mineralization in a shear-zone. It outcrops in a canyon, which runs south-westerly down the precipitous end of "Sherwood Spur", and opens into Drinkwater valley at the top of a large talus fan. From the head of the canyon, half a mile westerly from the south-western corner of Love Lake, a shallow draw extends easterly, marking the northern side of the area of low relief, previously mentioned. Cuts, at 4,440 feet elevation, at the western end of the draw just above the portal of No. 1 level, expose the shear-zone. Other cuts, widely separated in 1,200 feet easterly from the portal, expose slips which may be the walls of the shear-zone.

The cuts go down as much as 10 feet without reaching definite vein-filling. They contain boulders and finer material some of which is decomposed.

The rock exposed near the draw and up the steep slope to the top of "Sherwood Knob" is cut by many open fractures, some of which strike from due west to north 30 degrees west and dip steeply generally northward or north-eastward. Other fractures strike north-easterly and dip steeply north-westward or south-eastward. Several scarps on the surface have the same general strike and granitic rock is found at some points along them. Many dykes are indicated along the canyon.

From No. 1 level to well below No. 3 level the outcrops of the shear-zone are in the bottom of the canyon, much of which cannot be reached safely. The portal of No. 1 level is reached by a shelf cut along the side of the canyon. On No. 3 and No. 7 levels it was necessary to drive underground workings to crosscut the shear-zone below the steep floor of the canyon. The two levels start from points at the edge and are driven northerly to north-easterly to the shear-zone. In both, before the shear-zone was reached, it was found convenient to break through into the canyon to improve ventilation and reduce tramming of waste.

The shear-zone strikes north of east and dips a little less than 70 degrees northward as indicated by the underground workings. The width, from 3 or 4 to at least 6 feet, is rather indefinite, because branch-shears run off into the walls and the walls and the filling of the shear are greatly altered. In the outer part of No. 1 level the vein strikes about north 70 degrees east, it begins to curve to the right about 240 feet from the portal, and in the inner end of the working strikes about north 85 degrees east. About 280 feet from the portal vein-mineralization in the shear is offset a few feet to the south, on the north-eastern side of a north-westerly striking cross-back.

Mineralization in the shear is in lenses or veins from a few inches to about 2 1/2 feet wide. Frequently two or more veins or lenses occur within the width of the shear-zone and are separated by wall-rock from a few inches to two or three feet wide, or by clay gouge a few inches thick. Narrow veins branch into the walls of the workings. The shear-zone cuts volcanic and granitic rocks and at some points follows along a contact. Some of the branch-shears, or branch-fractures containing mineralization, follow contacts.

Almost all the material in the shear-zone, exposed when

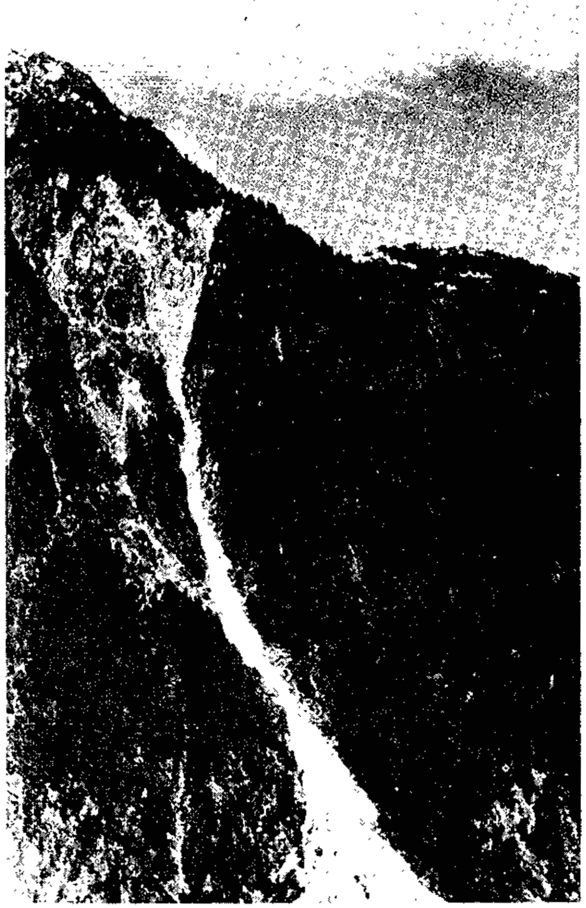


Plate IV A. Slide in which Sherwood vein outcrops.

Plate IV B. Tatterhorns Peak.

the writer examined the property, is greatly altered. The width of the zone, open fracturing, and the precipitous surface have favoured deep oxidation. Primary vein-mineralization includes quartz and sulphides. Most of this material has been reduced to a rusty, crumbly, and often porous, state. Some narrow harder sections contain recognizable sulphides and on No. 1 and No. 3 levels, toward the faces indicated on (Fig. 6), more sulphide mineralization is recognizable. However, even here the alteration has gone far, and the primary sulphides have been destroyed in part. Sampling by the writer indicates that clay gouge and horses of wall-rock separating lenses or veins of mineralization are essentially barren, and that where sulphide minerals are found values in gold and silver are usually attractive. There is a wide range in assays from samples of rusty decomposed vein-matter.

Sulphides recognized in hand specimens included sphalerite, galena, chalcopyrite and covellite. Pyrrhotite and marcasite replacing it were recognized under the microscope. Selected samples of sulphide mineralization assayed several ounces of gold per ton. Several sections containing sulphides were polished for microscopic study. With the exception of pyrite, the sulphides in the sections are greatly altered. the margins of the grains are destroyed, and the primary minerals are partly, or almost completely, replaced by covellite, malachite, anglesite and possibly by other secondary minerals. For this reason the primary relationships are not clearly indicated. The range of the ratio of silver assays to gold assays is wide, probably in part because of secondary alteration; but it is probable that silver values are in part associated with galena and that galena and other sulphides are distributed irregularly in the primary mineralization.

No. 1 level is a drift driven 376 feet easterly from a point at 4,402 feet elevation, about at the top of the canyon. In about 40 feet easterly from the portal the surface rises to 4,440 feet elevation. Thence easterly the surface rises gradually. Over the inner end of the working the surface is about 100 feet higher than the floor of the adit. Work on this level was stopped before the writer visited the property. Much of the working is timbered and lagged, and for that reason could not be examined. Extensive alteration at some points makes identification of the wall-rock difficult.

Over an average width of 39 inches company sampling indicated commercial values in the first 185 feet of this working. Beyond that point values and widths indicated were markedly less. The company samples were spaced closely and were cut before the roof was lagged.

The greatest width of vein-mineralization exposed is at the portal, immediately to the west below the portal the vein is split. The writer took samples in the outer part of the working in seven places, where the roof was not lagged, between 92 feet and 155 feet from the portal set. At most of these points the sampling was done in two or three sections because of a difference in character of the material sampled or because of differences in the slope of the surfaces sampled. The positions from which samples were taken are indicated on (Fig. 6). Data from this sampling are shown in the following table, widths given are horizontal, where the surface sampled was inclined the equivalent horizontal width is used.

No. 1 Level

Sample No.	Width Inches	Distance from hanging-wall Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
1	26	0 - 26	Soft vein-matter	0.90	1.1
2	24	0 - 24	Decomposed vein-matter	1.50	3.0
	9	24 - 33	Hard siliceous section	0.56	6.3
	10	33 - 43	Soft rusty material	0.28	0.9
3	10	0 - 10	Rusty rather hard vein-matter	1.30	1.9
	18	10 - 28	Decomposed vein-matter	1.10	5.5
4	10	0 - 10	Quartz and 2 inches of gouge	0.02	Trace
	16	10 - 26	Quartz with sulphides	2.38	13.5

No. 1 Level (Cont'd)

Sample No.	Width Inches	Distance from hanging-wall Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
5	11	0 - 11	Decomposed vein-matter, quartz and some sulphides	9.58	0.2
	8	11 - 19	Rusty vein-matter, quartz and some sulphides	1.00	1.0
6	9	0 - 9	6 inches soft vein-matter plus 3 inches gouge	Trace	1.6
	11	9 - 20	Soft rusty vein-matter, largely quartz	9.16	Nil
	2	20 - 22	Grey gouge at foot-wall	0.02	Nil
7	9	0 - 9	Soft vein-matter	0.34	0.5

The maximum width sampled is 43 inches. Widths of vein-mineralization from 12 to 26 inches are to be seen in most places where the roof is fully exposed. There is also narrower mineralization some distance to the foot-wall. It will be seen that there is a wide range in assays. Samples would need to be much more closely spaced throughout the length of the mineralized shoot in order to delimit ore and obtain dependable average values. Beyond this section vein-mineralization to be seen is narrower and is not continuous. In the inner end of the working the mineralization is less altered but it is limited to short lenticular masses 4 or 5 inches wide. Some further geological details are indicated on (Fig. 6).

No. 3 level, portal elevation 4,190 feet, reached the vein after crosscutting for 235 feet in the foot-wall in volcanic rock. The vein was then followed westerly by a drift which in about 20 feet breaks into the canyon, and easterly where the face of the drift was about 200 feet from the center line of the crosscut when the writer last examined the working.

It is reported that when work was suspended in December the total length of drift on this level was 449 feet. Company sampling is understood to have indicated a section regarded as commercial for a length of 100 feet, in the outer part of the drift. Widths were less but average values were greater than those obtained on No. 1 level. Beyond this section it is understood that vein-mineralization is less continuous.

The writer took samples at 10 foot intervals in 80 feet of the outer part of the drift. The positions from which samples were taken are indicated on (Fig. 6), and the data are shown in the following table.

<u>No. 3 Level</u>

Sample No.	Width Inches	Distance from hanging-wall Inches	Description	Assay	
				Gold oz. per ton	Silver oz. per ton
8	14	0 - 14	Mostly soft vein-matter, includes 3-inch hard rib	0.60	2.1
9	9	0 - 9	7 inches quartz and 2 inches gouge at foot-wall	4.00	5.0
10	11	0 - 11	Soft rusty vein-matter and 1 1/2 inches gouge at foot-wall	1.10	2.3
11	15	0 - 15	Rusty decomposed vein-matter, 1 1/2 inches gouge at foot-wall	0.28	1.3
12	21	0 - 21	0-9 inches porous black vein-matter 9-15 inches rusty vein-matter 15-21 inches gouge at foot-wall	0.02	Trace

No. 3 Level (Cont'd)

Sample No.	Width Inches	Distance from hanging-wall Inches	Description	Assay Gold oz. per ton	Assay Silver oz. per ton
13	17	0 - 17	Decomposed mineralized vein-matter	0.50	1.1
	17	17 - 34	A little quartz, chiefly crushed wall-rock and gouge	Trace	Nil
14	21	0 - 21	Rusty decomposed vein-matter, ground is crushed for 3 feet to foot-wall of sample	1.46	3.6
15	19	0 - 19	Rusty decomposed vein-matter, ground is crushed for 22 inches to foot-wall of sample	0.32	3.6
16	12	0 - 12	Soft vein-matter	0.30	0.3
	21	12 - 33	Crushed wall-rock	Trace	1.6
17	24	0 - 24	Full width of vein-matter, from face August 20, 1940. This sample also assayed: copper, 0.1 per cent, lead 3.9 per cent.	3.40	4.0

Beyond the section sampled the drift is in altered quartz-diorite, the mineralization is broken and shows a tendency to split. Values in gold occur where well-mineralized vein-matter is found, as indicated by Sample 17, taken from the face on August 19th.

No. 7 level, portal elevation 3,698 feet, had not reached the vein when the writer left the property. It is understood that when work was suspended in December drifting easterly had not encountered mineralization carrying substantial values.

P. D. Q. Veins

In mid-August 1940 two veins, referred to as "No. 1" and "No. 2", discovered that summer, were being prospected by surface workings. Distances given in the following notes are estimated from pacing, and elevations are from corrected barometer readings.

No. 1 vein had been traced west of south across "P. D. Q. Spur", from a point at 4,400 feet elevation on the eastern side. Cuts, generally closely spaced, followed the vein almost to the summit at about 4,750 feet elevation, 700 feet on the southerly course. For about 600 feet southerly from the summit cuts were spaced at intervals of 120 to 150 feet. Continuing southerly the cuts were widely spaced and some, in deep overburden, did not reach bed-rock. Farther southerly cuts were being made following a vein-filled fracture in a small draw which runs down the very steep slope of the southern end of the spur. The lowest cut was at about 3,975 feet elevation. At that time it could not be said definitely that the vein exposed in the more southerly cuts is the one exposed on the eastern side of the spur. The distance between the first exposure on the eastern side and the lowest cut in the draw was roughly 2,300 feet.

The vein or veins strike about north 20 degrees east and dip 70 to 85 degrees westward. On the eastern side and on the summit the rock is basalt, probably an intrusive related to Mesozoic volcanics. Across the rounded top of the spur the vein, 4 to 8 inches wide, is exposed in a shallow depression. Toward the southern end of the depression a small mass of quartz-diorite is exposed extending southeasterly. Thence southerly the country rock is a fine-grained to andesitic volcanic, but the fracture-walls are usually of quartz-diorite, and it seems probable that the vein-fracture or fractures follow earlier fracturing along which quartz-diorite had been intruded. Much of this slope is heavily drift-covered and rock exposures are infrequent. The lower cuts on this slope indicate vein widths from 12 to 20 inches.

The most encouraging results are reported to have been obtained from a section about 300 feet long on the eastern slope between 4,600 and 4,725 feet elevation, where the vein 6 to 18 inches wide had been exposed in cuts spaced at intervals of 6 to 20 feet. Toward the upper end of this section the writer took a sample across the width of the fracture.

In succession from the hanging-wall it included: rusty streak, 1 inch wide; honey-combed quartz with yellow-green stain, 8 inches wide; and rusty altered wall-rock, 9 inches wide, extending to the foot-wall. The sample from this 18 inch width assayed: Gold, 1.84 oz. per ton; silver, 2.6 oz. per ton.

In general the vein-fracture is from 4 to 20 inches wide and contains about half vein-mineralization and half altered wall-rock. In the exposures most of the material is oxidized and rusty. Introduced gangue consists of quartz and some carbonate. Pyrite, chalcopyrite, sphalerite, and galena, were seen irregularly distributed; and a greenish yellow stain suggested the alteration of an arsenic- or perhaps an antimony-bearing sulphide.

No. 2 Vein

Trending east of south on the eastern side of "P. D. Q. Spur", an escarpment forms the western wall of a draw which opens into a basin. This escarpment may mark a branch of the large fault described in the general part of this report. At about 4,150 feet elevation, just east of the escarpment, No. 2 vein was exposed in a surface-cut. The most northerly exposure of the No. 1 vein was about 1,000 feet northerly from this point. No. 2 vein strikes north 20 to 30 degrees east and dips 60 to 70 degrees north-westward. It had been traced about 325 feet north-easterly across part of the basin, with little change of elevation. Cuts at intervals in this distance incompletely exposed the vein, 8 inches to 2 feet wide. The vein-filling consists of rusty quartz and altered wall-rock with more or less sulphide mineralization. A fair amount of galena was to be seen at some points.

The best exposure was in a stripping from 150 to 170 feet north-easterly from the cut near the escarpment. Here vein-filling consists largely of quartz with sulphide mineralization concentrated in 2 or 3 inches at both walls. A sample taken toward the south-western end of the stripping, across 15 inches, the full width of the vein, assayed: Gold, 0.94 oz. per ton; silver, 4.2 oz. per ton; lead 1.4 per cent. A sample taken 5 feet north-easterly, at the footwall-side, across 3 inches, containing sulphides notably galena, assayed: Gold, 2.32 oz. per ton; silver, 6.2 oz. per ton; lead 8.4 per cent. Selected material containing sulphides and showing a yellow-green stain assayed: Gold, 0.26 oz. per ton; silver, 5.0 oz. per ton; lead 7.6 per cent. A section representing this selected material was studied under the microscope. It was very much altered. Pyrrhotite, pyrite, chalcopyrite, sphalerite, and galena, were recognized; small islands of another mineral in the galena may be grey copper.