Minister of Mines

PROVINCE OF BRITISH COLUMBIA

ANNUAL REPORT

for the Year Ended 31st December

1959

Printed by DON McDIARMID, Printer to the Queen's Most Excellent Majesty
in right of the Province of British Columbia.
1960

BRITISH COLUMBIA DEPARTMENT OF MINES

VICTORIA, B.C.

HON. W. K. KIERNAN, *Minister.*

P. J. MULCAHY, Deputy Minister.

J. W. PECK, *Chief Inspector of Mines.*

S. METCALFE, *Chief Analyst and Assayer.*

HARTLEY SARGENT, *Chief, Mineralogical Branch.*

K. B. BLAKEY, *Chief Gold Commissioner and Chief Commissioner. Petroleum and Natural Gas.*

J. D. LINEHAM, *Chief, Petroleum and Natural Gas Conservation Branch.*

To His Honour FRANK **MACKENZIE** ROSS, C.M.G., MC., LL.D.,
Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

The Annual Report of the Mining Industry of the Province for the year 1959 is herewith respectfully submitted.

W. K. KIERNAN,
Minister of Mines.

Minister of Mines Office,
March 31st, 1960.

Brian Terence O'Grady died at Victoria on July 12th, 1959, at the age of 76. He had been in the employ of the Department from 1920 until his retirement in April, 1948. He was very well known in the mining industry.

Mr. O'Grady was born in Madras, India, and was educated in England at Wellington College and the Royal School of Mines. After three years in South Africa he came to Canada in 1907. From 1910 to 1913 he was engineer in charge of surveys for the Municipality of Victoria. He was on active service from 1914 to 1918, winning the Military Cross and the Serbian White Eagle. He joined the Department as Assistant Resident Mining Engineer at Revelstoke in 1920, became successively Resident Mining Engineer at Nelson and Vancouver, and from 1938 was engaged in special work at Victoria. In 1942 he joined up as a captain in the Pacific Command and was field supervisor of the Pacific Coast Militia Rangers. While in Victoria he was adviser to the Superintendent of Brokers, and for several years after retirement he did consultive engineering work for the Department of Public Works and the Department of Mines.

Mr. O'Grady is survived by his widow, one son, and one daughter.

CONTENTS

LIST OF ILLUSTRATIONS

PHOTOGRAPHS

LIST OF ILLUSTRATIONS-Continued

PHOTOGRAPHS—*Continued*

DRAWINGS

DRAWINGS—*Continued*

ANNUAL REPORT OF THE MINISTER OF MINES 1959

Introduction

A Report of the Minister of Mines of the Province of British Columbia has been published each year since 1874.

The Annual Report records the salient facts in the progress of the mineral industry, also much detail about individual operations, including those undertaken in the search for, exploration of, and development of mineral deposits, as well as the actual winning of material from mineral deposits.

The Annual Report of the Minister of Mines now contains introductory sections dealing with Statistics and Departmenta! Work, followed by sections dealing with Lode Metals; Placer; Structural Materials and Industrial Minerals; Petroleum and Natural Gas; Inspection of Lode Mines, Placer Mines, and Quarries; Coal; and Inspection of Electrical Equipment and Installations at Mines and Quarries, each with its own table of contents. A table listing the properties described, in geographic groupings, precedes the index.

An introductory review of the mineral industry and notes at the first of several of the main sections deal generally with the industry or its principal subdivisions. Notes in the various sections deal briefly with exploration or production operations during the year or describe a property in more complete detail, outlining the history of past work and the geological setting as well as describing the workings and the mineral deposits exposed in them. Some notes deal with areas rather than with a single property.

The work of the branches of the Department is outlined briefly in the section on Departmental Work. This section is followed by notes dealing briefly with the work of other British Columbia or Federal Government services of particular interest to the mineral industry of British Columbia. Information concerning mine operations and some of the activities of the Inspection Branch of the Department of Mines is contained in the section on Inspection of Lode Mines, Placer Mines, and Quarries, early in the section on Coal and in the section on Inspection of Electrical Equipment and Installations at Mines and Quarries.

The section on Statistics begins with an outline of current and past practice in arriving at quantities and calculating the value of the various products.

Review of the Mineral Industry*

The final figures for 1959 mineral production in British Columbia indicate that, compared with 1958, the aggregate value increased 2.8 million dollars. However, the 1959 figure, $149,568,162, is 8 per cent below the average for the past decade.

Compared with 1958, the value for principal metals was virtually unchanged, gains were recorded for miscellaneous metals, industrial minerals, and fuels, and a 5-per-cent loss was recorded for structural materials.

Average prices for the principal metals year by year are shown on page A 14. The 1959 price for gold, almost the lowest in ten years, reflects the high discount on United States funds in Canada. The average discount for 1959 was 4.09 per cent, compared with 2.91 per cent for 1958. For silver, copper, and zinc, price gains more than offset the greater discount, and the prices in Canadian funds exceeded those of 1958. The lead price was slightly below that of 1958.

The price for copper improved almost 12 per cent compared with the 1958 price and stimulated copper output, which substantially exceeded the 1958 figures in quantity and value. The improvement in copper production is partly obscured by the fact that from late August until the last few days of 1959 the Tacoma smelter was closed because of a strike. During that period most of the copper concentrates produced in British Columbia and some gold concentrates were stockpiled. Although the mines operated during the period, the concentrates remaining in the stockpiles at the end of the year are not credited to 1959 production.

For the other lode metals of the principal metals group, 1959 quantities were a little below those of 1958 and, except for zinc, values also were below 1958 levels.

The miscellaneous metals group increased, compared with 1958, because of increases in iron ore and by-product metals. Industrial minerals increased because of increases in asbestos, sulphur, and gypsum. The decline in the structural materials group from the 195X level stems from reduced output of sand, gravel, rubble, riprap, and crushed stone; the other items of the group-cement, lime and limestone, and stone-increased. Coal output has been falling since 1956, and the 1959 value was about half that of 1956; however, increases for oil, natural gas, and natural-gas liquids more than offset the decrease in coal, giving a combined value for fuels that is the highest in three decades.

Comparison of 1959 output for any mineral product with that of 195X or any year in the period 1950-59 can readily be made in Table III, pages A 16 and A 17. The percentage of the aggregate value contributed by each group of products in 1959, with the average for the ten-year period in brackets, were: Principal metals, 62.6 (72.7) per cent; miscellaneous metals, 7.6 (6.8) per cent; industrial minerals, 9.4 (4.5) per cent; structural materials, 12.7 (9.X) per cent; fuels, 7.6 (6.0) per cent.

Comparison with earlier decades would make it apparent that industrial minerals and structural materials, and some metals of the miscellaneous group have been gaining in relative importance as well as in dollar value.

The increased output of copper resulted from the resumption of production at the Britannia and Woodgreen mines and the beginning of production by Phoenix Copper Company Limited. Nickel production was resumed at the Pride of Emory property, which had closed in 195X. Iron ore was shipped from four mines, the Nimpkish and Hualpai companies shipping for the first time. The Torbrit company closed its operation at Alice Arm, having produced 18,600,000 ounces of silver since production began in 1949.

*By Hartley Sargent.

Exploration and development were carried on actively in many parts of the Province, interest being directed toward the principal metals, toward iron and molybdenum, and also toward siliceous flux and industrial minerals. The number of lode mineral claims recorded in 1959 was 13,455, just four fewer than in 1958; the number of certificates of work issued was 13,818, some 3,760 more than in 1958.

The acreage held for petroleum and natural gas under lease, permit, or licence in northeastern British Columbia increased; holdings in other areas decreased substantially. Exploration was carried on in many areas, but drilling was confined to northeastern British Columbia. In that area drilling was done on 140 wells—forty-four were completed as gas wells, twenty as oil wells, forty-six were abandoned, and at the end of the year two were suspended and twenty-eight drilling. Production of oil, natural gas, and natural-gas liquids all increased, oil production increasing more than SO per cent compared with 1958.

Revenue to the Government from petroleum and natural gas amounted to $16,575,155.81, including rental fees, penalties, and miscellaneous $4,790,850.90, tender bonus $10,990,814.32, and royalties $793,453.90.

The average number employed through 1959 in placer, lode, coal, industrial-mineral, and structural-material mining was 10,779. Major expenditures by all branches of the industry included: Salaries and wages, $49,961,996; fuel and electricity, $7,677,321; process supplies (inclusive of explosives, chemicals, drill-steel, lubricants, etc.), $17,371,638; Federal taxes, $8,401,819; Provincial taxes, $2,195,194; municipal and other taxes, $2,059,480; levies for workmen's compensation (including silicosis), unemployment insurance, and other items, $2,140,-113. Dividends amounted to $16,444,281. The lode-mining industry spent $27,079,911 in freight and treatment charges on ores and concentrates. Returns from the operators indicate that in addition to the foregoing items the metal-mining and industrial-mineral sections of the industry spent a further $640,000 for work done by contract.

Of the expenditures listed in the preceding paragraph, $5,892,000 is expenditure by the petroleum and natural-gas section of the industry. A return from the Canadian Petroleum Association shows that on December 31st, 1959, the number employed in petroleum and natural-gas activities in British Columbia was 473, and the total expenditure in 1959 (including the $5,892,000 already mentioned) was $57,450,000, made up of: Exploration, $42,942,000; development drilling, $5,503,000; capital expenditures (mainly field equipment), $3,540,000; operation of wells, $1,138,000; natural-gas plants, $3,440,000; taxes and royalties, $737,000; and all other expenses, $150,000.

Statistics

The statistics of the mineral industry are collected and compiled and the statistical tables for this Report are prepared by the Bureau of Economics and Statistics, Department of Industrial Development, Trade, and Commerce.

The tabulated statistics are designed to cover mineral production in quantity and value, employment, principal expenditures of the mineral industry, and dividends paid. The data are arranged so as to facilitate comparison of the production records for the various mining divisions, and from year to year (1951, 1958).*

From time to time, revisions have been made to earlier figures as additional data became available or errors came to light.

* In these notes, references such as (1958) are to this section of the Report of the Minister of Mines for the year indicated, where additional information will be found.

METHODS OF COMPUTING PRODUCTION

The tables of statistics recording the mineral production of the Province for each year are compiled from certified returns made by the operators, augmented by some data obtained from the Royal Canadian Mint, from the operators of custom smelters, and from the records of the Petroleum and Natural Gas Branch of the Department of Mines and Petroleum Resources. The values are in Canadian funds.

METALS

Prior to 1925 the average prices for gold and copper are true average prices, but, as a means of correcting for losses in smelting and refining, the prices of other metals were taken at the following percentages of the year's average price for the metal: Silver, 95 per cent; lead, 90 per cent; and zinc, 85 per cent. For 1925 and subsequent years the value has been calculated using the true average price and the net metal contents, in accordance with the procedures adopted by the Dominion Bureau of Statistics and the Department of Mines and Petroleum Resources.

PLACER GOLD

The value of placer gold in dollars is obtained from returns received annually from the operators (1958). A fineness of 822% is taken as the average for crude placer gold (p. A 14).

LODE METALS, GROSS AND NET CONTENTS, AND CALCULATED VALUE

The gross contents are compiled from the returns made each year by the producers and for any metal are the total assay contents, obtained by multiplying the assay by the weight of ore, concentrates, or bullion.

The value for each principal metal is calculated by multiplying the quantity (gross for gold, net for silver, copper, lead, and zinc) by the average price for the year. The net contents are calculated by taking a percentage of the gross content: in lead ores and concentrates and zinc concentrates-silver, 98 per cent; lead, 95 per cent; zinc, 85* per cent of the total assay content; and in copper concentrates, 9.5 per cent of the silver and the total assay content of copper less 10 pounds per ton of concentrates.

AVERAGE METAL PRICES

The methods of computing prices have varied because of changing conditions (1958). The prices are now arrived at by methods given in footnotes to the table of average prices on page A 14.

FUEL

Coal

All coal produced, including that used in making coke, is shown as primary mine production. As the data are of interest to the mining industry, Table X is included in the Report to show the total coke and by-products made in the Province, and the values given by the producers. Pre-1926 data have been reworked and brought into conformity with current practice. Quantities of coal or coke, expressed as long tons (2,240 pounds) until 1947, have been recalculated as short tons (2,000 pounds) (1958)

* For zinc concentrates shipped to foreign smelters the net contents are calculated as the assay content less eight units of zinc per ton of concentrate.

The average price for coal, listed year by year (see p. A 14), is the total value divided by the quantity. Up to and including 1945, the quantity (Table IXA) is the gross mine output; for 1946 and subsequent years, the quantity is that sold and used (Tables IXA and IXC). For 1946 and subsequent years, the value (Tables I, III, VIIA, IXA, IXB, and IXC) is the amount realized from sales of coal, at colliery loading points, plus the colliery valuation of coal used under companies' boilers and in making coke. Washery loss and changes in stocks, year by year, are shown in the table " Collieries of British Columbia, Production and Distribution by Collieries and by Districts " (p. 253).

Natural Gas

Commercial production of natural gas began in 1954. The production* shown in Tables I, III, VIIA, and VIIIA is the total dry and residue gas sold. The quantity is reported as thousands of cubic feet at standard conditions (14.4 pounds per square inch pressure, 60° F. temperature).

Natural-gas Liquid By-products

This heading covers condensate removed from natural gas in preparation for transmission through the main gas pipe-line. The by-products* consist of butane, propane, and natural gasoline.

Petroleum

Production of petroleum began in 1955, and is shown* in Tables I, III, VIIA, and VIIIA. The quantity is reported in barrels (35 imperial gallons=1 barrel).

CO-OPERATION WITH DOMINION BUREAU OF STATISTICS

In the interests of uniformity and to avoid duplication of effort, beginning with the statistics for 1925, arrangements were made between the Dominion Bureau of Statistics and the various Provincial Departments for co-operation in the collection and processing of mineral statistics. Producers of metals, industrial minerals, structural materials, and coal are requested to submit returns in duplicate on forms prepared for use by the Province and by the Dominion Bureau of Statistics.

So far as possible both organizations follow the same practice in processing the data. The final compilation by the Dominion Bureau is usually published considerably later than the Report of the Minister of Mines and Petroleum Resources for British Columbia. When the publications are compared, some differences became apparent. Differences in quantities of metals arise primarily from the fact that the Dominion Bureau bases its quantities mainly on returns made by smelter operators, whereas the British Columbia Mining Statistician uses the returns from individual mines covering shipments in the same period. Since the arrangement was made between the statisticians, the production of copper and zinc, and to a lesser extent of lead, has increased in other parts of Canada. The Dominion Bureau now uses prices for those metals that may differ from those applicable to British Columbia production. The latter continues to be valued mainly on United States prices converted to Canadian funds. Another reason for differences in the total net value of mineral products for British Columbia arises from the fact that the Dominion Bureau includes peat under the classification fuel. Peat has not been regarded as mineral or fuel in British Columbia and accordingly is not included in the Provincial statistics of mineral production.

* The figures are compiled from the monthly disposition report and Crown royalty statement filed with the Department of Mines and Petroleum Resources by the producer.

Average Prices Used in Valuing Provincial Production of Gold, Silver, Copper, Lead, Zinc, and Coal

Year	Gold,[1] Crude, Oz.	Gold, Fine, Oz.	Silver, Fine, Oz.	Copper, Lb.	Lead, Lb.	Zinc, Lb.	Coal, Short Ton
	$	$	Cents	Cents	Cents	Cents	$
1901	17.00	20.67	56.002 N.Y.	16.11 N.Y.	2.577 N.Y.	....	2.679
1902	....	....	49.55 ,,	11.70 ,,	3.66 ,,	....	....
1903	....	....	50.78 ,,	13.24 ,,	3.81 ,,	....	....
1904	....	....	53.36 ,,	12.82 ,,	3.88 ,,	....	....
1905	....	....	51.33 ,,	15.59 ,,	4.24 ,,	....	....
1906	....	....	63.45 ,,	19.28 ,,	4.81 ,,	....	....
1907	....	....	62.06 ,,	20.00 ,,	4.80 ,,	....	3.125
1908	....	....	50.22 ,,	13.20 ,,	3.78 ,,	....	....
1909	....	....	48.93 ,,	12.98 ,,	3.85 ,,	....	....
1910	....	....	50.812 ,,	12.738 ,,	4.00 ,,	4.60 E. St. L.	....
1911	....	....	50.64 ,,	12.38 ,,	3.98 ,,	4.90 ,,	....
1912	....	....	57.79 ,,	16.341 ,,	4.024 ,,	5.90 ,,	....
1913	....	....	56.80 ,,	15.27 ,,	3.93 ,,	4.80 ,,	....
1914	....	....	52.10 ,,	13.60 ,,	3.50 ,,	4.40 ,,	....
1915	....	....	47.20 ,,	17.28 ,,	4.17 ,,	11.25 ,,	....
1916	....	....	62.38 ,,	27.202 ,,	6.172 ,,	10.88 ,,	....
1917	....	....	77.35 ,,	27.18 ,,	7.91 ,,	7.566 ,,	....
1918	....	....	91.93 ,,	24.63 ,,	6.67 ,,	6.94 ,,	4.464
1919	....	....	105.57 ,,	18.70 ,,	5.19 ,,	6.24 ,,	....
1920	....	....	95.80 ,,	17.45 ,,	7.16 ,,	6.52 ,,	....
1921	....	....	59.52 ,,	12.50 ,,	4.09 ,,	3.95 ,,	....
1922	....	....	64.14 ,,	13.38 ,,	5.16 ,,	4.86 ,,	....
1923	....	....	61.63 ,,	14.42 ,,	6.54 ,,	5.62 ,,	....
1924	....	....	63.442 ,,	13.02 ,,	7.287 ,,	5.39 ,,	....
1925	....	....	69.065 ,,	14.042 ,,	7.848 Lond.	7.892 Lond.	....
1926	....	....	62.107 ,,	13.795 ,,	6.751 ,,	7.409 ,,	....
1927	....	....	56.37 ,,	12.92 ,,	5.256 ,,	6.194 ,,	....
1928	....	....	58.176 ,,	14.570 ,,	4.575 ,,	5.493 ,,	....
1929	....	....	52.993 ,,	18.107 ,,	5.050 ,,	5.385 ,,	....
1930	....	....	38.154 ,,	12.982 ,,	3.927 ,,	3.599 ,,	....
1931	....	....	28.700 ,,	8.116 ,,	2.710 ,,	2.554 ,,	4.018
1932	19.30	23.47	31.671 ,,	6.380 Lond.	2.113 ,,	2.405 ,,	3.795
1933	23.02	28.60	37.832 ,,	7.454 ,,	2.391 ,,	3.210 ,,	....
1934	28.37	34.50	47.461 ,,	7.419 ,,	2.436 ,,	3.044 ,,	....
1935	28.94	35.19	64.790 ,,	7.795 ,,	3.133 ,,	3.099 ,,	....
1936	28.81	35.03	45.127 ,,	9.477 ,,	3.913 ,,	3.315 ,,	....
1937	28.77	34.99	44.881 ,,	13.078 ,,	5.110 ,,	4.902 ,,	....
1938	28.93	35.18	43.477 ,,	9.972 ,,	3.344 ,,	3.073 ,,	....
1939	29.72	36.14	40.488 ,,	10.092 ,,	3.169 ,,	3.069 ,,	....
1940	31.66	38.50	38.249 ,,	10.086 ,,	3.362 ,,	3.411 ,,	....
1941	31.66	38.50	38.261 ,,	10.086 ,,	3.362 ,,	3.411 ,,	....
1942	31.66	38.50	41.166 ,,	10.086 ,,	3.362 ,,	3.411 ,,	....
1943	31.66	38.50	45.254 ,,	11.75 ,,	3.754 ,,	4.000 ,,	....
1944	31.66	38.50	43.000 ,,	12.000 ,,	4.500 ,,	4.300 ,,	....
1945	31.66	38.50	47.000 ,,	12.550 ,,	5.000 ,,	6.440 ,,	....
1946	30.22	36.75	83.650 ,,	12.80 ,,	6.750 ,,	7.810 ,,	4.68
1947	28.78	35.00	72.000 ,,	20.39 ,,	13.670 ,,	11.230 ,,	5.12
1948	28.78	35.00	75.000 Mont.	22.35 U.S.	18.040 ,,	13.930 ,,	6.09
1949	29.60	36.00	74.250 U.S.	19.973 ,,	15.800 U.S.	13.247 U.S.	6.51
1950	31.29	38.05	80.635 ,,	23.428 ,,	14.454 ,,	15.075 ,,	6.43
1951	30.30	36.85	94.55 ,,	27.70 ,,	18.4 ,,	19.9 ,,	6.46
1952	28.18	34.27	83.157 ,,	31.079 ,,	16.121 ,,	15.874 ,,	6.94
1953	28.31	34.42	83.774 ,,	30.333 ,,	13.265 ,,	10.675 ,,	6.88
1954	27.52	34.07	82.982 ,,	29.112 ,,	13.680 ,,	10.417 ,,	7.00
1955	28.39	34.52	87.851 ,,	38.276 ,,	14.926 ,,	12.127 ,,	6.74
1956	28.32	34.44	89.373 ,,	39.787 ,,	15.756 ,,	13.278 ,,	6.59
1957	27.59	33.55	87.057 ,,	26.031 ,,	14.051 ,,	11.175 ,,	6.76
1958	27.94	33.98	86.448 ,,	23.419 ,,	11.755 ,,	10.009 ,,	7.45
1959	**27.61**	**33.57**	**87.469 ,,**	**27.708 ,,**	**11.670 ,,**	**10.978 ,,**	**7.93**

[1] Unrefined placer gold, average price per ounce, is taken as $17 divided by $20.67 times the price of an ounce of fine gold.

Prices for fine gold are the Canadian Mint buying prices. Prices for other metals are those of the markets indicated, converted into Canadian funds. The abbreviations are: Mont.=Montreal; N.Y.=New York; Lond.=London; E. St. L.=East St. Louis; and U.S.=United States.

Prior to 1925 the prices for gold and copper are true average prices, but the prices of other metals were taken at the following percentages of the year's average price for the metal: Silver, 95 per cent; lead, 90 per cent; and zinc, 85 per cent.

For coal *see* last paragraph under " Fuel," page A 13.

TABLE I.—TOTAL MINERAL PRODUCTION FOR ALL YEARS UP TO AND INCLUDING 1959

	Total Quantity	Total Value	Quantity, 1959	Value, 1959
Gold—placer .... crude, oz.	5,213,516	$96,322,003	7,570	$208,973
„ lode .... fine, oz.	15,509,443	447,785,413	173,146	5,812,511
Silver .... oz.	416,319,732	251,574,189	6,197,159	5,420,593
Copper .... lb.	2,945,608,237	484,580,078	16,233,546	4,497,991
Lead .... lb.	12,844,584,437	943,571,720	287,423,357	33,542,306
Zinc .... lb.	10,661,832,830	860,903,024	402,342,850	44,169,198
Miscellaneous metals[1]	....	151,442,183	....	11,424,134
Industrial minerals[2]	....	102,484,431	....	14,028,055
Structural materials[3]	....	287,753,534	....	19,025,209
Coal[4] .... tons	142,072,696	551,618,564	690,011	5,472,064
Natural gas delivered direct to pipe-line .... M s.c.f.	143,058,018	7,775,815	69,959,566	3,928,839
Natural-gas liquid by-products[5]	....	893,359	....	465,062
Petroleum, crude .... bbls.	1,872,915	3,646,389	866,109	1,573,227
Totals	....	$4,190,350,702	....	$149,568,162

[1] For individual miscellaneous metals, *see* Table III and VIIIc, pages A 16 and A 29.
[2] For individual industrial minerals, including sulphur, *see* Tables III and VIIID, pages A 16 and A 31.
[3] For individual structural materials, *see* Tables III and VIIIE, pages A 16 and A 33.
[4] Total quantity is *gross* mine output; it includes material discarded in picking and washing. The quantity shown for 1959 is that sold and used (*see* also Table IXc).
[5] Includes value of propane, butane, and natural-gasoline shipments.

TABLE II.—PRODUCTION FOR EACH YEAR FROM 1836 TO 1959, INCLUSIVE

1836-95 (incl.)	$95,027,608	1929	$68,791,020
1896	7,507,956	1930	55,769,578
1897	10,455,268	1931	35,247,837
1898	10,906,861	1932	28,803,214
1899	12,429,707	1933	32,652,542
1900	16,344,751	1934	42,481,319
1901	19,671,572	1935	48,886,303
1902	17,486,550	1936	54,179,442
1903	17,495,954	1937	74,475,902
1904	18,977,359	1938	64,485,551
1905	22,600,525	1939	65,707,398
1906	24,997,646	1940	75,121,424
1907	25,928,660	1941	77,514,446
1908	23,950,573	1942	76,699,878
1909	24,443,025	1943	67,204,417
1910	26,377,066	1944	54,740,844
1911	23,499,072	1945	62,070,548
1912	32,440,800	1946	72,453,745
1913	30,296,398	1947	112,582,204
1914	26,388,825	1948	145,517,874
1915	29,447,508	1949	132,956,254
1916	42,290,462	1950	139,837,689
1917	37,010,392	1951	176,330,205
1918	41,782,474	1952	171,309,429
1919	33,296,313	1953	153,193,544
1920	35,543,084	1954	153,267,393
1921	28,066,641	1955	174,711,086
1922	35,162,843	1956	190,084,303
1923	41,304,320	1957	172,331,610
1924	48,704,604	1958	146,757,699
1925	61,492,242	1959	149,568,162
1926	67,188,842		
1927	60,729,358	Total	$4,190,350,702
1928	65,372,583		

NOTE.—For revisions to lead and zinc production *see* footnote 3, Table VI.

Table III.—Quantity and Value of Mineral Products for Years 1950 to 1959

Description	1950		1951		1952		1953		1954	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Principal Metals		$		$		$		$		$
Gold—placer, crude ... oz.	19,134	598,717	23,691	717,911	17,554	494,756	14,245	403,230	8,684	238,967
,, lode, fine ... oz.	283,983	10,805,553	261,274	9,627,947	251,393	8,615,238	253,553	8,727,294	258,388	8,803,279
Silver ... oz.	9,507,225	7,666,151	8,215,884	7,768,118	8,796,720	7,315,088	8,376,953	7,017,709	9,825,153	8,153,108
Copper ... lb.	42,212,133	9,889,458	43,249,658	11,980,155	42,005,512	13,054,893	49,021,013	14,869,544	50,150,087	14,599,693
Lead ... lb.	284,024,522	41,052,905	273,456,604	50,316,015	284,949,396	45,936,692	297,634,712	39,481,244	332,474,456	45,482,505
Zinc ... lb.	290,344,227	43,769,392	337,511,324	67,164,754	372,871,717	59,189,656	382,300,862	40,810,618	334,124,560	34,805,755
Totals ...	...	113,782,176	...	147,574,900	...	134,606,323	...	111,309,639	...	112,083,307
Miscellaneous Metals										
Antimony ... lb.	643,540	216,229	1,310,836	622,647	2,333,239	1,028,025	1,551,043	570,474	1,302,333	382,104
Bismuth ... lb.	162,616	369,138	191,471	451,872	142,246	312,941	71,298	157,569	225,351	493,519
Cadmium ... lb.	650,540	1,535,274	1,164,933	3,122,021	726,172	1,561,270	787,158	1,550,701	680,734	1,123,211
Indium ... oz.	4,952	12,132	582	1,368	404	889	6,752	14,922	477	1,281
Iron ore concentrates ... tons	...	...	113,535	790,000	900,481	5,474,924	991,248	6,763,105	535,746	3,733,891
Platinum ... oz.	111	9,239	22	2,085	2	176	...	...	4	408
Tin ... lb.	796,403	828,259	346,718	495,807	212,113	250,293	1,092,228	581,746	587,528	280,437
Tungsten (WO_3) ... lb.	281,160	281,160	...	...	1,434,640	4,565,024	2,168,977	5,950,323	2,172,163	5,752,172
Totals ...	...	3,251,431	...	5,485,800	...	13,193,542	...	15,588,840	...	11,767,023
Industrial Minerals										
Asbestos ... tons	...	...	...	...	20	23,000	3,102	988,716	8,599	2,920,751
Barite ... tons	1,440	17,284	1,248	16,224	848	13,408	3,560	52,845	5,056	115,337
Diatomite ... tons	4	108	8	223	12	240	...	...	...	...
Flux (quartz, limestone) ... tons	144,325	268,411	144,235	292,100	55,588	141,478	37,358	110,698	39,897	40,804
Granules (quartz, limestone, granite) ... tons	7,886	104,590	5,727	73,767	1,610	21,026	4,620	59,321	4,541	65,507
Gypsum and products ... tons	92,882	620,108	124,729	263,072	91,112	235,453	172,665	387,655	175,480	421,734
Mica ... lb.	456,000	5,533	606,000	7,462	314,000	3,001	604,000	11,338	284,000	5,326
Perlite ... tons	...	...	...	...	...	...	1,112	11,120	...	...
Sulphur ... tons	143,343	1,421,806	194,874	1,840,992	182,607	1,745,258	151,954	1,590,055	219,999	2,308,422
Totals ...	...	2,437,840	...	2,493,840	...	2,182,864	...	3,211,748	...	5,877,881
Structural Materials										
Brick—common ... No.	3,980,500	117,770	1,353,000	41,820	830,815	28,248	1,382,883	51,381	1,289,911	35,550
,, face, paving, sewer ... No.	974,380	52,823	3,127,888	153,575	2,566,540	121,254	4,307,894	226,459	5,651,262	316,676
,, firebrick, blocks ...	...	282,962	...	380,742	...	435,681	...	426,783	...	372,528
Clays ... tons	6,706	32,264	14,786	60,255	11,483	51,797	5,226	31,990	6,609	36,425
Structural tile, hollow blocks ...	...	191,016	...	171,481	...	60,273	...	123,469	...	122,903
Drain-tile, sewer-pipe, flue-linings ...	...	428,418	...	410,206	...	468,110	...	627,097	...	753,297
Pottery—glazed or unglazed ...	...	5,860	...	4,695	...	6,536	...	30,012	...	31,081
Other clay products ...	...	11,335	...	10,393	...	11,296	...	19,267	...	32,697
Cement ...	...	3,088,296	...	3,311,439	...	3,603,273	...	5,071,260	...	4,935,298
Lime and limestone ... tons	221,454	1,133,776	241,723	1,251,327	321,710	1,552,772	338,005	1,357,958	317,976	1,555,002
Rubble, riprap, crushed rock ... tons	1,164,049	990,257	972,178	1,145,072	739,504	982,792	770,415	1,122,516	920,707	1,253,856
Sand and gravel ...	...	3,723,487	...	3,355,693	...	3,839,965	...	4,388,594	...	4,850,469
Stone ... tons	26,758	188,675	4,837	309,350	122,308	434,964	2,611	78,252	3,055	99,392
Totals ...	...	10,246,939	...	10,606,048	...	11,596,961	...	13,555,038	...	14,395,174
Fuel										
Coal[1] ... tons	1,574,006	10,119,303	1,573,572	10,169,617	1,402,347	9,729,739	1,384,138	9,528,279	1,308,284	9,154,544
Natural gas ... M s.c.f.	...	...	...	...	...	...	...	...	60,883	6,545
Petroleum, crude ... bbls.	...	...	...	...	...	...	...	...	...	...
Totals ...	...	...	...	...	...	...	...	...	...	9,161,089
Provincial totals ...	...	139,837,689	...	176,330,205	...	171,309,429	...	153,193,544	...	153,284,474

Description	1955		1956		1957		1958		1959	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Principal Metals		$		$		$		$		$
Gold—placer, crude .... oz.	7,666	217,614	3,865	109,450	2,936	80,990	5,650	157,871	7,570	208,973
„ lode, fine .... oz.	242,477	8,370,306	191,743	6,603,628	222,506	7,465,076	194,354	6,604,149	173,146	5,812,511
Silver .... oz.	7,902,145	6,942,113	8,404,600	7,511,443	8,129,971	7,077,708	7,040,416	6,086,299	6,197,159	5,420,593
Copper .... lb.	44,328,031	16,932,549	43,360,575	17,251,872	29,318,494	7,631,897	12,658,649	2,964,529	16,233,546	4,497,991
Lead .... lb.	302,567,640	45,161,245	283,718,073	44,702,619	281,603,346	39,568,086	294,573,159	34,627,075	287,423,357	33,542,306
Zinc .... lb.	429,198,565	52,048,909	443,853,004	58,934,801	449,448,607	50,225,881	432,002,790	43,234,839	402,342,850	44,169,198
Totals	....	129,672,736	....	135,113,813	....	112,049,638	....	93,674,762	....	93,651,572
Miscellaneous Metals										
Antimony .... lb.	2,021,721	667,776	2,140,432	768,843	1,360,731	577,344	858,633	284,208	1,657,797	540,276
Bismuth .... lb.	160,767	356,903	156,753	346,424	145,634	314,569	154,034	308,068	181,843	345,502
Cadmium .... lb.	1,593,591	2,677,233	1,937,927	3,236,388	1,946,397	3,172,627	1,425,108	2,166,164	1,695,821	2,170,651
Indium .... oz.	104,774	232,389	363,192	795,390	384,360	693,770	75,434	117,677	....	....
Iron concentrates .... tons	610,930	3,228,756	369,955	2,190,847	357,342	2,200,637	630,271	4,193,442	849,248	6,363,848
Mercury .... lb.	75	250	....	....	....	....	....	....	....	....
Nickel .... lb.	....	....	....	....	....	....	1,408,490	996,507	1,061,532	743,072
Platinum .... oz.	....	....	....	....	....	....	4	260	....	....
Tin .... lb.	391,228	311,613	756,934	637,792	709,102	555,936	795,496	625,260	747,443	627,852
Tungsten (WO_3) .... lb.	1,914,000	5,460,967	2,264,775	6,351,376	1,921,483	5,240,479	690,976	1,884,209	....	....
Others	....	....	....	....	....	....	....	....	....	632,933
Totals	....	12,935,887	....	14,327,010	....	12,755,362	....	10,575,795	....	11,424,134
Industrial Minerals										
Asbestos .... tons	17,187	4,265,971	20,356	6,620,060	31,714	9,245,800	30,078	8,203,384	33,883	9,742,504
Barite .... tons	9,465	238,825	11,436	287,626	20,072	433,200	16,144	341,700	23,142	187,368
Diatomite .... tons	14	280	40	800	120	2,400	27	540	5	100
Fluxes (quartz, limestone) .... tons	111,759	208,198	176,311	392,429	137,433	442,204	90,635	311,630[1]	70,570	248,913
Granules (quartz, limestone, granite) .... tons	6,355	73,858	13,220	173,214	17,295	221,864	22,674	284,330	19,072	254,251
Gypsum and products .... tons	149,719	383,934	72,973	391,919	66,499	142,751	70,498	211,494	112,223	282,030
Mica .... lb.	505,300	2,861	200,000	1,100	180,000	1,200	....	....	....	....
Sulphur .... tons	216,520	2,624,171	212,885	2,523,190	226,550	2,872,332	211,300	2,410,395	255,445	3,312,889
Totals	....	7,798,098	....	10,390,338	....	13,361,751	....	11,763,473	....	14,028,055
Structural Materials										
Brick—common .... No.	4,853,940	232,139	2,248,447	75,767	663,828	24,345	427,550	15,125	385,810	11,954
„ face, paving, sewer .... No.	3,901,866	248,913	6,913,682	485,176	4,660,231	345,081	4,871,562	344,133	5,412,822	428,100
„ firebrick, blocks .... No.	....	578,578	....	600,753	....	658,873	....	405,485	....	538,566
Clays .... tons	8,033	46,757	7,985	47,101	3,849	29,495	4,105	12,579	6,250	17,001
Structural tile, hollow blocks	....	114,460	....	129,257	....	200,216	....	122,877	....	149,383
Drain-tile, sewer-pipe, flue-linings	....	801,019	....	696,385	....	697,611	....	639,173	....	680,702
Pottery—glazed or unglazed	....	38,035	....	38,385	....	47,612	....	68,387	....	46,902
Other clay products	....	55,514	....	69,659	....	38,868	....	32,416	....	80,910
Cement	....	5,474,875	....	6,339,071	....	7,078,108	....	6,755,619	....	7,049,638
Lime and limestone .... tons	318,152	1,711,348	396,012	1,220,792	334,303	1,494,578	269,747	997,819	519,580	1,481,292
Rubble, riprap, crushed rock .... tons	890,613	962,272	2,028,143	2,210,315	2,364,301	4,272,768	1,866,950	2,098,952	1,169,854	1,128,353
Sand and gravel	....	4,886,890	....	8,535,348	....	10,503,274	....	8,442,676	....	7,342,698
Stone .... tons	26,079	148,454	35,266	139,510	2,403	236,110	2,141	64,335	13,710	69,710
Totals	....	15,299,254	....	20,587,159	....	25,626,939	....	19,999,576	....	19,025,209
Fuels										
Coal[2] .... tons	1,332,874	8,986,501	1,417,209	9,346,518	1,085,657	7,340,339	796,413	5,937,860	690,011	5,472,064
Natural gas delivered to pipe-line .... M s.c.f.	168,948	18,130	269,736	20,143	8,547,100	433,830	64,051,785	3,368,327	69,959,566	3,928,839
Natural-gas liquid by-products[3]	....	....	....	....	....	....	....	428,297	....	465,062
Petroleum, crude .... bbls.	582	480	148,545	299,322	345,320	763,751	512,359	1,009,609	866,109	1,573,227
Totals	....	9,005,111	....	9,665,983	....	8,537,920	....	10,744,093	....	11,439,192
Provincial totals	....	174,711,086	....	190,084,303	....	172,331,610	....	146,757,699	....	149,568,162

[1] Includes 32 tons of fluorspar mined in 1958.
[2] The quantity of coal is that sold and used.
[3] Butane, propane, natural gasoline.

TABLE IV.-MINERAL PRODUCTION VALUE, 1895-1959

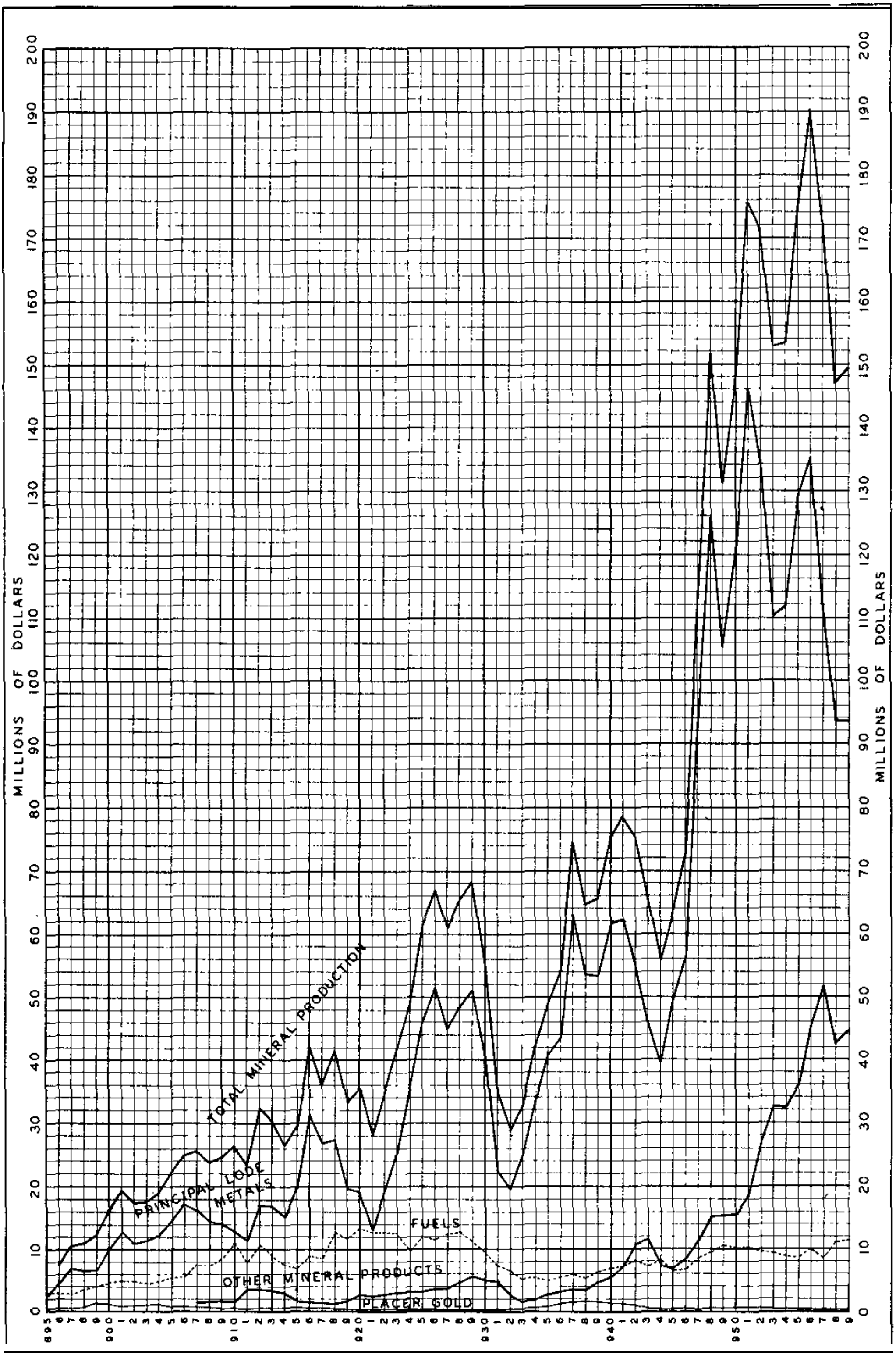


TABLE V.—PRINCIPAL LODE-METALS PRODUCTION. 1913-1959

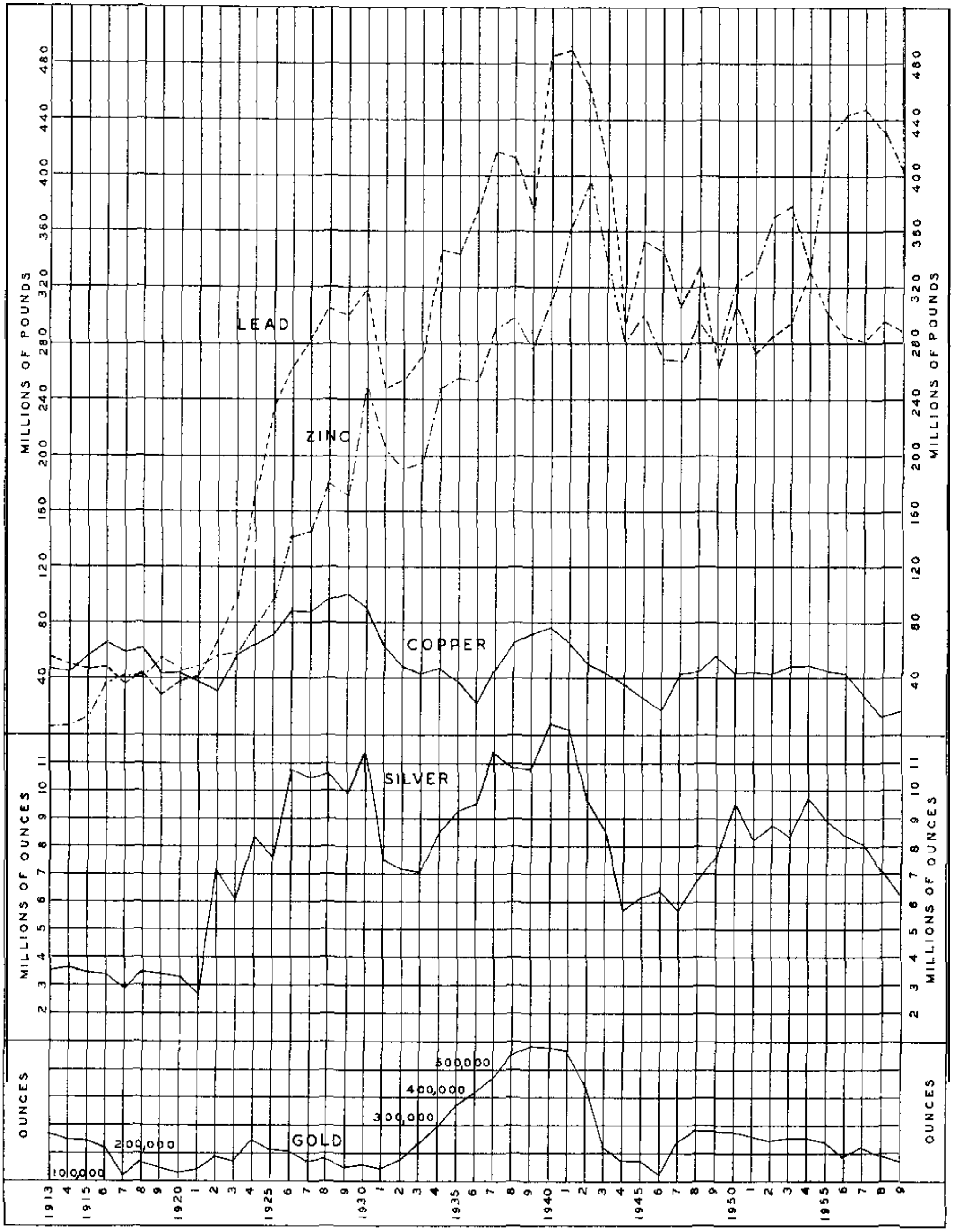


TABLE VI.—PRODUCTION OF PRINCIPAL METALS, 1858–1959

Year	Placer Gold		Gold		Silver		Copper		Lead[3]		Zinc[3 4]		Total Value
	Quantity[1]	Value	Quantity[2]	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
	Oz.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
1858–86, inclusive	3,105,775	52,798,364											52,798,364
1887	40,810	693,709			17,690	17,331			204,800	9,216			720,256
1888	36,280	616,731			79,780	75,000			674,500	29,813			721,544
1889	34,640	588,923			53,192	47,873			165,100	6,498			643,294
1890	29,080	494,436			70,427	73,948							568,384
1891	25,280	429,811			4,500	4,000							433,811
1892	23,500	399,526			77,160	66,935			808,420	33,064			499,525
1893	20,950	356,131	1,170	23,404	227,000	195,000			2,135,023	78,996			653,531
1894	23,850	405,516	6,252	125,014	746,379	470,219	324,680	16,234	5,662,523	169,875			1,186,858
1895	28,330	481,683	39,270	785,400	1,496,522	977,229	952,840	47,642	16,475,464	532,255			2,824,209
1896	32,000	544,026	62,259	1,244,180	3,135,343	2,100,689	3,818,556	190,926	24,199,977	721,384			4,801,205
1897	30,210	513,520	106,141	2,122,820	5,472,971	3,272,836	5,325,180	266,258	38,841,135	1,390,517			7,565,951
1898	37,840	643,346	110,061	2,201,217	4,292,401	2,375,841	7,271,678	874,781	31,693,559	1,077,581			7,172,766
1899	79,110	1,344,900	138,315	2,857,573	2,939,413	1,663,708	7,722,591	1,351,453	21,862,436	878,870			8,096,504
1900	75,220	1,278,724	167,153	3,453,381	3,958,175	2,309,200	9,997,080	1,615,289	63,358,621	2,691,887			11,348,481
1901	57,060	970,100	210,384	4,348,605	4,396,447	2,462,008	27,603,746	4,446,963	51,582,906	2,010,260			14,237,936
1902	63,130	1,073,140	236,491	4,888,269	3,917,917	1,941,328	29,636,057	3,446,673	22,536,381	824,832			12,174,242
1903	62,380	1,060,420	232,831	4,812,616	2,996,204	1,521,472	34,359,921	4,547,535	18,089,283	689,744			12,631,787
1904	65,610	1,115,300	222,042	4,589,608	3,222,481	1,719,516	35,710,128	4,578,037	36,646,244	1,421,874			13,424,335
1905	57,020	969,300	238,660	4,933,102	3,439,417	1,971,818	37,692,251	5,876,222	56,580,703	2,399,022		139,200	16,288,664
1906	55,790	948,400	224,027	4,630,639	2,990,262	1,897,320	42,990,488	8,288,565	52,408,217	2,667,578		17,100	18,449,602
1907	48,710	828,000	196,179	4,055,020	2,745,448	1,703,825	40,832,720	8,166,544	47,738,703	2,291,458		46,100	17,090,947
1908	38,060	647,000	255,582	5,282,880	2,631,389	1,321,483	47,274,614	6,240,249	43,195,733	1,632,799		99,296	15,223,707
1909	28,060	477,000	238,224	4,924,090	2,532,742	1,239,270	45,597,245	5,918,522	44,396,346	1,709,259	8,500,000	400,000	14,668,141
1910	31,760	540,000	267,701	5,533,380	2,450,241	1,245,016	38,243,934	4,871,512	34,658,746	1,386,350	4,184,192	192,473	13,768,731
1911	25,060	426,000	228,617	4,725,513	1,892,364	958,293	36,927,656	4,571,644	26,872,397	1,069,521	2,634,544	129,092	11,880,063
1912	32,680	555,500	257,496	5,322,442	3,132,108	1,810,045	51,456,537	8,408,513	44,871,454	1,805,627	5,358,280	316,139	18,218,266
1913	30,000	510,000	272,254	5,627,490	3,465,856	1,968,606	46,460,305	7,094,489	55,364,677	2,175,832	6,758,768	324,421	17,700,838
1914	33,240	565,000	247,170	5,109,004	3,602,180	1,876,736	45,009,699	6,121,319	50,625,048	1,771,877	7,866,467	346,125	15,790,061
1915	45,290	770,000	250,021	5,167,934	3,366,506	1,588,991	56,918,405	9,835,500	46,503,590	1,939,200	12,982,440	1,460,524	20,762,149
1916	34,150	580,500	221,932	4,587,334	3,301,923	2,059,739	65,379,364	17,784,494	48,727,516	3,007,462	37,168,980	4,043,985	32,063,514
1917	29,180	496,000	114,523	2,367,190	2,929,216	2,265,749	59,007,565	16,038,256	37,307,465	2,951,020	41,848,513	3,166,259	27,284,474
1918	18,820	320,000	164,674	3,403,812	3,498,172	3,215,870	61,483,754	15,143,449	43,899,661	2,928,107	41,772,916	2,899,040	27,910,278
1919	16,850	286,500	152,426	3,150,645	3,403,119	3,592,673	42,459,339	7,939,896	29,475,968	1,526,855	56,737,651	3,540,429	20,036,998
1920	13,040	221,600	120,048	2,481,392	3,377,849	3,235,980	44,887,676	7,832,899	39,331,218	2,816,115	47,208,268	3,077,979	19,665,965
1921	13,720	233,200	135,663	2,804,154	2,673,389	1,591,201	39,036,993	4,879,624	41,402,288	1,693,354	49,419,372	1,952,065	13,153,598
1922	21,690	368,800	197,856	4,089,684	7,101,311	4,554,781	32,359,896	4,329,754	67,447,985	3,480,316	57,146,548	2,777,322	19,600,657
1923	24,710	420,000	179,245	3,704,994	6,032,986	3,718,129	57,720,290	8,323,266	96,663,152	6,321,770	58,343,462	3,278,903	25,767,062

	Oz.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
1924	24,750	420,750	247,716	5,120,535	8,341,768	5,292,184	64,845,393	8,442,870	170,384,481	12,415,917	79,130,970	4,266,741	35,958,997
1925	16,476	280,092	209,719	4,335,269	7,654,844	5,286,818	72,306,432	10,153,269	237,899,199	18,670,329	98,257,099	7,754,450	46,480,227
1926	20,912	355,503	201,427	4,163,859	10,748,556	6,675,606	89,339,768	12,324,421	263,023,937	17,757,535	142,876,947	10,586,610	51,863,534
1927	9,191	156,247	178,001	3,679,601	10,470,185	5,902,043	89,202,871	11,525,011	282,996,423	14,874,292	145,225,443	8,996,135	45,133,329
1928	8,284	143,208	188,087	3,888,097	10,627,167	6,182,461	97,908,316	14,265,242	305,140,792	13,961,412	181,763,147	9,984,613	48,425,033
1929	6,983	118,711	145,387	3,005,411	9,960,172	5,278,194	102,793,669	18,612,850	307,999,153	15,555,189	172,096,841	9,268,792	51,839,147
1930	8,955	152,235	160,853	3,325,126	11,328,263	4,322,185	92,362,240	11,990,466	321,803,725	12,638,198	250,479,310	9,017,005	41,445,215
1931	17,176	291,992	146,133	3,020,837	7,550,331	2,254,979	64,134,746	5,365,690	261,902,236	7,097,812	202,071,702	5,160,911	23,192,221
1932	20,400	395,542	181,651	4,263,349	7,150,655	2,264,729	50,608,036	3,228,892	252,007,574	5,326,432	192,120,091	4,621,641	20,100,585
1933	23,928	562,787	223,589	6,394,645	7,021,754	2,656,526	43,149,460	3,216,701	271,689,217	6,497,719	195,963,751	6,291,416	25,619,794
1934	25,181	714,431	297,216	10,253,952	8,613,977	4,088,280	49,651,733	3,683,662	347,366,967	8,461,859	249,152,403	7,584,199	34,786,383
1935	30,929	895,058	365,343	12,856,419	9,269,944	6,005,996	39,428,208	3,073,428	344,268,444	10,785,930	256,239,446	7,940,860	41,557,691
1936	43,389	1,249,940	404,578	14,172,367	9,547,124	4,308,330	21,671,711	2,053,828	377,971,618	14,790,029	254,581,393	8,439,373	45,013,867
1937	54,153	1,558,245	460,781	16,122,727	11,308,685	5,075,451	46,057,584	6,023,411	419,118,371	21,416,949	291,192,278	14,274,245	64,471,028
1938	57,759	1,671,015	557,522	19,613,624	10,861,578	4,722,288	65,769,906	6,558,575	412,979,182	13,810,024	298,497,295	9,172,822	55,548,348
1939	49,746	1,478,492	587,336	21,226,957	10,821,393	4,381,365	73,254,679	7,392,862	378,743,763	12,002,390	278,409,102	8,544,375	55,026,441
1940	39,067	1,236,928	583,416	22,461,516	12,327,944	4,715,315	77,980,223	7,865,085	466,849,112	15,695,467	312,020,671	10,643,025	62,617,336
1941	43,775	1,385,962	571,026	21,984,501	12,175,700	4,658,545	66,435,583	6,700,693	456,840,454	15,358,976	367,869,579	12,548,031	62,636,708
1942	32,904	1,041,772	444,518	17,113,943	9,677,881	4,080,775	50,097,716	5,052,856	507,199,704	17,052,054	387,236,469	13,208,636	57,550,036
1943	14,600	462,270	224,403	8,639,516	8,526,310	3,858,496	42,307,510	4,971,132	439,155,635	16,485,902	336,150,455	13,446,018	47,863,334
1944	11,433	361,977	186,632	7,185,332	5,705,334	2,453,293	36,300,589	4,356,070	292,922,888	13,181,530	278,063,373	11,956,725	39,494,927
1945	12,589	398,591	175,373	6,751,860	6,157,307	2,893,934	25,852,366	3,244,472	336,976,468	16,848,823	294,791,635	18,984,581	49,122,261
1946	15,729	475,361	117,612	4,322,241	6,365,761	5,324,959	17,500,538	2,240,070	345,862,680	23,345,731	274,269,956	21,420,484	57,128,846
1947	6,969	200,585	243,282	8,514,870	5,707,691	4,109,538	41,783,921	8,519,741	313,733,089	42,887,313	253,006,168	28,412,593	92,644,640
1948	20,332	585,200	286,230	10,018,050	6,718,122	5,038,592	43,025,388	9,616,174	320,037,525	57,734,770	270,310,195	37,654,210	120,646,996
1949	17,886	529,524	288,396	10,382,256	7,636,053	5,669,769	54,856,808	10,956,550	265,378,899	41,929,866	288,188,620	38,176,346	107,644,311
1950	19,134	598,717	283,983	10,805,553	9,507,225	7,666,151	42,212,133	9,889,458	284,024,522	41,052,905	290,344,227	43,769,392	113,782,176
1951	23,691	717,911	261,274	9,627,947	8,215,884	7,768,118	43,249,658	11,980,155	273,456,604	50,316,015	337,511,324	67,164,754	147,574,900
1952	17,554	494,756	251,393	8,615,238	8,796,720	7,315,088	42,005,512	13,054,893	284,949,396	45,936,692	372,871,717	59,189,656	134,606,323
1953	14,245	403,230	253,553	8,727,294	8,376,953	7,017,709	49,021,013	14,869,544	297,634,712	39,481,244	382,300,862	40,810,618	111,309,639
1954	8,684	238,967	258,388	8,803,279	9,825,153	8,153,108	50,150,087	14,599,693	332,474,456	45,482,505	334,124,560	34,805,755	112,083,307
1955	7,666	217,614	242,477	8,370,306	7,902,145	6,942,113	44,238,031	16,932,549	302,567,640	45,161,245	429,198,565	52,048,909	129,672,736
1956	3,865	109,450	191,743	6,603,628	8,404,600	7,511,443	43,360,575	17,251,872	283,718,073	44,702,619	443,853,004	58,934,801	135,113,813
1957	2,936	80,990	222,506	7,465,076	8,129,971	7,077,708	29,318,494	7,631,897	281,603,346	39,568,086	449,448,607	50,225,881	112,049,638
1958	5,650	157,871	194,354	6,604,149	7,040,416	6,086,299	12,658,649	2,964,529	294,573,159	34,627,075	432,002,790	43,234,839	93,674,762
1959	7,570	208,973	173,146	5,812,511	6,197,159	5,420,593	16,233,546	4,497,991	287,423,357	33,542,306	402,342,850	44,169,198	93,651,572
Totals	5,213,516	96,322,003	5,503,711	447,604,627	416,341,205	251,568,639	2,945,544,280	484,153,110	12,865,084,040	944,593,328	10,661,893,246	860,915,092	3,085,156,799

[1] Ounces of crude gold.

[2] Ounces of fine gold.

[3] Revisions have been made in 1958 to some yearly totals for lead and zinc to bring them into agreement with the best records of recoveries of lead and zinc from slags treated at the Trail smelter.

[4] For 1905–08, inclusive, records show shipments of a combined total of 18,847 tons of zinc ore and zinc concentrates of unstated zinc content.

TABLE VIIA.—PRODUCTION, 1958 AND 1959, BY MINING DIVISIONS—SUMMARY

Division	Year	Placer Gold		Principal Lode Metals	Miscellaneous Metals	Industrial Minerals	Structural Materials	Fuels							Division Totals
								Coal		Petroleum		Natural Gas			
												Direct to Pipe-line		Liquid By-products, Value[3]	
		Quantity[1]	Value					Quantity	Value	Quantity	Value	Quantity	Value		
		Oz.	$	$	$	$	$	Tons	$	Bbls.	$	M S.C.F.	$	$	$
Alberni	1958	3	84	1,144			54,594								55,822
	1959			**33,052**			**30,104**								**63,156**
Atlin	1958	965	26,964				26,102								53,066
	1959	**957**	**26,418**				**39,066**								**65,484**
Cariboo	1958	4,189	117,048	950,953		540	536,095								1,604,636
	1959	**6,322**	**174,521**	**598,453**		**100**	**508,675**								**1,281,749**
Clinton	1958	9	251				15,483								15,734
	1959														
Fort Steele	1958	20	559	48,889,971	625,450	663,861	153,770	633,557	4,241,619						54,575,230
	1959	**24**	**662**	**47,991,149**	**627,878**	**907,020**	**225,846**	**542,422**	**3,957,498**						**53,710,053**
Golden	1958			2,431,487	82,814	553,194	133,262								3,200,757
	1959			**2,631,335**	**43,398**	**469,398**	**87,066**								**3,231,197**
Greenwood	1958	5	140	936,360	6,553		12,400								955,453
	1959			**1,640,272**	**7,039**		**28,718**								**1,676,029**
Kamloops	1958	7	195				1,205,153								1,205,348
	1959	**24**	**663**				**385,165**								**385,828**
Liard	1958					8,203,384	206,174	3,194	28,738	512,359	1,009,609	64,051,785	3,368,327	428,297	13,244,529
	1959					**9,742,504**	**186,063**	**3,319**	**31,040**	**866,109**	**1,573,227**	**69,959,566**	**3,928,839**	**465,062**	**15,926,735**
Lillooet	1958	72	2,012	5,102,133			155,898								5,260,043
	1959	**106**	**2,926**	**4,619,810**			**101,319**								**4,724,055**
Nanaimo	1958[2]			416,810	4,193,442	23,806	995,759	154,296	1,615,490						7,245,307
	1959			**296,858**	**6,363,848**	**16,026**	**1,488,955**	**137,240**	**1,415,971**						**9,581,658**
Nelson	1958	2	56	11,598,949	2,609,068		83,535								14,291,608
	1959	**6**	**166**	**13,336,208**	**685,385**		**65,799**								**14,087,558**
New Westminster	1958	14	391	160,916	996,507	143,945	4,175,832								5,477,591
	1959	**36**	**994**	**137,818**	**743,072**	**107,248**	**4,661,005**								**5,650,137**
Nicola	1958	4	112				62,670	543	5,919						68,701
	1959						**33,799**	**416**	**3,710**						**37,509**
Omineca	1958	71	1,984	327,290	17,839		537,292	4,677	44,972						929,377
	1959	**36**	**994**	**34,818**	**940**		**306,733**	**5,453**	**55,318**						**398,803**
Osoyoos	1958			301,666		428,209	603								730,478
	1959	**18**	**497**	**250,044**		**379,830**	**525**								**630,896**
Revelstoke	1958			546,082			78,757								624,839
	1959	**5**	**138**				**38,185**								**38,323**
Similkameen	1958	30	838	16,845	260		82,950	146	1,122						102,015
	1959	**7**	**193**	**17,511**			**23,050**	**1,161**	**8,527**						**49,281**
Skeena	1958			1,311,276			278,797								1,590,073
	1959			**869,030**			**247,896**								**1,116,926**
Slocan	1958	2	56	8,055,865	183,395		60,967								8,300,283
	1959	**2**	**55**	**6,352,608**	**136,997**		**40,337**								**6,529,997**
Trail Creek	1958			22,662			127,461								150,123
	1959	**1**	**28**	**26,017**			**93,669**								**119,714**
Vancouver	1958			1,355,525	19,783	75,501	4,614,786								6,065,595
	1959			**2,317,360**	**14,383**	**43,412**	**4,595,256**								**6,970,411**
Vernon	1958	257	7,181				224,249								231,430
	1959	**26**	**718**				**262,453**								**263,171**
Victoria	1958			1,023,801			6,176,987								7,200,788
	1959			**1,386,176**		**60**	**5,575,525**								**6,961,761**
Not assigned	1958			10,067,156	1,840,684	1,671,033									13,578,873
	1959			**10,904,080**	**2,801,194**	**2,362,457**									**16,067,731**
Totals	1958	5,650	157,871	93,516,891	10,575,795	11,763,473	19,999,576	796,413	5,937,860	512,359	1,009,609	64,051,785	3,368,327	428,297	146,757,699
	1959	**7,570**	**208,973**	**93,442,599**	**11,424,134**	**14,028,056**	**19,025,209**	**690,011**	**5,472,064**	**866,109**	**1,573,227**	**69,959,566**	**3,928,839**	**465,062**	**149,568,162**

[1] Crude gold. 1958 equivalent in fine gold ounces was 4,646, and 6,225 fine ounces in 1959. [2] Nanaimo 1958 figures for gold, silver, copper, and total value include 1957 production as follows: Gold, 261 oz.; silver, 9,011 oz.; copper, 640,555 lb.; total value, $141,133. [3] Includes propane, butane, natural gasoline.

TABLE VIIB.—PRODUCTION, 1958 AND 1959, BY MINING DIVISIONS—PRINCIPAL LODE METALS

Division	Year	Lode Gold		Silver		Copper		Lead		Zinc		Division Totals
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
		Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
Alberni	1958	33	1,121	27	23							1,144
	1959	953	31,992	539	471			5,043	589			33,052
Atlin	1958											
	1959											
Cariboo	1958	27,892	947,770	3,682	3,183							950,953
	1959	17,746	595,734	3,108	2,719							598,453
Clinton	1958											
	1959											
Fort Steele	1958	314	10,670	3,041,368	2,629,202			195,172,210	22,942,493	232,889,745	23,307,606	48,889,971
	1959	313	10,507	3,383,110	2,959,172			190,663,665	22,250,449	207,424,129	22,771,021	47,991,149
Golden	1958	60	2,039	138,194	119,466	151,688	35,524	6,134,534	721,115	15,521,013	1,553,343	2,431,487
	1959	4	134	228,024	199,450	126,066	34,930	8,377,769	977,686	12,927,081	1,419,135	2,631,335
Greenwood	1958	496	16,854	884,971	765,040			692,605	81,416	729,917	73,050	936,360
	1959	4,490	150,729	882,015	771,490	1,859,595	515,257	845,796	98,704	948,191	104,092	1,640,272
Kamloops	1958											
	1959											
Liard	1958											
	1959											
Lillooet	1958	149,347	5,074,811	31,596	27,314			50	6	15	2	5,102,133
	1959	136,897	4,595,633	27,641	24 177							4,619,810
Nanaimo	1958[2]	1,564	53,145	19,523	16,877	1,480,797	346,788					416,810
	1959	769	25,815	15,898	13,906	928,024	257,137					296,858
Nelson	1958	105	3,568	151,680	131,124			31,368,216	3,687,334	77,707,063	7,776,923	11,598,949
	1959	255	8,560	149,790	131,020			31,809,997	3,712,227	86,394,614	9,484,401	13,336,208
New Westminster	1958	33	1,121	504	.. 436	680,470	159,359					160,916
	1959					497,394	137,818					137,818
Nicola	1958											
	1959											
Omineca	1958	273	9,277	178,855	154,617	17,605	4,123	534,394	62,818	963,780	96,455	327,290
	1959	16	537	13,883	12,143			113,532	13,249	80,969	8,889	34,818
Osoyoos	1958	8,762	297,733	4,370	3,778			718	84	714	71	301,666
	1959	7,430	249,426	706	618							250,044
Revelstoke	1958	1,136	38,601	141,017	121,906			1,813,785	213,210	1,722,268	172,365	546,082
	1959											
Similkameen	1958	441	14,985	146	126	7,403	1,734					16,845
	1959	18	604	477	417	59,514	16,490					17,511
Skeena	1958	250	8,495	1,310,282	1,132,713			1,439,596	169,225	8,423	843	1,311,276
	1959	650	21,821	853,615	746,649			853,118	99,559	9,114	1,001	869,030
Slocan	1958	241	8,189	922,308	797,317			36,058,520	4,238,679	30,092,729	3,011,680	8,055,865
	1959	107	3,592	523,153	457,597			23,238,045	2,711,880	28,962,829	3,179,539	6,352,608
Trail Creek	1958	649	22,053	225	194			2,809	330	848	85	22,662
	1959	257	8,627	921	805	58,399	16,181	2,974	347	522	57	26,017
Vancouver	1958	2,585	87,838	18,406	15,912	4,016,258	940,567	85,842	10,091	3,008,766	301,117	1,355,525
	1959	3,174	106,551	27,521	24,072	6,714,761	1,860,526	64,539	7,532	2,902,887	318,679	2,317,360
Vernon	1958											
	1959											
Victoria	1958			23,328	20,167	4,285,555	1,003,634					1,023,801
	1959			23,232	20,321	4,929,462	1,365,855					1,386,176
Not assigned[1]	1958	173	5,879	169,934	146,904	2,018,873	472,800	21,269,880	2,500,274	69,357,509	6,941,299	10,067,156
	1959	67	2,249	63,526	55,566	1,060,331	293,797	31,448,879	3,670,084	62,692,514	6,882,384	10,904,080
Totals	1958	194,354	6,604,149	7,040,416	6,086,299	12,658,649	2,964,529	294,573,159	34,627,075	432,002,790	43,234,839	93,516,891
	1959	173,146	5,812,511	6,197,159	5,420,593	16,233,546	4,497,991	287,423,357	33,542,306	402,342,850	44,169,198	93,442,599

[1] Gold, silver, copper, and some lead "not assigned" were recovered at the Tacoma smelter from dross shipped from the Trail smelter. The zinc and most of the lead were recovered at the Trail smelter by fuming current and reclaimed slag. [2] *See* footnote 2 of Table VIIA.

TABLE VIIc.—PRODUCTION, 1958 AND 1959, BY MINING DIVISIONS—MISCELLANEOUS METALS

Division	Year	Antimony[1]		Bismuth		Cadmium[2]		Indium		Iron Ore		Nickel		Tin		Tungsten (WO_3)		Division Totals
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
		Lb.	$	Lb.	$	Lb.	$	Oz.	$	Tons	$	Lb.	$	Lb.	$	Lb.	$	$
Atlin	1958																	
	1959																	
Fort Steele	1958					125	190							795,496	625,260			625,450
	1959					20	26							747,443	627,852			627,878
Golden	1958					54,483	82,814											82,814
	1959					33,905	43,398											43,398
Greenwood	1958					4,311	6,553											6,553
	1959					5,499	7,039											7,039
Lillooet	1958																	
	1959																	
Nanaimo	1958									630,271	4,193,442							4,193,442
	1959									849,248	6,363,848							6,363,848
Nelson	1958					476,881	724,859									690,976	1,884,209	2,609,068
	1959					535,457	685,385											685,385
New Westminster	1958											1,408,490	996,507					996,507
	1959											1,061,532	743,072					743,072
Omineca	1958					11,736	17,839											17,839
	1959					734	940											940
Revelstoke	1958																	
	1959																	
Similkameen	1958																	260[4]
	1959																	
Skeena	1958																	
	1959																	
Slocan	1958					120,655	183,395											183,395
	1959					107,029	136,997											136,997
Vancouver	1958					13,015	19,783											19,783
	1959					11,237	14,383											14,383
Not assigned[1 2 3]	1958	858,633	284,208	154,034	308,068	743,902	1,130,731	75,434	117,677									1,840,684
	1959	1,657,797	540,276	181,843	345,502	1,001,940	1,282,483											2,168,261
Totals	1958	858,633	284,208	154,034	308,068	1,425,108	2,166,164	75,434	117,677	630,271	4,193,442	1,408,490	996,507	795,496	625,260	690,976	1,884,209	10,575,795
	1959	1,657,797	540,276	181,843	345,502	1,695,821	2,170,651			849,248	6,363,848	1,061,532	743,072	747,443	627,852			11,424,134[5]

[1] Antimony assigned to individual mining divisions is the reported content of concentrates exported to foreign smelters. Antimony "not assigned" is the antimony content of antimonial lead or of other antimony products recovered at the Trail smelter.

[2] Cadmium assigned to individual mining divisions is the reported content of custom shipments to the Trail smelter and to foreign smelters. Cadmium "not assigned" is the remainder of the reported estimated recovery at the Trail smelter from British Columbia concentrates.

[3] Bismuth and indium recovered at the Trail smelter are not assigned to mining divisions and may include some metal from sources outside British Columbia.

[4] Includes 4 ounces of platinum valued at $260. [5] Includes $632,933 for "others."

TABLE VIId.—PRODUCTION, 1958 AND 1959, BY MINING DIVISIONS—INDUSTRIAL MINERALS

Division	Year	Asbestos		Barite		Diatomite		Fluxes (Limestone and Quartz)		Granules (Quartz, Limestone, and Granite)		Gypsum and Products		Mica		Sulphur		Division Totals
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
		Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	$
Cariboo	1958					27	540											540
	1959					**5**	**100**											**100**
Fort Steele	1958															38,845	663,861	663,861
	1959											**51**				**39,062**	**907,020**	**907,020**
Golden	1958			16,144	341,700							70,498	211,494					553,194
	1959			**23,142**	**187,368**							**112,172**	**282,030**					**469,398**
Greenwood	1958																	
	1959																	
Liard	1958	30,078	8,203,384[1]															8,203,384
	1959	**33,883**	**9,742,504**[1]															**9,742,504**
Nanaimo	1958							23,457	23,806									23,806
	1959							**15,697**	**16,026**									**16,026**
New Westminster	1958									11,623	143,945							143,945
	1959									**8,621**	**107,248**							**107,248**
Osoyoos	1958							67,178	287,824[2]	11,051	140,385							428,209
	1959							**54,867**	**232,827**	**10,451**	**147,003**							**379,830**
Vancouver	1958															5,965	75,501	75,501
	1959															**3,654**	**43,412**	**43,412**
Victoria	1958																	
	1959							**6**	**60**									**60**
Not assigned	1958															166,490[3]	1,671,033	1,671,033
	1959															**212,729**[3]	**2,362,457**	**2,362,457**
Totals	1958	30,078	8,203,384	16,144	341,700	27	540	90,635	311,630	22,674	284,330	70,498	211,494			211,300	2,410,395	11,763,473
	1959	**33,883**	**9,742,504**	**23,142**	**187,368**	**5**	**100**	**70,570**	**248,913**	**19,072**	**254,251**	**112,223**[4]	**282,030**			**255,445**	**3,312,889**	**14,028,055**

[1] Does not include value of containers.
[2] Includes 32 tons of fluorspar, worth $1,386.
[3] Includes $20,813 value of elemental sulphur in 1958 and $687,337 in 1959.
[4] Includes 51 tons of gypsum residue from Trail smelter for testing, and of no commercial value.

Table VIIe.—Production, 1958 and 1959, by Mining Divisions—Structural Materials

Division	Year	Cement	Lime and Limestone	Building-stone	Rubble, Riprap, and Crushed Rock	Sand and Gravel	Brick (Common)	Face, Paving, and Sewer Brick	Fire-bricks, Blocks	Clays	Structural Tile (Hollow Blocks), Roof-tile, Floor-tile	Drain-tile and Sewer-pipe	Pottery (Glazed or Unglazed)	Other Clay Products	Division Totals
		$	$	$	$	$	$	$	$	$	$	$	$	$	$
Alberni	1958				6,802	47,792									54,594
	1959				1,337	28,767									30,104
Atlin	1958				2,948	23,154									26,102
	1959				23,087	15,979									39,066
Cariboo	1958				165,326	370,769									536,095
	1959				218,036	290,639									508,675
Clinton	1958					15,483									15,483
	1959														
Fort Steele	1958				28,155	125,615									153,770
	1959				45,680	180,166									225,846
Golden	1958				1,825	131,437									133,262
	1959				370	85,196								1,500	87,066
Greenwood	1958				7,400	5,000									12,400
	1959				22,233	6,485									28,718
Kamloops	1958				822,714	382,439									1,205,153
	1959				321,288	63,877									385,165
Liard	1958				85	206,089									206,174
	1959				850	185,213									186,063
Lillooet	1958				8,250	147,648									155,898
	1959				1,952	99,367									101,319
Nanaimo	1958		849,702		5,013	141,044									995,759
	1959		1,323,682		5,302	159,971									1,488,955
Nelson	1958				26,972	56,563									83,535
	1959					65,799									65,799
New Westminster	1958		109,667		541,426	2,112,365	13,625	291,607	360,835	12,579	76,292	573,453	60,725	23,258	4,175,832
	1959		104,793	9,310	326,178	2,450,267	11,006	394,826	498,222	15,951	135,557	599,509	46,902	68,484	4,661,005
Nicola	1958				3,000	59,670									62,670
	1959				20,645	13,154									33,799
Omineca	1958				162,367	374,925									537,292
	1959				15,529	291,204									306,733
Osoyoos	1958					603									603
	1959					525									525
Revelstoke	1958				23,395	55,362									78,757
	1959				5,732	32,453									38,185
Similkameen	1958					82,950									82,950
	1959				2,000	21,050									23,050
Skeena	1958		25,900		97,871	155,026									278,797
	1959		40,712		38,903	168,281									247,896
Slocan	1958					60,967									60,967
	1959					40,337									40,337
Trail Creek	1958			3,500	12,500	111,461									127,461
	1959			11,600	10,000	72,069									93,669
Vancouver	1958	1,560,000		60,835	155,967	2,741,294		52,526	35,006					9,158	4,614,786
	1959	2,647,240		48,800	49,804	1,794,603		33,274	21,535						4,595,256
Vernon	1958				3,780	220,469									224,249
	1959				4,829	257,624									262,453
Victoria	1958	5,195,619	12,550		23,156	814,551	1,500		9,644		46,585	65,720	7,662		6,176,987
	1959	4,402,398	519,580		14,598	1,019,672	948		18,809	1,050	13,826	81,193		10,926	5,575,525
Totals	1958	6,755,619	997,819	64,335	2,098,952	8,442,676	15,125	344,133	405,485	12,579	122,877	639,173	68,387	32,416	19,999,576
	1959	7,049,638	1,481,282	69,710	1,128,353	7,342,698	11,954	428,100	538,566	17,001	149,383	680,702	46,902	80,910	19,025,209

Table VIIIa.—Production to Date by Mining Divisions—Summary

Division	Placer Gold[1]		Principal Lode Metals	Miscellaneous Metals	Industrial Minerals	Structural Materials	Fuels: Coal		Fuels: Petroleum		Fuels: Natural Gas, Direct to Pipe-line		Fuels: Natural Gas, Liquid By-products, Value[2]	Division Totals
	Quantity	Value					Quantity	Value	Quantity	Value	Quantity	Value		
	Oz.	$	$	$	$	$	Tons	$	Bbls.	$	M S.C.F.	$	$	$
Alberni	1,613	33,136	11,691,688		9,398	975,008								12,709,230
Atlin	730,079	17,223,616	37,482,188	562,122	20,325	253,188								55,541,439
Cariboo	2,600,643	53,880,266	38,239,602	23,730	166,804	3,987,363	290	1,100						96,298,865
Clinton	10,093	240,834	847,454	900	162,427	110,928								1,362,543
Fort Steele	20,469	466,584	1,485,438,262	9,448,788	4,288,502	4,409,427	53,957,853	220,456,966						1,724,508,529
Golden	469	11,268	38,145,894	512,111	3,325,664	1,395,629								43,390,566
Greenwood	5,056	115,136	117,266,318	80,091	2,323,897	768,559								120,554,001
Kamloops	27,550	603,452	3,044,836	65,678	6,528,308	7,436,261	14,995	59,765						17,738,300
Liard	50,082	1,245,186	6,312	79	42,010,186	1,335,272	93,156	637,330	1,872,915	3,646,389	143,058,018	7,775,815	893,359[2]	57,549,928
Lillooet	91,829	1,891,775	118,090,899	48,350	5,129	1,181,935								121,218,088
Nanaimo	866	19,300	6,594,601	35,116,370	703,036	29,987,417	80,004,599	297,251,634						369,672,358
Nelson	3,581	88,871	152,357,892	39,807,269	64,126	2,642,771								194,960,929
New Westminster	11,581	242,839	425,968	1,827,303	552,493	59,747,692								62,796,295
Nicola	234	4,764	571,128		10,050	435,580	2,929,331	11,074,901						12,096,423
Omineca	52,475	1,389,533	17,311,592	15,631,235	11,460	2,910,986	417,210	2,590,461						39,845,267
Osoyoos	208	4,639	50,694,165	1,020	3,016,906	972,522	1,122	5,008						54,694,260
Revelstoke	7,579	164,389	10,775,731	173,175		1,208,608								12,321,903
Similkameen	12,143	288,069	120,038,106	128,661	18,558	2,198,392	4,654,140	19,541,399						142,213,185
Skeena	4,603	105,569	209,832,697	337,504	1,240,215	6,729,437								218,245,422
Slocan	366	9,397	171,839,364	2,729,113		755,892								175,333,766
Trail Creek	849	24,204	82,729,432	35,774		1,655,023								84,444,433
Vancouver	182	5,306	196,826,571	921,806	6,214,068	38,014,431								241,982,182
Vernon	2,677	71,487	188,310		3,978	2,459,457								2,723,232
Victoria	628	15,680	8,003,041	35,437	188,126	104,917,505								113,159,789
Not assigned[3]	1,577,661	18,176,703	109,972,373	43,955,667	31,620,775	11,264,251								214,989,769
Totals	5,213,516	96,322,003	2,988,414,424	151,442,183	102,484,431	287,753,534	142,072,696	551,618,564	1,872,915	3,646,389	143,058,018	7,775,815	893,359	4,190,350,702

[1] Quantity of placer gold is given in ounces of crude gold. The year of first recorded production for the major placer-producing mining divisions was: Atlin, 1898; Cariboo, 1858; Lillooet, 1874; Quesnel, 1858.

[2] Includes propane, butane, natural gasoline.

[3] *Re* "not assigned," *see* footnotes under Tables VIIIb and VIIIc.

Note.—Full details for placer gold are given in this table. The columns headed "Principal Lode Metals," "Miscellaneous Metals," "Industrial Minerals," and "Structural Materials" give the total value only, details being set forth in Tables VIIIb, VIIIc, VIIId, and VIIIe. The quantity of coal is gross output; *see* footnotes to Tables IXa, IXb, and IXc.

Table VIIIb.—Production to Date by Mining Divisions—Principal Lode Metals

Division	Lode Gold		Silver		Copper		Lead		Zinc[1]		Division Totals
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
	Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
Alberni	301,089	11,265,115	162,423	77,993	2,290,699	343,518	117,937	5,062			11,691,688
Atlin	344,163	12,125,578	3,375,330	2,893,940	24,777,661	8,160,266	23,765,211	3,437,907	91,067,749	10,864,497	37,482,188
Cariboo	1,061,383	38,157,697	120,879	77,242	2,352	920	24,560	3,724	505	19	38,239,602
Clinton	23,390	827,328	31,564	14,214	57,548	5,905	193	7			847,454
Fort Steele	4,552	125,774	197,689,390	111,443,351	28,592	6,193	11,005,989,401	780,196,399	7,942,394,000	593,666,545	1,485,438,262
Golden	169	4,844	2,989,697	2,197,589	905,759	288,639	204,605,643	19,094,116	214,987,494	16,560,706	38,145,894
Greenwood	1,140,605	24,624,473	32,002,859	19,077,475	444,254,301	71,325,940	14,865,085	1,142,534	15,655,427	1,095,896	117,266,318
Kamloops	47,868	1,608,328	304,512	181,984	6,411,583	1,179,668	538,097	45,030	438,023	29,826	3,044,836
Liard	114	4,120	540	446	56	22	10,102	1,724			6,312
Lillooet	3,372,426	117,578,781	829,561	509,527	400	41	62,513	2,548	15	2	118,090,899
Nanaimo	86,342	1,998,958	605,746	367,064	24,544,256	4,228,569					6,594,601
Nelson	1,329,147	41,563,680	7,915,535	4,739,013	14,798,370	1,682,270	265,402,846	32,017,116	588,377,162	72,355,813	152,357,892
New Westminster	4,449	113,528	14,154	6,616	1,206,031	304,224	28,425	1,119	12,755	481	425,968
Nicola	8,525	234,914	267,419	126,588	555,712	108,513	2,235,428	90,516	320,683	10,597	571,128
Omineca	25,053	773,147	9,532,550	7,571,006	6,750,202	1,545,334	27,810,882	3,529,479	31,438,025	3,892,626	17,311,592
Osoyoos	1,638,153	49,902,321	589,474	386,021	2,783,966	399,900	125,982	5,454	7,553	469	50,694,165
Revelstoke	37,292	1,068,988	4,104,668	2,763,861	153,686	51,037	36,250,885	3,843,129	25,087,535	3,048,716	10,775,731
Similkameen	183,474	6,308,995	4,219,216	2,582,068	601,170,373	111,129,775	381,427	13,304	72,275	3,964	120,038,106
Skeena	2,393,855	60,253,658	68,367,648	43,656,991	687,106,270	98,025,648	59,747,092	5,407,195	16,807,574	2,489,205	209,832,697
Slocan	15,532	446,832	69,369,794	44,289,839	229,696	43,512	825,295,501	66,279,337	639,977,188	60,779,844	171,839,364
Trail Creek	2,949,702	62,586,129	3,621,887	2,067,040	121,200,022	18,050,907	135,697	10,997	119,570	14,359	82,729,432
Vancouver	444,003	14,145,040	4,758,378	2,891,369	929,089,216	152,434,266	17,884,833	1,799,089	197,190,364	25,556,807	196,826,571
Vernon	5,223	176,048	12,823	8,084	654	100	24,914	2,932	10,816	1,146	188,310
Victoria	37,663	812,730	862,158	493,791	33,406,307	6,392,749	210,097	19,848	3,568,709	283,923	8,003,041
Not assigned[2]	55,271	1,078,407	4,571,527	3,151,077	43,884,525	8,872,152	359,071,686	26,623,154	894,299,408	70,247,583	109,972,373
Totals	15,509,443	447,785,413	416,319,732	251,574,189	2,945,608,237	484,580,078	12,844,584,437	943,571,720	10,661,832,830	860,903,024	2,988,414,424

[1] *See* footnote 3 to Table VI.

[2] Includes zinc and lead recovered at the Trail smelter from current and reclaimed slags and also metals recovered at the Tacoma smelter from dross shipped by the Trail smelter.

TABLE VIIIc.—PRODUCTION TO DATE BY MINING DIVISIONS—MISCELLANEOUS METALS

Division	Antimony		Bismuth		Cadmium		Chromite		Cobalt		Indium		Iron Ore		Magnesium		Manganese	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Lb.	$	Lb.	$	Lb.	$	Tons	$	Lb.	$	Oz.	$	Tons	$	Lb.	$	Tons	$
Atlin					319,212	561,762												
Cariboo																		
Clinton							126	900										
Fort Steele					1,837	3,823									204,632	88,184		
Golden	40,062	14,906			242,834	409,021	670	31,395										
Greenwood					27,866	48,696												
Kamloops													17,109	59,883				
Liard																		
Lillooet	13,466	4,321																
Nanaimo													5,414,674	35,116,370				
Nelson					3,376,189	5,888,580												
New Westminster																		
Omineca	104,489	15,217			260,487	515,635			1,730	420								
Osoyoos																	16[1]	
Revelstoke	9,394	3,455			95,113	164,033												
Similkameen																		
Skeena					141,890	316,764							1,200	6,000				
Slocan	31,865	8,133			1,487,499	2,712,820											541	8,160
Trail Creek					115	210							550	1,925				
Vancouver					440,300	921,806												
Victoria					7,000	10,929											1,167	24,508
Not asigned [2] [3] [4]	37,578,140	9,419,642	4,913,977	8,152,724	18,350,519	23,878,750					942,087	1,871,618						
Totals	37,777,416	9,465,674	4,913,977	8,152,724	24,750,861	35,432,829	796	32,295	1,730	420	942,087	1,871,618	5,433,533	35,184,178	204,632	88,184	1,724	32,668

[1] Estimated manganese content of about 40 tons of ore shipped for testing purposes by Olalla Mines Ltd., in 1956.

[2] Antimony assigned to individual mining divisions is the reported content of concentrates exported to foreign smelters. Antimony " not assigned " is the antimony content of antimonial lead or of other antimony products recovered at the Trail smelter.

[3] Cadmium assigned to individual mining divisions is the reported content of custom shipments to the Trail smelter and to foreign smelters. Cadmium " not assigned " is the remainder of the reported estimated recovery at the Trail smelter from British Columbia concentrates.

[4] Bismuth and indium recovered at the Trail smelter are not assigned to mining divisions and may include some metal from sources outside British Columbia.

Year of first recorded production: Antinomy, 1907; bismuth, 1929; chromite, 1918; indium, 1942; iron ore, 1885; magnesium, 1941; manganese, 1918.

TABLE VIIIc.—PRODUCTION TO DATE BY MINING DIVISIONS—MISCELLANEOUS METALS—*Continued*

Division	Mercury		Molybdenite		Nickel		Palladium		Platinum		Selenium		Tin		Tungsten (WO_3)		Division Totals
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
	Lb.	$	Lb.	$	Lb.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
Atlin															292	360	562,122
Cariboo									59	2,299					27,698	21,431	23,730
Clinton																	900
Fort Steele													12,077,465	9,444,965			9,448,788
Golden																	512,111
Greenwood																	80,091
Kamloops	10,987	5,795															65,678
Liard									2	79							79
Lillooet	1,783	3,555	2,448	2,440					3	113					32,353	37,921	48,350
Nanaimo																	35,116,370
Nelson			25,058	18,378											13,739,939	33,900,311	39,807,269
New Westminster					2,751,475	1,827,303											1,827,303
Omineca	4,150,892	10,400,259	1,600	1,840					3	154					2,210,892	4,697,710	15,631,235
Osoyoos			1,020	1,020													1,020
Revelstoke															7,784	5,687	173,175
Similkameen									1,280	128,661							128,661
Skeena			13,022	13,020							731	1,389			366	331	337,504
Slocan																	2,729,113
Trail Creek							749	30,462	53	1,177							35,774
Vancouver																	921,806
Victoria																	35,437
Not asigned																	43,322,734
Totals	4,163,662	10,409,609	43,148	36,698	2,751,475	1,827,303	749	30,462	1,400	134,483	731	1,389	12,077,465	9,444,965	16,019,324	38,663,751	151,442,183[5]

[5] Includes " Other Metals " valued at $632,933.

Year of first recorded production: Mercury, 1895; molybdenite, 1914; nickel, 1936; palladium, 1928; platinum, 1887; selenium, 1931; tin, 1941; tungsten, 1937.

Table VIIID.—Production to Date by Mining Divisions—Industrial Minerals

Division	Arsenious Oxide		Asbestos		Barite		Bentonite		Diatomite		Fluorspar		Flux (Quartz and Limestone)		Granules (Quartz, Limestone, and Granite)		Gypsum and Gypsite		Hydro-magnesite	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	Lb.	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$
Alberni																				
Atlin																			1,450	20,325
Cariboo									1,575	34,835[1]					48	168				
Clinton																	873	6,236	803	7,211
Fort Steele					8	80											112,878	298,824		
Golden					148,557	1,905,774											522,146	1,418,614		
Greenwood											35,309	783,578	1,790,502	1,540,319						
Kamloops																	1,246,918	6,323,178		
Liard			144,939	42,010,186																
Lillooet																				
Nanaimo													656,344	703,036						
Nelson													7,601	8,194	2	51				
New Westminster															46,002	552,493				
Nicola																	2,407	10,050		
Omineca	16,997	340																		
Osoyoos	22,002,423	272,861									32	1,386	468,394	2,179,256	39,155	516,165				
Similkameen							791	16,858									250	1,700		
Skeena													601,019	1,050,722						
Vancouver															29,692	418,606				
Vernon																				
Victoria													56	820	9,605	157,080				
Totals	22,019,420	273,201	144,939	42,010,186	148,565	1,905,854	791	16,858	1,575	34,835	35,341	784,964	3,523,949	5,482,327	124,504	1,644,563	1,885,472	8,058,602	2,253	27,536

[1] Includes 30 tons of volcanic ash, worth $300.

Year of first recorded production: Arsenious oxide, 1917; asbestos, 1952; barite, 1940; bentonite, 1926; diatomite, 1928; fluorspar, 1918; flux, 1911; granules, 1930; gypsum and gypsite, 1911; hydromagnesite, 1904.

TABLE VIIID.—PRODUCTION TO DATE BY MINING DIVISIONS—INDUSTRIAL MINERALS—*Continued*

Division	Iron Oxide and Ochre		Magnesium Sulphate		Mica		Natro-alunite		Perlite		Phosphate Rock		Sodium Carbonate		Sulphur		Talc		Division Totals
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
	Total	$	Tons	$	Lb.	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	$
Alberni							522	9,398											9,398
Atlin																			20,325
Cariboo					9,641,800	131,801													166,804[1]
Clinton			1,923	39,085															162,427
Fort Steele											3,842	16,894	9,524	109,895	207,298[2]	3,972,704			4,288,502
Golden	27	920															5	356	3,325,664
Greenwood																			2,323,897
Kamloops			8,742	193,967	424,700	2,075							968	9,088					6,528,308
Liard																			42,010,186
Lillooet																	296	5,129	5,129
Nanaimo																			703,036
Nelson	7,292	55,901																	64,126
New Westminster																			552,493
Nicola																			10,050
Omineca									1,112	11,120									11,460
Osoyoos			3,229	21,300	1,588,800	25,938													3,016,906
Similkameen																			18,558
Skeena					634,250	10,815									41,624	178,678			1,240,215
Vancouver	10,669	97,389													613,755	5,698,078			6,214,068
Vernon					160,500	3,978													3,978
Victoria	120	840															1,504	29,386	188,126
Not assigned															3,152,917	31,620,775			31,620,775
Totals	18,108	155,050	13,894	254,352	12,450,050	174,607	522	9,398	1,112	11,120	3,842	16,894	10,492	118,983	4,015,594	41,470,230	1,805	34,871	102,484,431

[1] Includes 30 tons of volcanic ash, worth $300.
[2] Recovery in 1953 and subsequent years.
Year of first recorded production: Iron oxide and ochre, 1918; magnesium sulphate, 1915; mica, 1932; natro-alunite, 1912; perlite, 1953; phosphate rock, 1927; sodium-carbonate, 1921; sulphur, 1916; talc, 1916.

Table VIIIe.—Production to Date by Mining Divisions-Structural Materials

Division	Cement	Lime and Limestone	Building-stone	Rubble, Riprap, and Crushed Rock	Sand and Gravel	Brick (Common)	Face, Paving, and Sewer Brick	Fire-bricks, Blocks	Clays	Structural Tile (Hollow Blocks), Roof-tile, Floor-tile	Drain-tile and Sewer-pipe	Pottery (Glazed or Un-glazed)	Other Clay Products	Division Totals
	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Alberni	...	...	...	53,204	921,804	...	...	...		...	...	...	...	975,008
Atlin	...	1,108	...	91,478	160,602	...	...	...		...	...	...	...	253,188
Cariboo	...	7,500	...	705,611	3,243,175	1,193	184	4,651	15,807	...	...	...	9,242	3,987,363
Clinton	...	...	...	1,606	109,322	...	...	...	...	...	...	...		110,928
Fort Steele	...	5,350	71,941	970,502	3,353,824	7,800	...	...	...	...	...	...		4,409,427
Golden	...	1,000	24,000	86,876	1,282,253	...	...	...	...	...	...	...	1,500	1,395,629
Greenwood	...	102,442	30,500	165,773	348,561	114,361	...	...	6,922	...	...	...		768,559
Kamloops	...	12,000	18,000	3,938,198	3,395,684	72,379	...	...	...	...	...	...		7,436,261
Liard	...	...	...	27,160	1,308,112	...	...	...	...	...	...	...		1,335,272
Lillooet	...	100	2,000	291,313	888,522	...	...	...	...	...	...	...		1,181,935
Nanaimo	...	23,536,955	3,184,532	68,042	2,018,896	1,104,295	38,939	...	35,758	...	...	...		29,987,417
Nelson	...	34,543	356,679	283,666	1,945,909	19,110	2,864	...	...	...	...	...		2,642,771
New Westm'r.	...	987,897	9,310	8,071,266	20,824,803	1,427,343	4,377,276	10,343,091	799,385	2,681,135	9,655,698	275,474	326,353	59,779,031
Nicola	...	...	8,000	97,706	329,874	...	...	...	...	...	...	...		435,580
Omineca	...	3,077	...	558,744	2,343,891	5,274	...	...	...	...	...	...		2,910,986
Osoyoos	...	32,070	14,850	145,557	780,045	...	...	...	...	...	...	...	...	972,522
Revelstoke	...	1,000	5,575	319,505	882,528	...	...	...	...	...	...	...	...	1,208,608
Similkameen	10,500	11,571	24,000	511,044	1,627,922	...	...	...	1,363	...	...	...	11,992	2,198,392
Skeena	...	1,342,956	144,000	1,147,144	4,082,088	...	...	...	4,925	...	...	...	8,324	6,729,437
Slocan	...	1,000	115,143	70,014	569,735	...	...	...	...	...	...	...	...	755,892
Trail Creek	...	28,000	61,650	212,042	1,353,331	...	...	...	...	...	...	...	...	1,655,023
Vancouver	4,542,958	40,885	3,846,026	7,599,368	20,941,215	132,194	208,910	542,237	17,633	...	...	23,362	88,304	37,983,092
Vernon	...	46,499	81,052	183,218	1,987,434	131,467	6,202	1,011	5	18,224	4,325	...	20	2,459,457
Victoria	88,575,462	764,852	...	453,790	11,483,072	1,807,435	23,052	47,642	1,050	705,821	905,695	127,705	21,929	104,917,505
Not assigned	...	315,498	505,018	282,455		...	...	...	...	...	...	...	...	11,264,251[1]
Totals	93,128,920	27,276,303	8,502,276	26,335,282	6,182,612	4,822,851	4,657,427	10,938,632	882,848	3,405,180	10,565,718	426,541	467,664	287,753,534[2]

[1] Structural materials that so far cannot be assigned to mining divisions include the three items shown, an amount of $3,150,828 for clay products, and a further $7,010,452 that cannot be allotted to a particular class of material.

[2] Includes items noted in footnote 1.

TABLE IXA.—QUANTITY (GROSS[1]) AND VALUE OF COAL PER YEAR TO DATE

Year	Tons (2,000 Lb.)	Value
1836–59	41,871	$149,548
1860	15,956	56,988
1861	15,427	55,096
1862	20,292	72,472
1863	23,906	85,380
1864	32,068	115,528
1865	36,757	131,276
1866	28,129	100,460
1867	34,988	124,956
1868	49,286	176,020
1869	40,098	143,208
1870	33,424	119,372
1871	55,458[2]	164,612
1872	55,458[2]	164,612
1873	55,459[2]	164,612
1874	91,334	244,641
1875	123,362	330,435
1876	155,895	417,576
1877	172,540	462,156
1878	191,348	522,538
1879	270,257	723,903
1880	299,708	802,785
1881	255,760	685,171
1882	315,997	846,417
1883	238,895	639,897
1884	441,358	1,182,210
1885	409,468	1,096,788
1886	365,832	979,908
1887	462,964	1,240,080
1888	548,017	1,467,903
1889	649,411	1,739,490
1890	759,518	2,034,420
1891	1,152,590	3,087,291
1892	925,495	2,479,005
1893	1,095,690	2,934,882
1894	1,134,509	3,038,859
1895	1,052,412	2,824,687
1896	1,002,268	2,693,961
1897	999,372	2,734,522
1898	1,263,272	3,582,595
1899	1,435,314	4,126,803
1900	1,781,000	4,744,530
1901	1,894,544	5,016,398
1902	1,838,621	4,832,257
1903	1,624,742	4,332,297
1904	1,887,981	4,953,024
1905	2,044,931	5,511,861
1906	2,126,965	5,548,044
1907	2,485,961	7,637,713
1908	2,362,514	7,356,866
1909	2,688,672	8,574,884
1910	3,515,944	11,108,335
1911	2,573,444	$8,071,747
1912	3,388,795	10,786,812
1913	2,879,251	9,197,460
1914	2,426,399	7,745,847
1915	2,209,290	7,114,178
1916	2,783,849	8,900,675
1917	2,686,561	8,484,343
1918	2,888,170	12,833,994
1919	2,698,022	11,975,671
1920	3,020,387	13,450,169
1921	2,877,995	12,836,013
1922	2,890,625	12,880,060
1923	2,848,146	12,678,548
1924	2,226,037	9,911,935
1925	2,737,607	12,168,905
1926	2,609,640	11,650,180
1927	2,748,286	12,269,135
1928	2,829,906	12,633,510
1929	2,521,402	11,256,260
1930	2,113,586	9,435,650
1931	1,912,501	7,684,155
1932	1,719,172	6,523,644
1933	1,416,516	5,375,171
1934	1,508,741	5,725,133
1935	1,330,524	5,048,864
1936	1,508,048	5,722,502
1937	1,618,051	6,139,920
1938	1,466,559	5,565,069
1939	1,655,217	6,280,956
1940	1,867,966	7,088,265
1941	2,018,635	7,660,000
1942	2,170,737	8,237,172
1943	2,040,253	7,742,030
1944	2,165,676	8,217,966
1945	1,700,914	6,454,360
1946	1,639,277	6,732,470
1947	1,923,573	8,680,440
1948	1,809,018	9,765,395
1949	1,917,296	10,549,924
1950	1,756,667	10,119,303
1951	1,824,384	10,169,617
1952	1,650,619	9,729,739
1953	1,576,105	9,528,279
1954	1,447,608	9,154,544
1955	1,484,066	8,986,501
1956	1,589,398	9,346,518
1957	1,221,766	7,340,339
1958	882,962	5,937,860
1959	757,628	5,472,064
Totals	142,140,313	551,618,564

[1] Gross mine output, including washery loss and coal used in making coke (*see* Table X and discussion under "Fuel," page A 12).

[2] A combined total for 1871, 1872, and 1873 has previously been noted in Annual Reports and the above breakdown is estimated.

TABLE IXB.—COAL PRODUCTION (GROSS[1]) BY DISTRICTS AND MINING DIVISIONS

District and Mining Division	Total to Date			1958		1959	
	Period	Quantity	Value	Quantity	Value	Quantity	Value
Vancouver Island District		Tons	$	Tons	$	Tons	$
Nanaimo Mining Division	1836–1959	80,017,027	297,251,634	182,304	1,615,490	137,240	1,415,971
Nicola-Princeton District							
Kamloops Mining Division	1893–1945	14,995	59,765	....	....	....	....
Nicola Mining Division	1907–1959	2,929,331	11,074,901	543	5,919	416	3,710
Osoyoos Mining Division	1926–1927	1,122	5,008	....	....	....	....
Similkameen Mining Division	1909–1959	4,654,140	19,541,399	146	1,122	1,161	8,527
District totals	1893–1959	7,599,588	30,681,073	689	7,041	1,577	12,237
Northern District							
Cariboo Mining Division	1942–1944	290	1,100	....	....	....	....
Liard Mining Division	1923–1959	93,156	637,330	3,094	28,738	3,319	31,040
Omineca Mining Division	1918–1959	417,281	2,590,461	5,233	44,972	5,453	55,318
District totals	1918–1959	510,727	3,228,891	8,327	73,710	8,772	86,358
East Kootenay District							
Fort Steele Mining Division	1898–1959	54,012,971	220,456,966	691,642	4,241,619	542,422	3,957,498
Provincial totals	1836–1959	142,140,313	551,618,564	882,962	5,937,860	690,011	5,472,064

[1] Gross mine output, including washery loss and coal used in making coke (*see* Table X and discussion under "Fuel," page A 12).

TABLE IXc.—QUANTITY[1] AND VALUE OF COAL SOLD AND USED,[2] 1949-59

Year	District and Mining Division	Total Sales[2]*	Used under Companies' Boilers[2]†	Used in Making Coke[2]‡	Total Sold and Used[2]		District Totals, 1959	
		Tons	Tons	Tons	Tons	$	Tons	$
	Vancouver Island						137,240	1,415,971
1949	Nanaimo	451,074	3,925		454,999	4,055,572		
1950	,,	472,690	4,329		477,019	4,060,337		
1951	,,	391,687	3,425		395,112	3,486,615		
1952	,,	267,346	2,986		270,332	2,749,206		
1953	,,	204,931	1,798		206,729	2,059,828		
1954	,,	181,534	536		182,070	2,029,099		
1955	,,	173,861	465		174,326	1,769,682		
1956	,,	172,140	389		172,529	1,629,168		
1957	,,	163,574	439		164,013	1,849,306		
1958	,,	153,892	404		154,296	1,615,470		
1959	,,	**136,879**	**361**		**137,240**	**1,415,971**		
	Nicola-Princeton						1,577	12,237
1949	Nicola	1,672			1,672	14,800		
1950	,,	1,125			1,125	9,926		
1951	,,	899			899	8,640		
1952	,,	1,139			1,139	11,493		
1953	,,	1,040			1,040	10,400		
1954	,,	1,256			1,256	12,769		
1955	,,	1,259			1,259	12,904		
1956	,,	1,170			1,170	12,092		
1957	,,	1,081			1,081	11,615		
1958	,,	543			543	5,919		
1959	,,	**416**			**416**	**3,710**		
1949	Similkameen	49,906			49,906	298,293		
1950	,,	16,784			16,784	87,483		
1951	,,	3,941			3,941	28,094		
1952	,,	6,306			6,306	48,760		
1953	,,	7,047			7,047	51,012		
1954	,,	29,713			29,713	138,080		
1955	,,	73,475			73,475	379,511		
1956	,,	72,102			72,102	366,820		
1957	,,	17,696			17,696	92,748		
1958	,,	146			146	1,122		
1959	,,	**1,161**			**1,161**	**8,527**		
	Northern						8,772	86,358
1949	Liard	12,364			12,364	76,697		
1950	,,	12,250			12,250	82,258		
1951	,,	3,199			3,199	26,095		
1952	,,	3,854			3,854	42,606		
1953	,,	4,815	20		4,835	50,895		
1954	,,	4,359			4,359	33,079		
1955	,,	3,650			3,650	32,850		
1956	,,	4,642			4,642	38,211		
1957	,,	2,758			2,758	28,421		
1958	,,	3,194			3,194	28,738		
1959	,,	**3,319**			**3,319**	**31,040**		
1949	Omineca	11,468	63		11,531	92,865		
1950	,,	13,037	62		13,099	104,790		
1951	,,	27,904			27,904	206,799		
1952	,,	37,270			37,270	285,732		
1953	,,	42,079			42,079	324,986		
1954	,,	36,572			36,572	292,862		
1955	,,	30,015			30,015	227,010		
1956	,,	8,553			8,553	71,234		
1957	,,	4,991			4,991	47,414		
1958	,,	4,677			4,677	44,972		
1959	,,	**5,453**			**5,453**	**55,318**		
	East Kootenay						542,422	3,957,498
1949	Fort Steele	842,979	19,025	228,792	1,090,796	6,011,688		
1950	,,	825,315	15,196	213,218	1,053,729	5,774,509		
1951	,,	889,669	15,977	236,871	1,142,517	6,413,374		
1952	,,	822,071	15,813	245,528	1,083,412	6,591,942		
1953	,,	878,865	12,729	230,814	1,122,408	7,031,158		
1954	,,	820,081	15,310	218,923	1,054,314	6,648,655		
1955	,,	803,125	16,560	230,464	1,050,149	6,564,544		
1956	,,	890,100	19,518	248,595	1,158,213	7,228,993		
1957	,,	677,534	17,830	199,754	895,118	5,310,835		
1958	,,	401,875	7,274	224,408	633,557	4,241,619		
1959	,,	**358,682**	**10,813**	**172,927**	**542,422**	**3,957,498**		
1949	Provincial totals	1,369,463	23,013	228,792	1,621,268	10,549,924		
1950	,,	1,341,201	19,587	213,218	1,574,006	10,119,303		
1951	,,	1,317,299	19,402	236,871	1,573,572	10,169,617		
1952	,,	1,137,986	18,799	245,528	1,402,313	9,729,739		
1953	,,	1,138,777	14,547	230,814	1,384,138	9,528,279		
1954	,,	1,073,515	15,846	218,923	1,308,284	9,154,544		
1955	,,	1,085,385	17,025	230,464	1,332,874	8,986,501		
1956	,,	1,148,707	19,907	248,595	1,417,209	9,346,518		
1957	,,	867,634	18,269	199,754	1,085,657	7,340,339		
1958	,,	564,327	7,678	224,408	796,413	5,937,860		
1959	,,	**505,910**	**11,174**	**172,927**	**690,011**	**5,472,064**	**690,011**	**5,472,064**

[1] For differences between gross mine output and coal sold refer to table "Production and Distribution by Collieries and by Districts" in section headed "Coal" or "Coal-mining" in Annual Reports of the Minister of Mines.

[2] The totals "sold and used" include:—

* Sales to retail and wholesale dealers, industrial users, and company employees.

† Coal used in company boilers, including steam locomotives.

‡ Coal used in making coke.

See also discussion under "Fuel," page A 12.

TABLE X.—COKE AND BY-PRODUCTS PRODUCTION FOR YEARS 1895 TO 1925 AND 1926 TO 1959

Year	Coal Used in Making Coke		Coke Made in Bee-hive Ovens		Coke Made in By-product Ovens		Coke Made in Gas Plants		Total Coke Made		Gas Sold and Used	Tar Produced	Other By-products[1]	Total Production Value of Coke Industry
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value				
	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	$	$	$	$
1895–1925	7,955,795	25,673,600	4,920,457	25,673,600	—	—	—	—	4,920,457	25,673,600	—	—	—	25,673,600
1926	299,839	1,338,565	105,227	795,841	42,209	244,469	42,468	221,600	189,904	1,261,910	1,009,613	50,035	45,772	2,367,330
1927	269,482	1,290,760	95,281	595,504	35,900	327,215	39,464	178,682	170,645	1,101,401	1,222,379	44,402	18,080	2,386,262
1928	210,207	940,668	68,734	429,590	32,322	263,781	41,711	187,882	142,767	881,253	1,313,407	45,313	14,036	2,254,009
1929	226,363	950,243	75,426	574,279	33,339	308,867	46,573	214,732	155,338	1,097,878	1,461,445	61,084	39,203	2,659,610
1930	225,325	1,002,684	73,708	558,801	31,904	298,004	45,751	232,917	151,363	1,089,722	1,547,092	65,770	11,935	2,714,519
1931	211,334	924,279	73,248	548,550	27,717	236,537	41,836	210,470	142,801	995,557	1,541,454	66,506	32,603	2,636,120
1932	151,750	710,432	33,090	247,615	25,436	217,221	44,645	237,174	103,171	702,010	1,589,656	54,771	14,109	2,360,546
1933	107,400	554,152	6,097	44,813	24,263	213,750	34,156	214,454	64,516	473,017	1,473,433	45,610	3,666	1,995,726
1934	141,384	571,167	24,840	154,105	23,512	213,653	51,184	198,217	99,536	565,975	1,439,287	43,939	4,756	2,053,957
1935	127,776	494,492	27,066	160,565	14,911	109,684	46,111	160,694	88,088	430,943	1,430,057	44,876	3,081	1,908,957
1936	125,810	436,595	34,009	191,843	—	—	48,859	138,787	82,868	330,630	1,422,783	38,872	—	1,792,285
1937	166,124	570,250	48,393	277,726	—	—	59,141	330,821	107,534	608,547	1,746,047	46,698	—	2,401,292
1938	176,877	623,649	54,602	315,294	—	—	58,643	345,790	113,245	661,084	1,770,839	44,324	—	2,476,247
1939	171,242	569,945	50,153	286,491	7,196	37,015	55,395	325,435	112,744	648,941	1,768,977	44,108	—	2,462,026
1940	184,160	577,706	37,845	220,211	29,124	151,931	60,726	303,421	127,695	675,563	1,810,083	54,379	3,060	2,543,085
1941	235,809	717,584	64,707	392,473	86,656	467,440	8,378	43,758	159,741	903,671	1,925,270	63,569	1,716	2,894,226
1942	255,862	866,795	66,824	439,464	96,428	608,521	6,528	54,307	169,780	1,102,292	2,165,888	86,113	22,028	3,376,321
1943	260,334	983,910	42,766	291,843	43,895	274,402	93,714	647,482	180,375	1,213,727	2,453,592	96,249	18,321	3,781,889
1944	212,883	1,439,891	36,966	301,201	47,401	347,245	88,430	565,393	172,797	1,213,839	2,562,610	56,476	19,046	3,851,971
1945	230,868	1,211,584	13,464	117,369	59,098	434,876	91,682	577,479	164,244	1,129,724	2,721,690	83,828	20,756	3,955,998
1946	251,954	1,441,415	20,542	178,556	53,525	423,025	101,094	648,297	175,161	1,249,878	3,079,009	88,947	53,097	4,470,931
1947	284,049	1,682,602	44,517	427,330	59,638	531,114	91,755	579,635	195,910	1,538,079	3,390,713	124,885	25,780	5,079,457
1948	235,297	1,440,415	47,461	559,735	57,112	630,390	57,678	455,096	162,251	1,645,221	4,520,886	153,130	19,489	6,338,726
1949	323,899	1,979,138	66,407	690,045	89,268	1,018,288	67,449	496,933	223,124	2,205,266	4,148,124	194,728	27,406	6,575,524
1950	333,955	2,027,470	23,703	269,728	127,477	997,200	92,704	686,871	243,884	1,953,799	4,298,161	277,138	27,044	6,557,042
1951	332,416	1,949,117	32,598	387,796	138,051	1,552,764	72,215	571,161	242,864	2,511,721	4,263,754	277,786	22,132	7,075,393
1952	323,922	1,972,918	35,110	440,756	142,156	1,729,924	64,906	525,384	242,172	2,696,064	4,625,747	252,070	25,639	7,599,520
1953	310,431	2,005,551	—	—	177,790	2,090,147	60,407	525,411	238,197	2,615,558	4,857,116	238,771	21,046	7,732,491
1954	302,052	2,052,641	—	—	168,982	2,032,902	67,108	566,660	236,090	2,599,562	5,113,334	226,824	20,586	7,960,306
1955	314,994	2,122,303	—	—	177,031	2,180,516	70,387	594,482	247,418	2,774,998	5,407,842	292,984	18,369	8,494,193
1956	328,805	2,277,402	—	—	180,263	2,270,167	78,185	738,292	258,448	3,008,459	5,145,851	287,437	20,961	8,462,708
1957	199,654	1,284,833	—	—	153,493	2,005,570	—	—	153,493	2,005,570	14,600	121,849	—	2,142,019
1958	224,158	1,420,328	—	—	173,920	2,253,102	—	—	173,920	2,253,102	14,600	97,803	—	2,365,505
1959	173,227	1,135,222	—	—	134,134	1,789,906	—	—	134,134	1,789,906	14,600	76,891	—	1,881,397
Totals	15,885,437	65,240,306	6,223,241	35,571,124	2,494,151	26,259,626	1,829,283	11,777,717	10,545,772	73,608,467	83,269,939	3,848,165	554,617	161,281,188

[1] "Other by-products" total includes ammonium sulphate, $52,492; ammonia liquor, $103,850; light oils, $16,571; motor fuel, $7,009; naphthalene, $4,077; creosote, $34; benzol (thinning), $312; solvent naphtha, $644; cinders, $344,682; pitch, $5,131; sulphuric acid, $6,658; tar-paint, $2,330; and miscellaneous, $10,827.

TABLE XI.—DIVIDENDS PAID BY MINING COMPANIES, 1897-1959

Dividends Paid during 1958 and 1959

	1958	1959
Bralorne Mines Ltd.	$374,100	
Bralorne Pioneer Mines Ltd.		$603,905
Cassiar Asbestos Corporation Ltd.	760,000	1,980,000
Consolidated Mining and Smelting Co. of of Canada, Ltd.	13,104,257	13,104,262
Crow's Nest Pass Coal Co. Ltd.	372,708	372,708
Highland-Bell Ltd.	78,293	78,293
Reeves MacDonald Mines Ltd.	292,250	292,250
Others	14,515	12,863
Totals	$14,996,123	$16,444,281

Dividends Paid Yearly, 1917 to 1959, Inclusive

Year	Amount Paid	Year	Amount Paid
1917	$3,269,494	1940	$14,595,530
1918	2,704,469	1941	16,598,110
1919	2,494,283	1942	13,627,104
1920	1,870,296	1943	11,860,159
1921	736,629	1944	11,367,732
1922	3,174,756	1945	10,487,395
1923	2,983,570	1946	15,566,047
1924	2,977,276	1947	27,940,213
1925	5,853,419	1948	37,672,319
1926	8,011,137	1949	33,651,096
1927	8,816,681	1950	34,399,330
1928	9,572,536	1951	40,921,238
1929	11,263,118	1952	32,603,956
1930	10,543,500	1953	22,323,089
1931	4,650,857	1954	25,368,262
1932	2,786,958	1955	35,071,583
1933	2,471,735	1956	36,262,682
1934	4,745,905	1957	24,247,420
1935	7,386,070	1958	14,996,123
1936	10,513,705	1959	16,444,281
1937	15,085,293		
1938	12,068,875	Total	$621,849,929
1939	11,865,698		

TABLE XL-DIVIDENDS PAID BY MINING COMPANIES, 1897–1959—*Continued*

Lode-gold Mines[1]

Company or Mine	Locality	Class	Amount Paid
Arlington	Erie	Gold	$94,872
Athabasca	Nelson	Gold	25,000
Bayonne	Tye Siding	Gold	25,000
Bralorne Mines Ltd.[2]	Bridge River	Gold	17,760,125
Bralorne Pioneer Mines Ltd.	Bridge River	Gold	603,905
Belmont-Surf Inlet	Princess Royal Island	Gold	1,437,500
Cariboo Gold Quartz Mining Co. Ltd.	Wells	Gold	1,679,976
Cariboo-McKinney Con. M. & M. Co.	Camp McKinney	Gold	565,588
Canadian Pacific Exploration (Porto Rico)	Nelson	Gold	37,500
Centre Star	Rossland	Gold-copper	472,255
Fairview Amalgamated	Oliver	Gold	5,254
Fern Gold Mining & Milling Co. Ltd.	Nelson	Gold	9,375
Gold Belt Mining Co. Ltd.	Sheep Creek	Gold	668,595[3]
Goodenough (leasers)	Ymir	Gold	13,731
Hedley Mascot Gold Mines Ltd.	Hedley	Gold	1,290,553
Island Mountain Mines Ltd.	Wells	Gold	2,491,236[3]
I.X.L.	Rossland	Gold	134,025
Jewel-Denero	Greenwood	Gold	11,751
Kelowna Exploration Co. Ltd. (Nickel Plate)	Hedley	Gold	2,040,000
Kelowna Mines Hedley Ltd.	Hedley	Gold	780,000[4]
Kootenay Belle Gold Mines Ltd.	Sheep Creek	Gold	357,856
Le Roi Mining Co.	Rossland	Gold-copper	1,475,000
Le Roi No. 2 Ltd.	Rossland	Gold-copper	1,574,640
Lorne (later Bralorne)	Bridge River	Gold	20,450
Motherlode	Sheep Creek	Gold	163,500
Mount Zeballos Gold Mines Ltd.	Zeballos	Gold	165,000
Nickel Plate (Hedley Gold Mining Co. Ltd.)	Hedley	Gold	3,423,191
Pioneer Gold Mines of B.C. Ltd.[2]	Bridge River	Gold	10,048,914
Poorman	Nelson	Gold	25,000
Premier Gold Mining Co. Ltd.	Premier	Gold	18,858,075[5]
Privateer Mine Ltd.	Zeballos	Gold	1,914,183
Queen (prior to Sheep Creek Gold Mines Ltd.)	Sheep Creek	Gold	98,674
Relief Arlington Mines Ltd. (Second Relief)	Erie	Gold	308,000[3]
Reno Gold Mines Ltd.	Sheep Creek	Gold	1,433,640[3]
Sheep Creek Gold Mines Ltd.[7]	Sheep Creek	Gold	3,609,375[6]
Silbak Premier Mines Ltd.	Premier	Gold	2,425,000[6]
Spud Valley Gold Mines Ltd.	Zeballos	Gold	168,000
Sunset No. 2	Rossland	Gold-copper	115,007
Surf Inlet Consolidated Gold Mines Ltd.	Surf Inlet	Gold	120,279
War Eagle	Rossland	Gold-copper	1,245,250
Ymir Gold	Ymir	Gold	300,000
Ymir Yankee Girl	Ymir	Gold	415,002[3]
Miscellaneous mines		Gold	108,623
Total, lode-gold mines			$78,278,902

[1] The gold-copper properties of Rossland are included in this table.

[2] Early in 1959 Bralorne Mines Ltd. and Pioneer Gold Mines of B.C. Ltd. were merged under the name of Bralorne Pioneer Mines Ltd., and dividend payments for 1959 are entered under the new company listing.

[3] Includes "return of capital" and "liquidating" payments.

[4] Former Kelowna Exploration Company Limited; changed in January, 1951.

[5] Up to and including 1936, dividends paid by Premier Gold Mining Company Limited were derived from operations of the company in British Columbia. Subsequent dividends paid by Premier Gold Mining Company Limited have been derived from the operations of subsidiary companies in British Columbia and elsewhere and are not included in the figure given. In 1936, Silbak Premier, a subsidiary of Premier Gold Mining Company, took over the former gold operations of that company in British Columbia. Dividends paid by Silbak Premier are given above.

[6] In several years, preceding 1953, company revenue has included profits from operations of the Lucky Jim zinc-lead mine.

[7] Since March, 1956, company name is Sheep Creek Mines Ltd.

TABLE XL-DIVIDENDS PAID BY MINING COMPANIES, 1897–1959—*Continued*

Silver-Lead-Zinc Mines

Company or Mine	Locality	Class	Amount Paid
Antoine	Rambler	Silver-lead-zinc	$10,000
Base Metals Mining Corporation Ltd. (Monarch and Kicking Horse)	Field	Silver-lead-zinc	586,143[1]
Beaverdell-Wellington	Beaverdell	Silver-lead-zinc	97,200
Beaver Silver Mines Ltd.	Greenwood	Silver-lead-zinc	48,000
Bell	Beaverdell	Silver-lead-zinc	388,297
Bosun (Rosebery-Surprise)	New Denver	Silver-lead-zinc	25,000
Canadian Exploration Ltd.	Salmo	Silver-lead-zinc	11,175,400
Capella	New Denver	Silver-lead-zinc	5,500
Consolidated Mining and Smelting Co. of Canada, Ltd.	Trail	Silver-lead-zinc	481,900,641[2]
Couverapee	Field	Silver-lead-zinc	5,203
Duthie Mines Ltd.	Smithers	Silver-lead-zinc	50,000
Florence Silver	Ainsworth	Silver-lead-zinc	35,393
Giant Mascot Mines Ltd.	Spillimacheen	Silver-lead-zinc	179,263
Goodenough	Cody	Silver-lead-zinc	45,668
H.B. Mining Co.	Hall Creek	Silver-lead-zinc	8,904
Highland Lass Ltd.	Beaverdell	Silver-lead-zinc	132,464
Highland-Bell Ltd.	Beaverdell	Silver-lead-zinc	1,632,904
Horn Silver	Similkameen	Silver-lead-zinc	6,000
Idaho-Alamo	Sandon	Silver-lead-zinc	400,000
Iron Mountain (Emerald)	Salmo	Silver-lead-zinc	20,000
Jackson	Retallack	Silver-lead-zinc	20,000
Last Chance	Three Forks	Silver-lead-zinc	213,000
Lone Bachelor	Sandon	Silver-lead-zinc	50,000
Lucky Jim	Three Forks	Silver-lead-zinc	80,000
Mercury	Sandon	Silver-lead-zinc	6,000
Meteor	Slocan City	Silver-lead-zinc	10,257
Monitor and Ajax	Three Forks	Silver-lead-zinc	70,500
Mountain Con	Cody	Silver-lead-zinc	71,387
McAllister	Three Forks	Silver-lead-zinc	45,088
Noble Five	Cody	Silver-lead-zinc	72,859
North Star	Kimberley	Silver-lead-zinc	497,901
No. One	Sandon	Silver-lead-zinc	6,754
Ottawa	Slocan City	Silver-lead-zinc	110,429
Payne	Sandon	Silver-lead-zinc	1,438,000
Providence	Greenwood	Silver-lead-zinc	142,238[3]
Queen Bess	Alamo	Silver-lead-zinc	25,000
Rambler-Cariboo	Rambler	Silver-lead-zinc	467,250
Reeves MacDonald Mines Ltd.	Remac	Silver-lead-zinc	2,630,250
Reco	Cody	Silver-lead-zinc	334,992
Ruth Mines Ltd.	Sandon	Silver-lead-zinc	125,490
St. Eugene	Moyie	Silver-lead-zinc	566,000
Sheep Creek Mines Ltd.	Invermere	Silver-lead-zinc	93,750
Silversmith and Slocan Star[4]	Sandon	Silver-lead-zinc	1,267,600
Silver Standard Mines Ltd.	Hazelton	Silver-lead-zinc	1,715,333
Spokane-Trinket	Ainsworth	Silver-lead-zinc	10,365
Standard Silver Lead	Silverton	Silver-lead-zinc	2,734,688
Sunset and Trade Dollar	Retallack	Silver-lead-zinc	88,000
Sunshine Lardeau Mines Ltd.	Beaton	Silver-lead-zinc	164,000
Torbrit Silver Mines Ltd.	Alice Arm	Silver-lead-zinc	390,000
Utica	Kaslo	Silver-lead-zinc	64,000
Violamac Mines (B.C.) Ltd.	New Denver	Silver-lead-zinc	850,000
Wallace Mines Ltd. (Sally)	Beaverdell	Silver-lead-zinc	135,000
Washington	Rambler Station	Silver-lead-zinc	20,000
Western Exploration Co. Ltd.	Silverton	Silver-lead-zinc	30,867
Whitewater	Retallack	Silver-lead-zinc	592,515
Yale Lead and Zinc Mines Ltd.	Ainsworth	Silver-lead-zinc	278,620
Miscellaneous mines			70,239
Total, silver-lead-zinc mines			$512,240,442

[1] Includes $466,143 " return of capital " distribution prior to 1949.
[2] Earnings of several company mines, and custom smelter at Trail.
[3] Includes $10,504 paid in 1944 but not included in the yearly figure.
[4] These two properties were amalgamated as Silversmith Mines Limited in August, 1939.

Table XI.—Dividends Paid by Mining Companies, 1897–1959—*Continued*

Copper Mines

Company or Mine	Locality	Class	Amount Paid
Britannia M. & S. Co.[1]	Britannia Beach	Copper	$18,803,772
Canada Copper Corporation	Greenwood	Copper	615,399
Cornell	Texada Island	Copper	8,500
Granby Cons. M.S. & P. Co.[2]	Copper Mountain	Copper	29,873,226
Marble Bay	Texada Island	Copper	175,000
Hall Mines	Nelson	Copper	233,280
Miscellaneous mines		Copper	261,470
Total, copper mines			$49,970,647

[1] The Britannia Mining and Smelting Co. Limited, a wholly owned subsidiary of the Howe Sound Company (Maine), paid the dividends shown to its parent company. On June 30th, 1958, consolidation between the Howe Sound Company (Maine) and Haile Mines Inc. became effective, bringing into existence Howe Sound Company (Delaware). The Britannia mine became a division of the new Howe Sound Company, and in August Britannia Mining and Smelting Co. was liquidated voluntarily.

[2] The Granby Consolidated Mining Smelting and Power Company dividends commenced in 1904 and cover all company activities in British Columbia to date. The figure includes all dividends, capital distributions, and interim liquidating payments, the latter being $4,500,000, paid, in 1936, prior to reorganization.

Coal Mines

Company or Mine	Locality	Class	Amount Paid
Wellington Collieries Ltd.	Nanaimo	Coal	$16,000,000
Bulkley Valley Collieries Ltd.	Telkwa	Coal	24,000
Crow's Nest Pass Coal Co. Ltd.	Fernie	Coal	17,091,906
Canadian Collieries Resources Ltd.	Nanaimo	Coal	828,271
Total, coal mines			$33,944,177

Aggregate of All Classes

Lode-gold mining	$78,278,902
Silver-lead-zinc mining and smelting	512,240,442
Copper-mining	49,970,647
Coal-mining	33,944,177
Miscellaneous, structural, and placer gold	9,668,533
Total	$684,102,701

Note.—The term " miscellaneous " noted in each class of dividend covers all payments of $5,000 and under, together with payments made by companies or individuals requesting that the item be not disclosed.

In compiling the foregoing table of dividends paid, the Department wishes to acknowledge the kind assistance given by companies, individuals, and trade journals in giving information on the subject.

TABLE XII.—PRINCIPAL ITEMS OF EXPENDITURE, REPORTED FOR OPERATIONS OF ALL CLASSES

Class	Salaries and Wages	Fuel and Electricity	Process Supplies
Lode-mining	$32,885,587	$3,638,714	$11,927,848
Placer-mining	21,714	837	5,545
Fuel—coal, coke and gas plants	3,448,394	446,206	383,096
„ —petroleum and natural gas	3,119,246	245,430[1]	2,527,344[1]
Miscellaneous metals and industrial minerals	4,992,308	1,045,688	1,393,881
Structural materials industry	5,494,797	2,300,446	1,134,424
Totals, 1959	**$49,961,996**	**$7,677,321**	**$17,371,638**
Totals, 1958	$48,938,560	8,080,989	15,053,036
1957	56,409,056	8,937,567	24,257,177
1956	57,266,026	9,762,777	22,036,839
1955	51,890,246	9,144,034	21,131,572
1954	48,702,746	7,128,669	19,654,724
1953	55,543,490	8,668,099	20,979,411
1952	62,256,631	8,557,845	27,024,500
1951	52,607,171	7,283,051	24,724,101
1950	42,738,035	6,775,998	17,500,663
1949	41,023,786	7,206,637	17,884,408
1948	38,813,506	6,139,470	11,532,121
1947	32,160,338	5,319,470	13,068,948
1946	26,190,200	5,427,458	8,367,705
1945	22,620,975	7,239,726	5,756,628
1944	23,131,874	5,788,671	6,138,084
1943	26,051,467	7,432,585	6,572,317
1942	26,913,160	7,066,109	6,863,398
1941	26,050,491	3,776,747	7,260,441
1940	23,391,330	3,474,721	6,962,162
1939	22,357,035	3,266,000	6,714,347
1938	22,765,711	3,396,106	6,544,500
1937	21,349,690	3,066,311	6,845,330
1936	17,887,619	2,724,144	4,434,501
1935	16,753,367	2,619,639	4,552,730
Grand totals, 1935/59	$913,769,506	$155,959,848	$329,231,281

[1] These figures are incomplete as they represent only twenty-eight reports received out of a total of forty-three listings.

NOTE.—" Process Supplies " include explosives, chemicals, drill-steel, lubricants, etc.

TABLE XIII.—AVERAGE NUMBER EMPLOYED IN THE MINING INDUSTRY, 1901–59

Year	Placer-mining	Lode-mining Under	Lode-mining Above	Lode-mining Total	In Concentrators	In Smelters	Coal-mining Under	Coal-mining Above	Coal-mining Total	Structural Materials Quarries and Pits	Structural Materials Plants	Miscellaneous	Total[1]
1901	...	2,736	1,212	3,948	...	...	3,041	931	3,974	...	...	...	7,922
1902	...	2,219	1,126	3,345	...	...	3,101	910	4,011	...	...	...	7,356
1903	...	1,662	1,088	2,750	...	...	3,137	1,127	4,264	...	...	...	7,014
1904	...	2,143	1,163	3,306	...	...	3,278	1,175	4,453	...	...	...	7,759
1905	...	2,470	1,240	3,710	...	...	3,127	1,280	4,407	...	...	...	8,117
1906	...	2,680	1,303	3,983	...	...	3,415	1,390	4,805	...	...	...	8,788
1907	...	2,704	1,239	3,943	...	...	2,862	907	3,769	...	...	...	7,712
1908	...	2,567	1,127	3,694	...	...	4,432	1,641	6,073	...	...	...	9,767
1909	...	2,184	1,070	3,254	...	...	4,713	1,705	6,418	...	...	...	9,672
1910	...	2,472	1,237	3,709	...	...	5,903	1,855	7,758	...	...	...	11,467
1911	...	2,435	1,159	3,594	...	...	5,212	1,661	6,873	...	...	...	10,467
1912	...	2,472	1,364	3,837	...	...	5,275	1,855	7,130	...	...	...	10,967
1913	...	2,773	1,505	4,278	...	...	4,950	1,721	6,671	...	...	...	10,949
1914	...	2,741	1,433	4,174	...	...	4,267	1,465	5,732	...	...	...	9,906
1915	...	2,709	1,435	4,144	...	...	3,708	1,283	4,991	...	...	...	9,135
1916	...	3,357	2,036	5,393	...	...	3,694	1,366	5,060	...	...	...	10,453
1917	...	3,290	2,198	5,488	...	...	3,760	1,410	5,170	...	...	...	10,658
1918	...	2,626	1,764	4,390	...	...	3,658	1,769	5,247	...	...	...	9,637
1919	...	2,513	1,746	4,259	...	...	4,145	1,821	5,966	...	...	...	10,225
1920	...	2,074	1,605	3,679	...	...	4,191	2,158	6,349	...	...	...	10,028
1921	...	1,355	975	2,330	...	...	4,722	2,163	6,885	...	...	...	9,215
1922	...	1,510	1,239	2,749	...	...	4,712	1,932	6,644	...	...	...	9,393
1923	...	2,102	1,516	3,618	...	...	4,342	1,807	6,149	...	...	...	9,767
1924	...	2,353	1,680	4,033	...	...	3,894	1,524	5,418	...	...	...	9,451
1925	...	2,298	2,840	5,138	...	...	3,828	1,615	5,443	...	...	...	10,581
1926	299	2,606	1,735	4,341	808	2,461	3,757	1,565	5,322	493	324	124	14,172
1927	415	2,671	1,916	4,587	854	2,842	3,646	1,579	5,225	647	138	122	14,830
1928	355	2,707	2,469	5,176	911	2,748	3,814	1,520	5,334	412	368	120	15,424
1929	341	2,926	2,052	4,978	966	2,948	3,675	1,353	5,028	492	544	268	15,565
1930	425	2,316	1,260	3,576	832	3,197	3,389	1,256	4,645	843	344	170	14,032
1931	688	1,463	834	2,297	581	3,157	2,957	1,125	4,082	460	526	380	12,171
1932	874	1,355	900	2,255	542	2,036	2,628	980	3,608	536	329	344	10,524
1933	1,134	1,786	1,335	3,121	531	2,436	2,241	853	3,094	376	269	408	11,369
1934	1,122	2,796	1,729	4,525	631	2,890	2,050	843	2,893	377	187	360	12,985
1935	1,291	2,740	1,497	4,237	907	2,771	2,145	826	2,971	536	270	754	13,737
1936	1,124	2,959	1,840	4,799	720	2,678	2,015	799	2,814	931	288	825	14,179
1937	1,371	3,603	1,818	5,421	1,168	3,027	2,286	867	3,153	724	327	938	16,129
1938	1,303	3,849	2,266	6,115	919	3,158	2,088	874	2,962	900	295	369	16,021
1939	1,252	3,905	2,050	5,955	996	3,187	2,167	809	2,976	652	311	561	15,890
1940	1,004	3,923	2,104	6,027	1,048	2,944	2,175	699	2,874	827	334	647	15,705
1941	939	3,901	1,823	5,724	1,025	3,072	2,229	494	2,723	766	413	422	15,084
1942	489	2,920	1,504	4,424	960	3,555	1,892	468	2,360	842	378	262	13,270
1943	212	2,394	1,699	4,093	891	2,835	2,240	611	2,851	673	326	567	12,448
1944	255	1,896	1,825	3,721	849	2,981	2,150	689	2,839	690	351	628	12,314
1945	209	1,933	1,750	3,683	822	2,834	1,927	503	2,430	921	335	586	11,820
1946	347	1,918	1,817	3,735	672	2,813	1,773	532	2,305	827	555	679	11,933
1947	360	3,024	2,238	5,262	960	3,461	1,694	731	2,425	977	585	869	14,899
1948	348	3,143	2,429	5,572	1,126	3,884	1,594	872	2,466	1,591	656	754	16,397
1949	303	3,034	2,724	5,758	1,203	3,763	1,761	545	2,306	2,120	542	626	16,621
1950	327	3,399	2,415	5,814	1,259	3,759	1,745	516	2,261	1,916	616	660	16,612
1951	205	3,785	3,695	7,480	1,307	4,044	1,462	463	1,925	1,783	628	491	17,863
1952	230	4,171	3,923	8,094	1,516	4,120	1,280	401	1,681	1,530	557	529	18,257
1953	132	3,145	2,589	5,734	1,371	3,901	1,154	396	1,550	1,909	559	634	15,790
1954	199	2,644	2,520	5,164	1,129	3,119	1,076	358	1,434	1,861	638	584	14,128
1955	103	2,564	2,553	5,117	1,091	3,304	1,100	378	1,478	1,646	641	722	14,102
1956	105	2,637	2,827	5,464	1,043	3,339	968	398	1,366	1,598	770	854	14,539
1957	67	2,393	2,447	4,840	838	3,328	1,020	360	1,380	1,705	625	474	13,257
1958	75	1,919	1,809	3,728	625	3,081	826	260	1,086	1,483	677	446	11,201
1959	**99**	**1,937**	**1,761**	**3,698**	**618**	**3,008**	**765**	**291**	**1,056**	**1,357**	**484**	**459**	**10,779**

[1] The average number employed in the industry is the sum of the averages for individual companies. The average for each company is obtained by taking the sum of the numbers employed each month and dividing by 12, regardless of the number of months worked.

TABLE XIV.—LODE-METAL MINES—TONNAGE, NUMBER OF MINES, NET AND GROSS VALUE OF PRINCIPAL METALS,* 1901–59

Year	Tonnage[1]	Number of Shipping Mines	Number of Mines Shipping over 100 Tons	Gross Value as Reported by Shipper[2]	Freight and Treatment[2]	Net Value to Shipper[3]	Gross Value of Lode Metals Produced[4]
1901	926,162	119	78	.....	.....	.....	$13,287,947
1902	1,009,016	124	75	.....	.....	.....	11,136,162
1903	1,288,466	125	74	.....	.....	.....	11,579,382
1904	1,461,609	142	76	.....	.....	.....	12,309,035
1905	1,706,679	146	79	.....	.....	.....	15,180,164
1906	1,963,872	154	77	.....	.....	.....	17,484,102
1907	1,805,614	147	72	.....	.....	.....	16,222,097
1908	2,083,606	108	59	.....	.....	.....	14,477,411
1909	2,057,713	89	52	.....	.....	.....	14,191,141
1910	2,216,428	83	50	.....	.....	.....	13,228,731
1911	1,770,755	80	45	.....	.....	.....	11,454,063
1912	2,688,532	86	51	.....	.....	.....	17,662,766
1913	2,663,809	110	58	.....	.....	.....	17,190,838
1914	2,175,971	98	56	.....	.....	.....	15,225,061
1915	2,720,669	132	59	.....	.....	.....	19,992,149
1916	3,229,942	169	81	.....	.....	.....	31,483,014
1917	2,797,368	193	87	.....	.....	.....	26,788,474
1918	2,912,516	175	80	.....	.....	.....	27,595,278
1919	2,146,920	144	74	.....	.....	.....	19,756,648
1920	2,215,445	121	60	.....	.....	.....	19,451,725
1921	1,586,428	80	35	.....	.....	.....	12,925,448
1922	1,592,163	98	33	.....	.....	.....	19,228,257
1923	2,447,672	77	28	.....	.....	.....	25,348,399
1924	3,413,912	86	37	.....	.....	.....	35,538,247
1925	3,849,269	102	40	.....	.....	.....	46,200,135
1926	4,775,327	138	55	.....	.....	$38,558,613	51,508,031
1927	5,416,411	132	52	.....	.....	27,750,364	44,977,082
1928	6,241,672	110	49	.....	.....	29,070,075	48,281,825
1929	6,977,903	106	48	.....	.....	34,713,887	51,720,436
1930	6,804,276	68	32	.....	.....	21,977,688	41,292,980
1931	5,549,622	44	22	.....	.....	10,513,931	22,900,229
1932	4,354,904	75	29	.....	.....	7,075,393	19,705,043
1933	4,063,775	109	47	.....	.....	13,976,358	25,057,007
1934	5,141,744	145	69	.....	.....	20,243,278	34,071,955
1935	4,927,204	177	72	.....	.....	25,407,914	40,662,633
1936	4,381,173	168	70	.....	.....	30,051,207	43,813,898
1937	6,145,244	185	113	$48,617,920	$4,663,843	43,954,077	62,950,536
1938	7,377,117	211	92	40,222,237	4,943,754	35,278,483	53,878,093
1939	7,212,171	217	99	45,133,788	4,416,919	40,716,869	53,554,092
1940	7,949,736	216	92	50,004,909	6,334,611	43,670,298	61,735,604
1941	8,007,937	200	96	52,354,870	5,673,048	46,681,822	62,607,882
1942	6,894,844	126	76	50,494,041	5,294,637	45,199,404	59,694,192
1943	5,786,864	48	32	37,234,070	3,940,367	33,293,703	52,651,868
1944	4,879,851	51	31	29,327,114	2,877,706	26,449,408	39,369,738
1945	4,377,722	36	27	34,154,917	2,771,292	31,383,625	48,724,001
1946	3,705,594	50	32	48,920,971	2,904,130	46,016,841	56,653,485
1947	5,011,271	75	33	81,033,093	4,722,010	76,311,087	93,124,847
1948	5,762,321	97	51	118,713,859	18,585,183	100,128,727	121,696,891
1949	6,125,460	118	54	99,426,678	19,613,185	79,814,604	107,775,413
1950	6,802,482	112	58	108,864,792	22,113,431	86,751,361	113,464,619
1951	6,972,400	119	64	142,590,427	25,096,743	117,493,684	147,646,989
1952	9,174,617	95	58	140,070,389	30,444,575	106,601,451	144,151,515
1953	9,660,281	80	48	94,555,069	27,815,152	66,739,892	123,619,837
1954	8,513,865	63	40	106,223,833	29,135,673	77,088,160	120,829,789
1955	9,126,902	63	34	119,039,285	30,696,044	88,343,241	138,145,095
1956	8,827,037	70	40	125,043,590	31,933,681	93,110,262	143,546,586
1957	7,282,436	59	40	95,644,930	30,273,900	65,370,185	119,409,764
1958	6,402,198	57	28	88,023,111	28,068,396	54,955,069	100,591,049
1959	**6,990,985**	**60**	**44**	**92,287,277**	**27,079,911**	**65,208,728**	**100,549,519**

[1] Includes ores of iron, mercury, nickel, tungsten, and silica (flux).

[2] Data not collected before 1937.

[3] Previous to 1937 the shipper reported "Net Value at Shipping Point," no indication being given as to how the net value was computed. From 1937 on, the shipper has reported "Gross Value," from which deduction of freight and treatment gives "Net Value."

[4] Gross value calculated by valuing gold, silver, copper, lead, zinc, mercury (1938–44, 1955), and nickel (1936–37, 1958–59) at yearly average prices, and iron (1901–03, 1907, 1918–23, 1928, 1948–59) and tungsten (1939–45, 1947–58) at values given by operators.

Table XV.—Lode-metal Production in 1959

Property or Operator	Location of Mine	Owner or Agent	Ore Shipped or Treated	Product Shipped	Gross Metal Contents					
					Gold	Silver	Copper	Lead	Zinc	Cad-mium
Northern British Columbia			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Atlin Mining Division										
Nil										
Liard Mining Division										
Nil										
Central British Columbia										
Cariboo Mining Division										
Cariboo Gold Quartz and Aurum	Wells	The Cariboo Gold Quartz Mining Co. Ltd., Vancouver	46,586	Bullion	17,746	3,108				
Clinton Mining Division										
Nil										
Omineca Mining Division										
Cronin Babine	Smithers	Lessees from New Cronin Babine Mines Ltd., Vancouver	1,000	Lead concentrates, 82 tons; zinc concentrates, 66 tons	11	9,716		108,055	81,374	969
Silver Standard	Hazelton	J. Gallo, lessee, from Silver Standard Mines Ltd., Vancouver	18	Crude ore, 18 tons; lead concentrates, 4 tons; zinc concentrates, 5 tons (clean-up material)	5	4,449	434	11,453	13,883	80
Coast and Islands										
Alberni Mining Division										
Buccaneer and Musketeer	Tofino	Bedwell River Gold Mines Ltd., Tofino	1,598	Concentrates, 51 tons	970	552	106	6,599		
Nanaimo Mining Division										
Hualpai	Head Bay	Hualpai Enterprises Ltd., Alberni	62,500	Iron concentrates, 25,000 tons						
Matteer	Lasqueti Island	Scott Bay Separation Co. Ltd., Vancouver	67	Crude ore	13	47	3,997			

TABLE XV.—LODE-METAL PRODUCTION IN 1959—*Continued*

Property or Operator	Location of Mine	Owner or Agent	Ore Shipped or Treated	Product Shipped	Gross Metal Contents					
					Gold	Silver	Copper	Lead	Zinc	Cadmium
			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
COAST AND ISLANDS—*Continued*										
Nanaimo Mining Division—Continued										
Merry Widow and Kingfisher	Benson Lake	Empire Development Co. Ltd., Vancouver	863,176	Iron concentrates, 393,558 tons	———	———	———	———	———	———
Nimpkish	Beaver Cove	Nimpkish Iron Mines Ltd., Vancouver	12,800	Iron concentrates, 8,123 tons	———	———	———	———	———	———
Prescott, Paxton, etc.	Texada Island	Texada Mines Ltd., Vancouver	752,660	Iron concentrates, 422,567 tons; copper concentrates, 3,878 tons	756	16,687	963,142	———	———	———
New Westminster Mining Division										
Pride of Emory	Choate	Giant Nickel Mines Ltd., Hope	124,500	Nickel concentrates, 5,743 tons; copper concentrates, 276 tons	———	———	564,063	———	———	———
Skeena Mining Division										
Silbak Premier	Premier	T. J. McQuillan, Vancouver, lessee from Silbak Premier Mines Ltd., Vancouver	62	Crude ore	650	16,829	———	6,386	10,722	———
Toric	Kitsault River	Torbrit Silver Mines Ltd., Toronto	93,577	Silver-lead concentrates, 1,280 tons; silver bullion	———	850,627	———	891,633	———	———
Vancouver Mining Division										
Britannia	Britannia Beach	Howe Sound Company (Britannia Division), Britannia Beach	300,946	Copper concentrates and precipitates, 11,198 tons; zinc concentrates, 2,919 tons; tailings, 35,488 tons	3,174	28,888	6,826,741	64,539	3,369,927	16,053
Victoria Mining Division										
Blue Grouse	Cowichan Lake	Cowichan Copper Co. Ltd., Lake Cowichan	86,106	Copper concentrates, 9,383 tons	———	24,455	5,023,292	———	———	———
SOUTH CENTRAL BRITISH COLUMBIA										
Greenwood Mining Division										
Bounty Fraction	Beaverdell	Sherritt-Lee Mines Ltd., Vancouver	1	Crude ore	———	246	———	189	309	———
Crescent	Greenwood	S. J. Kleman, Greenwood	1	Crude ore	1	181	———	119	64	———
Highland-Bell	Beaverdell	Highland-Bell Ltd., Vancouver	18,029	Lead concentrates, 2,147 tons; zinc concentrates, 777 tons; jig concentrates, 212 tons	633	883,446	———	891,056	1,115,146	7,856
Mother Lode	Greenwood	Consolidated Woodgreen Mines Ltd., Vancouver	78,781	Copper concentrates, 1,415 tons	1,347	4,836	666,909	———	———	———
Phoenix	Greenwood	Phoenix Copper Co. Ltd., Grand Forks	175,945	Copper concentrates, 2,910 tons	2,509	11,814	1,235,936	———	———	———

			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Kamloops Mining Division										
Nil										
Lillooet Mining Division										
Bralorne	Bridge River	Bralorne Pioneer Mines Ltd. (Bralorne Division), Vancouver	140,972	Bullion; gold concentrates, 2,668 tons	103,267	21,578				
Pioneer	Bridge River	Bralorne Pioneer Mines Ltd., (Pioneer Division), Vancouver	79,652	Bullion	33,630	6,955				
Nicola Mining Division										
Nil										
Osoyoos Mining Division										
Fairview	Oliver	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	26,717	Silica flux						
French	Hedley	French Mines Ltd., Vancouver	15,952	Bullion	7,430	706				
Similkameen Mining Division										
Copper Mountain	Copper Mountain	H.G. Mining Co. Ltd., lessee from Granby Mining Co., Ltd., Vancouver	109	Crude ore	18	502	60,059			
Vernon Mining Division										
Nil										
SOUTHEASTERN BRITISH COLUMBIA										
Fort Steele Mining Division										
Estella	Wasa	United Estella Ltd., Vancouver		Lead concentrates, 1 ton; zinc concentrates, 10 tons		31		1,715	10,420	28
Midway	Moyie	D. F. Scheck, Moyie	121	Crude ore	28	277		638	970	
Sullivan	Kimberley	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	2,440,396	Lead concentrates, 119,360 tons; zinc concentrates, 254,330 tons; tin concentrates, 407 tons	285	451,844	411,600	200,696,242	244,135,350	
Golden Mining Division										
Mineral King	Toby Creek	Sheep Creek Mines Ltd., Nelson	181,495	Lead concentrates, 6,779 tons; zinc concentrates, 13,071 tons		228,406	148,313	8,818,276	15,018,272	48,436
Ptarmigan	Horsethief Creek	Selkirk Ptarmigan Mines Ltd., Edgewater	43	Crude ore	4	4,271		428	199	

Table XV.—Lode-metal Production in 1959—*Continued*

Property or Operator	Location of Mine	Owner or Agent	Ore Shipped or Treated	Product Shipped	Gross Metal Contents: Gold	Silver	Copper	Lead	Zinc	Cadmium
			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Southeastern British Columbia—*Continued*										
Nelson Mining Division										
Gold Belt	Salmo	A. Endersby, Fruitvale	1,226	Siliceous ore	170	399	......	3,514	2,571	......
H.B.	Salmo	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	463,504	Lead concentrates, 5,033 tons; zinc concentrates, 37,253 tons	......	69,235	......	7,266,400	41,781,600	345,778
Jersey	Salmo	Canadian Exploration Ltd., Vancouver	325,564	Lead concentrates, 10,750 tons; zinc concentrates, 27,120 tons	......	50,686	......	17,394,593	32,057,454	258,423
Kootenay Belle	Salmo	M. M. Arishenkoff, Shoreacres	1,346	Siliceous ore	48	164	......	2,691	2,691	......
Queen	Salmo	O. W. Gowing, Ymir	189	Crude ore	33	53	......	683	587	......
Reeves MacDonald	Remac	Reeves MacDonald Mines Ltd., Vancouver	421,593	Lead concentrates, 7,302 tons; zinc concentrates, 25,069 tons	......	32,304	......	8,816,245	28,530,567	160,734
Second Relief	Erie Creek	A. Burgess, Ymir	14	Salvaged material	4	4	......	83	28	......
Tamarac	Ymir	Tamarac Mines Ltd., Victoria; Pacific Western Metals Ltd., Vancouver	200	Crude ore	......	......	......	......	......	......
Revelstoke Mining Division										
Nil	......	......	......	......	......	......	......	......	......	......
Slocan Mining Division										
Banker	Ainsworth	P. Gilchrist and C. Hartland, Ainsworth	142	Crude ore	1	3,465	......	184,931	11,499	......
Black Diamond	Ainsworth	T. Lane, Ainsworth	25	Crude ore	......	1,422	......	27,026	2,314	......
Bluebell	Riondel	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	251,366	Lead concentrates, 14,161 tons; zinc concentrates, 29,981 tons	......	307,951	246,000	21,215,525	30,171,642	139,562
Bosun	Silverton	W. H. McLeod, Silverton	12	Crude ore	......	436	......	3,125	2,870	......
Caledonia	Blaylock	Caledonia Mines Ltd., Kaslo	300	Lead concentrates, 15 tons; zinc concentrates, 58 tons	5	2,289	......	22,537	60,998	221
Galena Farm	Silverton	F. Mills, Silverton	350	Stockpiled at Western Exploration mill	......	......	......	......	......	......
Hope	Sandon	E. H. Peterson and A. Maxinuk, lessees from Carnegie Mining Corporation Ltd., Toronto	2	Crude ore	......	313	......	2,740	69	......

			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Highlander	Ainsworth	T. G. Laughton, lessee from Yale Lead & Zinc, Toronto	5,880	Lead concentrates, 510 tons; zinc concentrates, 172 tons; crude ore, 44 tons	3	12,068		821,788	213,158	1,022
Lakeshore	Ainsworth	S. Sonnenberg, Ainsworth, lessee from Western Mines Ltd., Vancouver	720	Lead concentrates, 92 tons; zinc concentrates, 61 tons		1,156		118,851	65,074	221
Laura M.	Ainsworth	M. B. Sirak, Ainsworth, lessee from Western Mines Ltd., Vancouver	3,270	Lead concentrates, 319 tons; zinc concentrates, 178 tons		6,685		439,679	180,168	795
L.T. (Little Tim)	Slocan	B. E. O'Neaill, Slocan City	3	Crude ore		743		516	277	
Lone Bachelor	Sandon	Lessees E. Perepolkin, L. Fried, E. De Rosa, and V. C. Hanson, New Denver	18	Crude ore		1,993		26,067	2,237	
Lucky Jim	Zincton	Lucky Four Leasers, New Denver	504	Lead concentrates, 51 tons; zinc concentrates, 91 tons	1	3,406		58,167	108,166	638
Maestro	Ainsworth	T. G. Laughton, Ainsworth	23	Crude ore		625		27,256	1,705	
Mammoth	Silverton	Western Exploration Co. Ltd., Silverton		Clean-up or salvage material, lead concentrates, 84 tons; zinc concentrates, 78 tons	3	15,561		117,211	100,618	729
Ottawa	Slocan	C. Thickett, Slocan	15	Crude ore		5,238		243	47	
Richmond-Eureka	Sandon	E. Perepolkin, L. Fried, and A. Maxinuk, lessees from Carnegie Mining Corporation Ltd., New Denver	534	Lead concentrates, 46 tons; zinc concentrates, 101 tons; crude ore, 14 tons	3	7,906		74,417	119,755	766
Ruth	Sandon	E. Perepolkin, J. Perepolkin, and L. Fried, lessees from Carnegie Mining Corporation Ltd., New Denver	540	Lead concentrates, 26 tons; zinc concentrates, 155 tons; crude ore, 18 tons	3	6,427		61,210	182,309	1,289
Silver Mountain	Sandon	Silver Mountain Mines Ltd., Sandon, and lessees (Reco Leasers), Sandon	552	Lead concentrates, 42 tons; zinc concentrates, 56 tons; crude ore, 39 tons	1	6,539		95,322	73,072	419
Victor	Sandon	Violamac Mines Ltd., New Denver	6,028	Lead concentrates, 703 tons; zinc concentrates, 896 tons; crude ore, 39 tons	84	62,746		1,078,086	1,083,134	6,989
Westmont	Silverton	Silver King Mines Ltd., Silverton	211	Crude ore	3	6,830		19,567	25,789	
Yale	Ainsworth	Yale Lead & Zinc Mines Ltd., Toronto		From stockpile, zinc concentrates, 1,590 tons		10,847		80,017	1,675,584	247
Trail Creek Mining Division										
Kilarney	Edgewood	H. O. Cooper, Edgewood	4	Crude ore		453		2,497	84	
Velvet	Rossland	Mid-West Copper & Uranium Mines Ltd., Vancouver	1,750	Concentrates, 67 tons	131	459	59,069			
W.D.	Trail	W.D. Mining Co. Ltd., Trail	265	Crude ore	126	42		602	451	

Table XVI.—Lode-Metal Mines Employing an Average of Ten or More Men during 1959[1]

Name of Mine or Operator	Days Operating		Tons		Average Number Employed	
	Mine	Mill	Mined	Milled	Mine	Mill
Shipping Mines						
Cariboo Gold Quartz Mining Co. Ltd.	218	365	46,586	46,586	91	8
Torbrit Silver Mines Ltd.	270	270	93,577	93,577	75	17
Howe Sound Co. (Britannia Division)	263	246	300,946	300,946	337	27
Highland-Bell Ltd.	245	245	18,029	18,029	42	6
Mother Lode (Consolidated Woodgreen Mines Ltd.)	264	168	135,116	78,781	23	7
Phoenix Copper Co. Ltd.	274	260	175,945	175,945	32	11
Bralorne Pioneer Mines Ltd. (Bralorne Division)	365	365	140,972	140,972	344	23
Bralorne Pioneer Mines Ltd. (Pioneer Division)	260	365	80,428	79,652	236	21
French Mines Ltd.	290	365	15,952	15,952	13	7
Bluebell (Cons. M. & S. Co. of Canada Ltd.)	254	352	251,366	251,366	265	19
Victor (Violamac Mines Ltd.)	365	......	6,028	......	22	......
H.B. (Cons. M. & S. Co. of Canada Ltd.)	365	365	463,504	463,504	104	13
Jersey (Canadian Exploration Ltd.)	324	324	325,564	325,564	145	10
Reeves MacDonald Mines Ltd.	252	356	421,593	421,593	94	25
Sullivan (Cons. M. & S. Co. of Canada Ltd.)	249	253	2,440,396	2,440,396	1,071	333
Mineral King (Sheep Creek Mines Ltd.)	307	359	181,495	181,495	81	12
Velvet (Mid-West Copper & Uranium Mines Ltd.)	131	68	1,750	1,750	17	1
Blue Grouse (Cowichan Copper Co. Ltd.)	255	250	86,103	86,103	79	13
Giant Nickel Mines Ltd.	204	168	124,500	124,500	52	12
Empire Development Co. Ltd. (Mannix Co. Ltd., Iron Production Division)	239	214	863,176	863,176	92	12
Hualpai Enterprises Ltd.	([2])	([2])	62,500[3]	62,500[3]	18[3]	
Nimpkish Iron Mines Ltd.	45	21	19,000	12,800	30	3
Texada Mines Ltd.	300	350	742,100	752,660	135	26
Non-shipping Mines						
Silver Standard Mines Ltd. (Moresby Island Iron)	......	......	......	......	10	
Birkett Creek Mining Operations	......	......	......	......	60	
Noranda Exploration Co. Ltd.	......	......	......	......	26	
Torwest Resources Ltd.	......	......	......	......	17	
Double Ed (Cons. M. & S. Co. of Canada Ltd.)	......	......	......	......	10	
Kennco Explorations Ltd.	......	......	......	......	29	
Duncan Group (Cons. M. & S. Co. of Canada Ltd.)	......	......	......	......	13	

[1] The average number employed includes wage-earners and salaried employees. The average is obtained by adding the monthly figures and dividing by 12, irrespective of the number of months worked.

[2] Not available.

[3] Estimated.

Departmental Work

ADMINISTRATION BRANCH

The Administration Branch is responsible for the administration of the Provincial laws regarding the acquisition of rights to mineral and to coal, petroleum and natural gas, and deals with other departments of the Provincial service for the Department or for any branch.

Amendments made to the Mineral Act in 1957 introduced a system of leasing of mineral rights with the object of abolishing the right of a mineral-claim holder to obtain a Crown-grant of his mineral rights. Further amendments were made in 195X and 1959 to allow those persons who, at the time of the 1957 amendments, were proceeding through the necessary stages leading up to an application being made for a grant, to continue with the application provided all things necessary to the application were completed on or before December 31st, 1959. It is recorded here, therefore, that the right to acquire title to a mineral deposit by obtaining a Crown grant was extinguished on December 31st, 1959, by virtue of amendments to the Mineral Act first introduced in 1957 and amended further in the years 1958 and 1959.

Gold Commissioners, Mining Recorders, and Sub-Mining Recorders, whose duties are laid down in the Mineral Act and the *Placer-mining* Act, administer these Acts and other Acts relating to mining. Mining Recorders, in addition to their own functions, may also exercise the powers conferred upon Gold Commissioners with regard to mineral claims within the mining division for which they have been appointed. Similar duties may be performed by Mining Recorders with regard to placer claims but not in respect of placer-mining leases. Recording of location and of work upon a mineral claim as required by the Mineral Act and upon a placer claim or a placer-mining lease as required by the *Placer-mining Act* must be made at the office of the Mining Recorder for the mining division in which the claim or lease is located. Information concerning claims and leases and concerning the ownership and standing of claims and leases in any mining division may be obtained from the Mining Recorder for the mining division in which the property is situated or from the Department's offices at Victoria, and Room 104, 739 West Hastings Street, Vancouver. Officials in the offices of the Gold Commissioner at Victoria and the Gold Commissioner at Vancouver act as Sub-mining Recorders for all mining divisions. Sub-Mining Recorders, who act as forwarding agents, are appointed at various places throughout the Province. They are authorized to accept documents and fees, and forward them to the office of the Mining Recorder for the correct mining division. Officials and their offices in various parts of the Province are listed in the table on page A 52.

Central Records Offices (Victoria and Vancouver)

The transcripts of all recordings made in Mining Recorders' offices throughout the Province are sent to the office of the Chief Gold Commissioner in Victoria twice each month, and include the names of lessees of reverted surveyed mineral claims. These records and maps showing the approximate positions of mineral claims held by record and of placer-mining leases may be consulted by the public during office hours at Victoria and at the office of the Gold Commissioner at Vancouver, Room 104, 739 West Hastings Street. The maps conform in geographical detail, size, and number to the reference and mineral reference maps issued by the Legal Surveys Branch of the Department of Lands and Forests, and the approximate positions of mineral claims held by record and of placer-mining leases are plotted from details supplied by the locators. Provision has been made to supply the general public, on request to the office of the Chief Gold Commissioner, with copies of the maps. The charge for these maps is $1 plus 5 per cent tax for each sheet.

LIST OF GOLD COMMISSIONERS AND MINING RECORDERS IN THE PROVINCE

Mining Division	Location of Office	Gold Commissioner	Mining Recorder
Alberni	Alberni	T. G. O'Neill	T. G. O'Neill.
Atlin	Atlin	L. P. Lean	L. P. Lean.
Cariboo	Quesnel	F. E. P. Hughes	F. E. P. Hughes.
Clinton	Clinton	W. E. McLean	W. E. McLean.
Fort Steele	Cranbrook	E. L. Hedley	E. L. Hedley.
Golden	Golden	R. E. Manson	R. E. Manson.
Greenwood	Grand Forks	R. Macgregor	R. Macgregor.
Kamloops	Kamloops	D. Dalgleish	D. Dalgleish.
Liard	Victoria	R. H. McCrimmon.	
Lillooet	Lillooet	E. B. Offin.	E. B. Offin.
Nanaimo	Nanaimo	W. H. Cochrane	W. H. Cochrane.
Nelson	Nelson	K. D. McRae	K. D. McRae.
New Westminster	New Westminster	J. F. McDonald	G. C. Kimberley.
Nicola	Merritt	T. S. Dobson	T. S. Dobson.
Omineca	Smithers	G. H. Beley	G. H. Beley.
Osoyoos	Penticton	T. S. Dalby	T. S. Dalby.
Revelstoke	Revelstoke	W. T. McGruder	W. T. McGruder.
Similkameen	Princeton	B. Kennelly	B. Kennelly.
Skeena	Prince Rupert	T. H. W. Harding	T. H. W. Harding.
Slocan	Kaslo		F. R. Carmichael.
Trail Creek	Rossland	W. L. Draper	W. L. Draper.
Vancouver	Vancouver	J. Egdell	Miss S. Hyham (Deputy).
Vernon	Vernon	G. F. Forbes	G. F. Forbes.
Victoria	Victoria	R. H. McCrimmon	E. J. Bowles.

GOLD COMMISSIONERS' AND MINING RECORDERS' OFFICE STATISTICS, 1959

Mining Division	Free Miners' Certificates			Lode-mining						Placer-mining					Revenue		
	Individual	Company	Provisional (Placer)	Mineral Claims Recorded	Certificates of Work	Cash in Lieu	Certificates of Improvements	Bills of Sale, etc.	Leases	Placer Claims Recorded	Placer Leases Granted	Certificates of Work	Cash in Lieu	Bills of Sale, etc.	Free Miners' Certificates	*Mining Receipts*	Total
Alberni	93	2	......	273	665	$900.00	......	22	3	1	......	......	......	......	$615.25	$4,124.00	$4,739.25
Atlin	137	2	......	118	82	700.00	......	14	1	7	18	115	$2,550.00	23	856.25	8,854.00	9,710.25
Cariboo	1,009	13	3	1,085	944	2,800.00	......	84	......	5	159	389	1,500.00	96	5,357.25	30,804.25	36,161.50
Clinton	59	......	......	329	87	1,300.00	6	17	2	......	1	9	......	......	271.50	3,417.50	3,689.00
Fort Steele	171	5	3	230	319	1,200.00	......	42	3	......	22	35	......	4	1,284.75	4,538.00	5,822.75
Golden	79	5	1	292	181	800.00	34	24	......	......	13	1	......	7	888.75	3,836.75	4,725.50
Greenwood	157	2	......	1,382	271	400.00	2	59	49		5	14	......	......	873.25	9,175.00	10,048.25
Kamloops	393	5	1	2,002	2,522	2,100.00	81	238	2	......	9	11	......	1	2,054.75	16,259.00	18,313.75
Liard	285	1	......	799	782	7,300.00	56	109	......	......	26	63	......	4	990.75	15,591.25	16,582.00
Lillooet	170	5	......	346	230	1,275.00	......	64	5	......	11	15	......	10	1,193.75	4,566.75	5,760.50
Nanaimo	96	1	......	409	480	4,940.00	7	62	3	......	......	......	......	......	483.25	7,946.50	8,429.75
Nelson	332	9	4	313	348	1,400.00	24	37	4	3	10	3	......	2	2,306.50	4,122.25	6,428.75
New Westminster	343	1	17	409	623	6,500.00	......	104	......	3	8	15	......	10	1,693.50	10,377.25	12,070.75
Nicola	101	......	......	1,760	2,587	3,200.00	21	385	1	......	......	1	......	1	356.75	18,082.50	18,439.25
Omineca	285	4	......	603	1,173	2,500.00	......	77	1	2	8	67	6,200.00	30	1,637.50	18,410.35	20,047.85
Osoyoos	138	4	2	262	247	1,200.00	8	22	2	......	......	......	......	......	943.75	2,054.70	2.998.45
Revelstoke	83	3	......	119	272	1,300.00	49	23	5	1	4	24	625.00	11	697.00	5,562.25	6,259.25
Similkameen	130	2	3	658	507	6,700.00	......	53	5	1	5	19	......	7	825.75	11,533.00	12,358.75
Skeena	235	3	......	582	407	4,500.00	65	100	4	......	1	1	......	......	1,381.25	9,628.25	11,009.50
Slocan	132	4	......	255	405	1,900.00	48	26	6	......	......	......	......	......	1,036.75	4,457.25	5,494.00
Trail Creek	87	1	......	18	16	......	......	......	2	......	1	......	......	......	523.00	198.00	721.00
Vancouver	1,589	185	......	560	294	1,100.00	......	28	2	......	1	1	......	......	23,447.75	3,482.25	26,930.00
Vernon	272	......	11	256	53	300.00	......	115	1	8	13	10	......	11	1,170.75	2,014.75	3,185.50
Victoria	367	21	21	395	323	300.00	8	24	......	......	6	20	......	1	3,355.75	4,342.00	7,697.75
Totals for Province, 1959	6,743	278	66	13,455	13,818	$54,615.00	409	1,729	101	31	321	813	$10,875.00	218	$54,245.50	$203,377.80	$257,623.30
Totals for Province, 1958	7,343	278	38	13,459	10,057	$56,200.00	83	2,175	106	39	316	598	$11,075.00	236	$56,658.25	$178,481.13	$235,139.38

COAL, PETROLEUM, AND NATURAL GAS

The Administration Branch is responsible for the administration of the Petroleum *and* Natural Gas Act and for the Coal Act. Information concerning applications for permits and leases issued under the *Petroleum and Natural Gas Act* and concerning the ownership and standing of them may be obtained upon application to the office of the Chief Commissioner, Department of Mines, Victoria, B.C. Similar information may be obtained respecting licences and leases issued under the Coal Act. Maps showing the locations of permits and leases under the Petroleum and Natural Gas Act are available, and copies may be obtained upon application to the office of the Department of Mines, Victoria, B.C. Monthly reports listing additions and revisions to permit-location maps and listing changes in title to permits, licences, and leases and related matters are available from the office of the Chief Commissioner upon application and payment of the required fee.

Petroleum and Natural-gas Statistics, 19.59

Permits—	
Issued	252
In good standing	636
Assigned	30
Natural-gas licences—Issued	4
Drilling reservations—Issued	17
Leases—	
Issued	243
In good standing	1,088
Assigned	116

Petroleum and Natural-gas Revenue, 1959

Permits—		
Fees	$124,250.00	
Rent	2,862,778.23	
Penalties and cash in lieu	13,308.31	
		$3,000,336.54
Drilling reservations—		
Fees	$4,250.00	
Rent	71,865.10	
		76,115.10
Licences—		
Fees	$75.00	
Rent	4,446.08	
		4,521.08
Leases—		
Fees	$5,675.00	
Rent	1,687,007.94	
Penalties	2,469.93	
		1,695,152.87
Tender bonus—		
Permits	$3,486,337.15	
Drilling reservations	1,004,710.69	
Leases	6,499,766.48	
		10,990,814.32

Royalties—		
Gas	$492,053.56	
Oil	231,402.63	
Processed products	69,997.71	
		$793,453.90
Operators' licences		11,940.00
Assignment fees		2,065.00
Miscellaneous		717.00
		$16,575,115.81

Coal Revenue, 1959

Licences—		
Fees	$1,025.00	
Rental	10,578.30	
		$11,603.30
Leases—		
Fees	$100.00	
Rental	1,195.35	
Cash in lieu of work	400.00	
		1,695.35
		$13,298.65

ANALYTICAL AND ASSAY BRANCH

By S. W. Metcalfe, Chief Analyst and Assayer

Rock Samples

During 1959 the chemical laboratory in Victoria issued reports on 1,688 samples from prospectors* and Departmental engineers. A laboratory examination of a prospector's sample generally consists of the following: (1) A spectrographic analysis to determine if any base metals are present in interesting percentages; (2) assays for precious metals and for base metals shown by the spectrographic analysis to be present in interesting percentages. The degree of radioactivity is measured on all samples submitted by prospectors and Departmental engineers; these radiometric assays are not listed in the table below.

The laboratory reports were distributed in the following manner among prospectors who were not grantees, prospectors who were grantees under the *Prospectors' Grub-stake Act,* and Departmental engineers:

	Samples	Spectrographic Analyses	Assays
Prospectors (not grantees)	1,104	1,130	2,759
Prospectors (grantees)	191	202	474
Departmental engineers	393	234	1,010
Totals	1,688	1,566	4,243

* A reasonable number of samples are assayed, without charge, for a prospector who makes application for free assays and who satisfies the Chief Analyst that prospecting is his principal occupation during the summer months. A form for use in applying for free assays may be obtained from the office of any Mining Recorder.

Spectrographic analyses, numbering 1,415, were conducted upon samples which had accumulated in the period between the destruction of the old spectrograph by fire in 1957 and the installation of the new instrument in 1958.

Mineralogical specimens submitted for identification and rocks for classification are examined by the Mineralogical Branch of the Department.

Petroleum and Natural-gas Samples

Thirty-eight samples were received but only thirty-seven were examined. Of these, thirty-one were samples of formation water from wells being drilled for gas and oil in the Province; five were samples of material tested for oil seepage; and one was a sample consisting of pebbles coated with a black material suspected of being petroleum but found to be an oxide of manganese.

Coal Samples

Reports were issued on thirty-two samples of coal submitted for proximate analysis and calorific value. Of this number, twenty-seven were analysed for the Purchasing Commission, two for the Indian Commissioner for British Columbia, one for the Inspection Branch of the Department of Mines, and two for prospectors in the Province.

Miscellaneous Samples

Reports on fifty samples of a miscellaneous nature were issued.

For the British Columbia Research Council, two samples of teredo shells were submitted to a semi-quantitative spectrographic analysis.

For the Purchasing Commission, two plastic cups and two brands of galvanized steel wire were examined for flaws.

For the Department of Agriculture (Field Crops Branch), four samples of hay were analysed for phosphorus, copper, manganese, and molybdenum; three samples of marl for calcium and magnesium oxides; and one sample of water for iron, calcium, and magnesium. Three samples of waste products from a pulp-mill were analysed for calcium and magnesium oxides, and one of them for sulphate, in addition. A semi-quantitative spectrographic analysis was conducted on a sample of calcareous material.

For the Department of Highways, a white material obtained from a marine engine was spectrographed and found to be an oxide of aluminum. The white coating on a sample of pebbles was found to be mainly calcium carbonate, and the percentage of water-soluble salts in a sample of beach sand was determined. A sample of silt was submitted to a semi-quantitative analysis, and the free quartz in a sample of pebbles was determined.

For the Department of Mines (Mineralogical Branch), one sample of water from a hot spring was analysed.

For the Provincial Museum, a semi-quantitative spectrographic analysis was conducted upon an alluvium lick sample.

For the Department of Lands and Forests (Forest Research), thirteen soil samples were spectrographed and analysed for sulphur.

For the Public Works Department, a spectrographic analysis was performed on three samples of slate for comparison purposes.

For the Municipality of Oak Bay, one sample of water was examined.

For the Victoria and Esquimalt Health Department (Sanitation Division), six samples of water were examined.

For Bralorne Pioneer Mines Limited, one sample of ore was spectrographed.

Research

For the Department of Lands and Forests (Assistant Chief Forester), a marker was investigated and recommended for addition to tree blaze paints used by that Department.

Examination for Assayers

Provincial Government examinations for certificates of competency and licence to practise assaying in British Columbia were held at Trail in May and December. In May, nine candidates were examined; five passed, two were granted supplement&, and two failed. In December, nine candidates were examined; seven passed and two were granted supplementals.

INSPECTION BRANCH

ORGANIZATION AND STAFF

Inspectors and Resident Engineers

J. W. Peck, Chief Inspector	Victoria
Robert B. Bona, Deputy Chief Inspector of Mines	Victoria
L. Wardman, Senior Electrical Inspector of Mines	Victoria
E. R. Hughes, Senior Inspector of Mines	Victoria
J. E. Merrett, Inspector and Resident Engineer	Vancouver
A. R. C. James, Inspector and Resident Engineer	Vancouver
J. D. McDonald, Inspector and Resident Engineer	Nelson
D. R. Morgan, Inspector and Resident Engineer	Fernie
David Smith, Inspector and Resident Engineer	Kamloops
W. C. Robinson, Inspector and Resident Engineer	Prince Rupert

The Inspectors are stationed at the places listed and inspect coal mines, metalliferous mines, and quarries in their respective districts. They also examine prospects, mining properties, and roads and trails.

E. R. Hughes supervised the Department's roads and trails programme and prospectors' grub-stakes.

Instructors, Mine-rescue Stations

Arthur Williams	Cumberland Station
T. H. Robertson	Princeton Station
Joseph J. Haile	Fernie Station
W. H. Childress	Nelson Station

staff *Changes*

Robert B. King resigned in June, 1959, to take up a position as Safety Director with the Mining Association of British Columbia. J. E. Merrett was transferred from Nelson to Vancouver. J. D. McDonald was appointed to replace Mr. Merrett at Nelson. David Smith was transferred from Prince Rupert to a new office at Kamloops. W. C. Robinson was appointed to replace Mr. Smith at Prince Rupert.

Board of *Examiners* for *Coal-mine Officials*

Robert B. Bonar, Chairman and Secretary	Victoria
A. R. C. James, Member	Vancouver
D. R. Morgan, Member	Fernie

R. B. Bonar, A. R. C. James, D. R. Morgan, and the mine-rescue instructors for the district in which an examination is being held form the Board for granting certificates of competency to coal-miners.

An Inspector is empowered to grant provisional certificates to coal-miners for a period not exceeding sixty days between regular examinations.

MINERALOGICAL BRANCH

Field work by officers of the Mineralogical Branch includes geological mapping and examination of mineral deposits, and studies related to ground-water and engineering geology. The results are published partly in the Annual Report of the Minister of Mines and partly in a series of bulletins. The Mineralogical Branch supplies information regarding mineral deposits and the mineral industry, in response to inquiries received in great number. The activities of the Branch also include identification of rock and mineral specimens submitted directly by prospectors and others, or through the Analytical Branch.

Professional Staff

On December 31st, 1959, the professional staff included the following engineers classified as geologists or mineral engineers: H. Sargent, Chief of the Mineralogical Branch; M. S. Hedley, S. S. Holland, J. W. McCammon, N. D. McKechnie, G. E. P. Eastwood, J. T. Fyles, A. Sutherland Brown, J. M. Carr, W. G. Jeffery, W. C. Jones, A. F. Shepherd, and J. E. Hughes. W. G. Jeffery and W. C. Jones joined the staff at the beginning of the field season.

Technical editing of the Annual Report of the Minister of Mines and of other publications was directed by M. S. Hedley. Copy for printing was prepared by and under the direction of the editor for English, Mrs. Rosalyn J. Moir. Messrs. Hedley and Holland assisted in directing and supervising field work. Most of the other members of the professional staff are assigned to mapping the geology of selected areas and of mineral deposits. Mr. McCammon is responsible for studies of industrial minerals and structural materials and Mr. Shepherd for records and library.

Field Work

A. Sutherland Brown, assisted by W. G. Jeffery, continued the geological mapping of Morseby Island in the Queen Charlotte Group.

J. M. Carr continued mapping in the Highland Valley area and began mapping in the Craigmont-Promontory Hills area.

G. E. P. Eastwood mapped the Lodestone Mountain stock in the Tulameen area. The mapping was mainly reconnaissance but included detailed studies of magnetite mineralization in selected areas.

J. T. Fyles mapped the Mastodon mine and the Mineral King mine area. The Mineral King project was started in 1957 by the late C. G. Hewlett.

S. S. Holland examined mines and prospects at Wells, in areas reached from the Alaska Highway, and at Owen Lake, Telkwa, Smithers, Pitman, Terrace, and Stewart.

J. E. Hughes logged cores from wells drilled to test the proposed dam-site at Peace River Canyon, and made surface studies in that area, including studying the burned shales resulting from underground combustion of coal seams.

W. C. Jones made ground-water studies in the Cowichan River and B.X. Creek (Vernon) areas, and studies in engineering geology related to mud-flows (Cheekye River), a slide at Drynoch, dam-sites on the Skeena River, Upper Fraser River, and Hansard Lake-Eaglet Lake, and water-supply in the North Okanagan area.

J. W. McCammon examined industrial-mineral deposits, including silica sand on Mount Moberly (Golden), magnesite on Perry Creek (Marysville), pyrophyllite on Granite Creek (Coalmont), diatomite in the Quesnel area, volcanic ash " pozzolan " on Deadman Creek (north of Kamloops), " pozzolan " shale at Port Alberni, and limestone in the Kamloops and Nelson areas.

N. D. McKechnie examined mines and prospects on Vancouver Island and the southwestern mainland, including Cowichan Lake, Nimpkish Lake, Mount Washington, Jordan River, Lang Bay, and Swakum Mountain, and collected specimens of ultrabasic rocks near Jessica, Kamloops, and Clinton for laboratory study.

Aeromagnetic Mapping

An area of about 500 square miles, including a considerable part of Moresby Island and most of Louise Island, was mapped by Canadian Aero Services Ltd. for the Department of Mines, using a light fixed-wing aircraft.

PETROLEUM AND NATURAL GAS BRANCH

STAFF

J. D. Lineham, Chief Petroleum Engineer	Victoria
R. R. McLeod, Senior Petroleum Engineer and member of the Board of Arbitration	Victoria
A. N. Lucie-Smith, Senior Petroleum Engineer and Chairman of the Conservation Committee	Victoria
W. L. Ingram, Petroleum Engineer	Victoria
K. C. Gilbart, Petroleum Engineer	Victoria
S. S. Cosburn, Mineral Engineer (Geology)	Victoria
D. L. Griffin, Mineral Engineer (Geology)	Victoria
D. M. Callan, Assistant Geologist	Victoria
T. A. Mackenzie, Engineering Assistant	Victoria
P. K. Huus, Engineering Assistant	Victoria
G. E. Blue, Petroleum Engineer in Charge	Dawson Creek
[1] R. N. Thompson, Petroleum Engineer	Dawson Creek
G. V. Rehwald, Petroleum Engineer	Dawson Creek
H. B. Fulton, Mineral Engineer (Geology)	Dawson Creek
H. A. Sharp, Engineering Assistant	Dawson Creek
M. A. Churchill, Engineering Assistant	Dawson Creek
[1] E. N. Jernslet, Field Survey Assistant	Dawson Creek

The main sections of the Branch and those in charge are as follows: Reservoir, R. R. McLeod; Reserves, A. N. Lucie-Smith; Development, W. L. Ingram; Geology, S. S. Cosburn; Records and Statistics, T. A. Mackenzie; Field Office, G. E. Blue.

STAFF CHANCES

R. N. Thompson resigned on March 31st and E. N. Jernslet on August 31st. G. V. Rehwald joined the field staff as petroleum engineer on April 20th and M. A. Churchill as engineering assistant on October 9th.

The Petroleum and Natural Gas Branch is responsible for the administration of the " Regulation Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas " made pursuant to the *Petroleum and Natural Gas Act, 1954.*

[1] Resigned in 1959.

The regulation provides for the use of efficient and safe practices in the drilling, completion, and abandonment of wells; for the orderly development of fields discovered within the Province; and for the conservation and prevention of waste of oil and natural gas within the reservoir and during production operations.

Board of Arbitration

Chairman: A. W. Hobbs, solicitor, Department of the Attorney-General. Members: R. R. McLeod, engineer, Department of Mines; S. G. Preston, agrologist, Department of Agriculture.

The Board of Arbitration, responsible to the Minister of Mines, held hearings in 1959 at Fort St. John and Pouce Coupe.

Eight applications concerning right of entry came before the Board. Of these, seven were settled by award orders of the Board and one was pending at the end of the year.

Conservation Committee

Chairman, A. N. Lucie-Smith, engineer. Members: N. D. McKechnie, geologist; M. H. A. Glover, economist.

Although no major problems were referred to the Committee by the Minister of Mines during 1959, it acted on several routine matters during the course of the year.

Grub-staking Prospectors

Under authority of the *Prospectors' Grub-stake Act* the Department of Mines has provided grub-stakes each year since 1943 to a limited number of applicants able to qualify. An amendment to the Act in 1958 authorized an increase in the maximum allowable grub-stake to $400, with an additional amount up to $300 for travelling expenses.

To qualify at the present time the Department requires that the applicant shall be a physically fit male British subject, holder of a valid free miner's certificate, who has been resident in the Province during the year preceding his application for a grub-stake, or who has been honourably discharged from Her Majesty's services, who is between the ages of 18 and 70, and who can identify common rocks and minerals.

It is required that in order to obtain the maximum grub-stake he agree to spend at least sixty days actually prospecting in the area of his choice in British Columbia considered favourably by officers of the Department of Mines. If he prospects a lesser time, the grant will be reduced proportionately. In the past, rebates have been recovered from grantees to whom payments have exceeded the proper amount for the time and effort devoted to prospecting.

The grantee must not accept pay from any other source for services rendered during the period credited to the grub-stake. At the end of the season he shall provide the Department with a diary and maps outlining his activities while working under the grub-stake. Any discoveries made, staked, and recorded are exclusively his own property.

Statistical information covering the grub-stake programme since its inception is given in the following table:-

GRUB-STAKE STATISTICS

Field Season	Approximate Expenditure	Men Grub-staked	Samples and Specimens Received at Department Laboratory	Mineral Claims Recorded
1943	$18,500	90	773	87
1944	27,215	105	606	135
1945	27,310	84	448	181
1946	35,200	95	419	162
1947	36,230	91	469	142
1948	35,975	92	443	138
1949	31,175	98	567	103
1950	26,800	78	226	95
1951	19,385	63	255	137
1952	19,083	50	251	95
1953	17,850	41	201	141
1954	19,989	48	336	123
1955	21,169	47	288	183
1956	20,270	47	163	217
1957	22,000	46	174	101
1958	24,850	47	287	211
1959	21,575	38	195	202

Samples and specimens received from grup-staked prospectors are spectrographed, assayed, and tested for radioactivity. Mineralogical identifications are made on request.

Fifty-six applications were received in 1959, and to forty-one of the applicants grub-stakes were authorized. For various reasons three did not go out, and of the remaining thirty-eight grantees seven were unable to fulfil the terms and conditions of the grant and received only partial payment. Eleven prospectors were given grants for the first time, and four of these proved unsatisfactory. Prospecting was done in seventeen of the twenty-four mining divisions. Nine grantees used aircraft for transportation to their prospecting areas.

D. H. Rae again gave able service in interviewing applicants and supervising grantees in the field. The following notes have been largely compiled from Mr. Rae's observations while in the field and from information provided in the diaries of the grantees.

Atlin Mining Division.-Close to Tulsequah prospecting was carried on up Canyon Creek and in the Wilms Creek valley. Quartz veins carrying some pyrites and minor amounts of chalcopyrite were found cutting volcanics near a granite contact. Limestone containing minor amounts of sphalerite was encountered near Mount Strong.

About 30 air miles east of Atlin the waterway from Eva Lake to the north end of Gladys Lake supplied canoe transportation for the establishment of a number of base camps from which the terrain for 6 miles east and west of the waterway was carefully prospected. Considerable heavy brush and overburden were encountered for some distance on either side of the waterway. Good prospecting ground was found at a higher elevation, although no important finds were reported. In Hirschfeld Creek valley much overburden was reported, but some milky quartz stringers were found in rocks of the Cache Creek series. Near Mount Farnsworth some iron pyrite was found in limestone, along with minor amounts of copper carbonates, and at Mount Snowdon some rusty-coloured argillite and chert. Near Sheep Mountain rusty-coloured granite was found to contain finely disseminated molybdenite and small crystals of tourmaline. Along the Marble Dome Range some serpentinized peridotite was observed. Near Black Mountain, west of Gladys Lake, a silicified zone containing some chalcopyrite and arsenopyritc was prospected.

Some excellent work was done from a main base camp established at Nome Lake. The lake lies at the centre of an extensive area underlain by granite. North-east of Nome Lake a wide oxidized zone containing much disseminated pyrite was given considerable attention. Values were low. Working toward the McNaughton basin, a granite-limestone contact was investigated and a wide zone containing much pyrrhotite and limonite was discovered. Work was done on the continuation of a heavily oxidized fault zone. Some prospecting was done in Redfish Creek valley. This area merits more prospecting.

Cariboo Mining Division.-Ten miles west of McLeod Lake, on the Hart Highway, some inconclusive work was done. Some intensive prospecting was done at Tudyah Lake near the Hart Highway.

Clinton Mining Division.-Some work was done in the area between McLean Lake and Upper Hat Creek. The area is mainly underlain by volcanic rocks and is not encouraging for prospecting.

Kamloops Mining *Division.*—On Sicamous Creek, near Salmon Arm, along the Mara Lake road, and near Blind Bay some prospecting was done in a discouraging schist formation. Work was also done near White Lake, in the Wallensteen Lake area, at Blanc Creek, and on Charcoal Creek. Nothing of interest was reported. Some inconclusive work was also done near Pement Lake.

Some excellent work was done from Eagle Lake northwesterly past the eastern section of the Jim Creek watershed, to Monticola Lake, to the northwest portion of Jim Creek, on past Shale Mountain, and on to Windy Mountain between Needa Lake and Taweel Lake. This generally northwesterly section was prospected across an east-west width of about 6 miles. Several exposed mineral outcrops were found, as well as some interesting float. More work will be done in parts of this area. The northwesterly end of this section extends into the Clinton mining division.

Liard Mining Division.-An exploratory trip was taken in an easterly direction from the Wilms camp at Mile 60 on the Cassiar road, but the weather was very bad and little effective prospecting was possible. This area will receive further attention.

Prospecting was continued in the area between the Toad and the Racing Rivers, and in the Dunedin River valley. Some small pipes of quartz containing chalcopyrite were investigated. Further prospecting was also done on both sides of the Alaska Highway between Mile 398 and Mile 415. Some interesting geology was mapped and considerable scattered barite and fluorite were reported, but nothing of commercial importance was found.

At Sheep Mountain some highly altered limestone was found to contain galena, sphalerite, and pyrite, but sampling did not indicate commercial values. Close to the Major Hart River some scattered mineralization was exposed in schist and slate. In a serpentine-peridotite zone 7 miles west of Sheep Mountain some brittle fibre chrysotile was prospected. Further inconclusive work was done near Blackfox Mountain and on Juniper Mountain.

Nanaimo Mining Division.-Some prospecting was done near the old O.K. property close to Nanoose Bay and at Leech River. Nothing of interest was reported.

Nelson *Mining* Division-Work was continued in the area close to the Bayonne mine on the west side of Kootenay Lake. Low-grade copper values associated with several shear zones were investigated.

Some work was done near the headwaters of Goat River, but nothing of importance was reported.

New Westminster Mining Division.-Some prospecting was done high up on the east side of Pitt Lake about 20 miles from the south end. Nothing important was reported.

Considerable work was done near the headwaters of Five Mile Creek, which flows into the Fraser from the west side a short distance from Yale. The valleys of Gordon and Urquhart Creeks were prospected, and traces of molybdenite and copper carbonate and fairly large amounts of pyrite were found in a wide dyke in coarse granite.

Some work was done on Ladner Creek in the vicinity of the old Home Gold property. Nothing important was found.

Nicola Mining Division.-A base camp was established close to Mamit Lake on the east side of Guichon Creek. This area is heavily covered with overburden, and shows very few outcrops. A systematic soil-testing programme was initiated, and the results thereof incorporated on a large-scale map. To date the results obtained are somewhat inconclusive, although some interesting information was obtained.

Omineca Mining *Division.*—Manson Creek was used as a base camp for one party. Skeleton Gulch, the lower part of the Germansen River valley, and Plughat Creek received some attention. Between Kildare and Slate Creeks, considerable prospecting was done in search of the source of mineralized float found in the vicinity. In the Wolverine Range some gold-bearing pyrite was found along a granite contact and some work was done around aplite dykes associated with a shear zone.

The area close to Goat Mountain, Blackjack Mountain, and the valley associated with Mill Creek, Josephine Creek, and Discovery Creek also received some attention. Up Lost Creek a narrow quartz vein containing heavy sulphides was prospected.

Some work was done in an area about 75 air miles northwest of Germansen Landing, but no information is at present available.

Considerable work was done in the Nation Lakes area, both east and west of the Fort St. James–Manson Creek road. Scattered low-grade chalcopyrite was found 3 miles north of the west end of Chuchi Lake. Further work was done on the north side of Tchentlo Lake, 3 miles from the outlet, on low-grade copper showings. On Rottacker Creek, 6 miles east of Indata Lake, considerable work was done, and some near-commercial showings of copper were investigated and sampled.

In the Chuchi Lake area, copper stain was observed along a porphyry-volcanic contact. On Klawdetelle Creek some malachite was found in quartz, and heavy pyrite mineralization was observed close to an anomaly mapped from an aerial survey. Near Milligan Lake heavy iron stain was found on altered intrusives. Rock outcrops here were mainly medium fine-grained intrusives, but a few quartz-carbonate-mariposite outcrops were also observed.

Prospecting was continued in the area adjacent to the end of the northwest arm of Stuart Lake, and more narrow stringers carrying low values in manganese were uncovered.

Quesnel Mining Division.-Some inconclusive work was done near Charlotte Lake.

Eight miles west of Williams Lake a base camp was established close to the main Chilcotin road, and some prospecting was done south of the road. The area proved to be badly covered with overburden, and apparently mainly underlain by recent volcanics.

Revelstoke Mining Division.-Near the mouth of Goldstream River considerable work was done on a large area underlain by fairly soft schist in which zones of pyrrhotite and pyrite parallel the schistosity. Sample values were low. Some quartz veins cutting across the schist carried medium to low values in gold, silver, and copper.

Some prospecting was carried on at the head of McCulloch Creek and on the south fork of La Forme Creek.

From a camp at Mile 64 on the Big Bend Highway some prospecting was done on high ground on the east side of the river, and in the many east-west stream valleys on that side. Much of the area is covered with deep overburden and pyritized schist appears to underlie much of the terrain. Some limestone was reported, and some volcanic rocks showing traces of copper stain.

Some work was done 15 miles west of Revelstoke on scattered showings of pyrite and chalcopyrite in quartz. Some work was done near Mount Begbie, and in the Albert Canyon area.

Similkameen Mining Division.-A large area in the vicinity of Princeton was prospected during the past season. This included copper showings on Rabbitt Mountain and on the south slopes of Holmes Mountain. More work was done on the Friday Creek copper showings and on copper and molybdenite showings near Hayes Creek and near Jura station. The Missezula Lake and Dry Creek areas also received some attention. Some work was also done near Apex, Kathleen, and Pike Mountains, as well as on Copper Creek.

Skeena Mining Division.-Some of the near-by islands and parts of the coast-line in reach of Prince Rupert received considerable attention during the past season. Some interesting geological features were reported and several commercial-grade deposits were worked on. The area merits further attention.

Southerly from Terrace some work was done near the north end of Lakelse Lake and in the mountainous country at the headwaters of Williams Creek. One small mineral deposit was reported.

Some work was also done up two of the long creek valleys extending westerly from near the south end of Kitsumkallum Lake. No report is available on the results of this work.

Near the Coast Range, west from Williams Lake, a base camp was established on Young Creek, about 20 miles west of Anahim Lake, and most of the area prospected around Young Creek, Green River extending northwesterly to the Rainbow Range of mountains, and embracing the area around Octopus Lake. Much overburden was encountered, and many outcroppings of volcanic rocks observed. It proved to be a poor area. Geological indications about 5 miles due west of Young Creek in what is known locally as Burned Bridge Creek valley are more promising and further work should be done in this area.

Another base camp was established at Middle Lake, not far east from Bella Coola. Traces of chalcopyrite were found at a number of places in this area, but nothing of commercial importance was reported. Areas contiguous to lower reaches of Dean River, Takia River, Pyramid Peak, and Talcheazoone Lake were all prospected. Some interesting geological conditions and minor mineralization were reported.

Slocan Mining Division.-Much prospecting was done on ground surrounding and between the old Millie Mack and Black Bear properties on Caribou Creek not far from Burton. The general geology in this area is good and some interesting mineral zones may be uncovered.

Vancouver Mining Division.-On the coast near Sullivan Bay, and extending from the bay to Lee Lake, a small amount of prospecting was done. One quartz lead was reported on the south side of the lake, but no samples were taken.

Vernon Mining Division.-Much of the high ground between Enderby and Lumby has been made more accessible by numerous logging-roads during the past few years. This area received some attention. Some inconclusive work was also done in the Silver Hills east of Vernon, south of Boulcau, and at the headwaters of Whiteman Creek.

MUSEUMS

The Department has a large exhibit of mineral rock specimens in the Douglas Building, Victoria; collections are also displayed in the joint office in Vancouver and in the offices of the Inspectors of Mines in Nelson and Prince Rupert.

Specimens from the collection in Victoria, accumulated in a period of more than sixty years, are displayed in cases on the fourth floor of the Douglas Building. The collection includes specimens from many of the mines and prospects in the Province, and also specimens of type rocks and special minerals from British Columbia and elsewhere.

British Columbia material includes specimens collected by officers of the Department of Mines and specimens donated by property-owners. The collection also includes type specimens purchased from distributors. Other valued specimens or groups of specimens have been donated or loaned to the museum.

ROCK AND MINERAL SPECIMENS

Information regarding collections of specimens of rocks and minerals available to prospectors and schools in British Columbia may be obtained from the Chief of the Mineralogical Branch.

PUBLICATIONS

Annual Reports of the Minister of Mines, bulletins, and other publications of the Department, with prices charged for them, are listed in the Department of Mines List of Publications available from the Chief of the Mineralogical Branch.

Publications may be obtained from the offices of the Department in Victoria and elsewhere in the Province. They are also available for reference “se in the Department’s library (Mineralogical Branch) at Victoria, in the joint office in Vancouver, and in the offices of the Inspectors of Mines in Nelson and Prince Rupert, as well as in public libraries.

MAPS SHOWING MINERAL CLAIMS, PLACER CLAIMS, AND PLACER-MINING LEASES

From the details supplied by the locators, the npproximatc positions of mineral claims held by record and of placer-mining leases are show” on maps that may be inspected in the central records offices of the Department of Mines in Victoria and in Vancouver. Copies of these maps may be obtained on request. The boundaries of surveyed claims and leases are show” on the reference maps and other maps of the British Columbia Department of Lands and Forests.

JOINT OFFICES OF THE BRITISH COLUMBIA DEPARTMENT OF MINES AND THE DEPARTMENT OF MINES AND TECHNICAL SURVEYS. CANADA.

The Provincial Department’s Inspector and Resident Engineer, the Gold Commissioner and Mining Recorder for the Vancouver Mining Division, and the officers of the Federal Geological Survey occupy one suite of offices. All official information relating to mining is now available to the public in the one suite of offices in Vancouver.

The services offered to the public include technical information on mining, the identification of mineral specimens, distribution of Federal and Provincial mining publications, a reference library, a display of rocks and minerals, and a central records office.

Topographic Mapping and Air Photography

During 1959 the Surveys and Mapping Branch of the Department of Lands and Forests continued to expand the framework of maps and surveys which are necessary for the orderly development of the Province.

Legal Surveys Division of the Surveys and Mapping Branch issued 597 sets of instructions to surveyors. Field assignments included seventeen subdivision surveys for the Lands Service in widely separated areas of the Province. Two projects were for the reestablishment of 152 corner posts at Beaverdell and Coalmont. In conjunction with other surveys, another 185 corner posts of sections and district lots were replaced by standard bronze-capped monuments. Highway survey was undertaken in the vicinity of Cranbrook (12 miles), Peachland (6.1 miles), Canoe (13 miles), Savona (8.3 miles), Dougan Lake (3 miles), Hixon (22.5 miles), and Engen (5.9 miles)

The latest " General Survey Instructions to British Columbia Land Surveyors " appeared in printed form in The British Columbia Gazette, Part 11, Vol. 2, No. 20 (November 12th, 1959). Among certain modifications incorporated into the new instructions were several relating to surveys made under authority of the *Mineral* Act. Standard bar posts shall now be used in place of angle-iron posts. Clarification was given to land surveyors in the interpretation of a corner of a mineral claim where several location posts for adjoining claims lie in close proximity. Also, it is now possible for surveyors to include up to four mineral claims in one field book.

Except for the northern one-third of the Province, Air Division's programme of I-inch-to-40-chain interim mapping was essentially completed in 1959, and the major effort is now concentrated on 1-inch-to-20-chain photography. A total of 13,220 aerial photographs embracing 12,2 15 square miles were obtained for forest-inventory purposes, and an additional 1,379 lineal miles were photographed for other Branches of the Government. As the result of aerial operations, 15,123 photo negatives were filed in the Air Photo Library, bringing the total number of air photographs (Federal and Provincial) now on hand to 46X,676.

A new Wild A-7 precision autograph plotter acquired by Topographic Division will enable mapping to be " bridged " across the most rugged areas between existing networks of ground control. Field survey parties established mapping control for 17% Standard National Topographic map-sheets, the bulk of which extended from Clinton northeast into Wells Gray Provincial Park and the remainder west from Anahim Lake. Draughting was completed for 18 Topographic manuscripts at a scale of 2 inches to 1 mile.

Geographic Division released seven new maps during 1959. Three variations of Map 1G (East Central British Columbia), at a scale of 1 inch to 10 miles, were produced. Maps of the National Topographic series, at 1-inch-to-2-miles scale, included Victoria 92 B/NW & SW (parts of), Grand Forks 82 E/SE, and Trail 82 F/SW. Another National Topographic map which appeared in 1959 was Anahim Lake (92C) at 1 :250,000 scale.

Federal Government agencies at Ottawa produced thirty-one full-colour National Topographic sheets at 1:50,000 scale. The Army Survey Establishment continued to make its manuscript mapping available to the public in provisional form. During 1959, five provisional sheets at 1:250,000 scale and 41 sheets at 1:50,000 scale became available. The Federal Departments of Mines and Technical Surveys and National Defence also completed field work for forty-one half-sheets of the National Topographic 1:50,000 series in this Province.

Indexes of air-photo cover and of topographic, interim, and lithographed maps may be found in the 1959 Annual Report of the British Columbia Lands Service. Further information concerning Provincial and Federal mapping may be obtained from the Director, Surveys and Mapping Branch, Department of Lands and Forests, Victoria, B.C.

Department of Mines and Technical Surveys

The Canadian Government Department of Mines and Technical Surveys, created by an Act of Parliament introduced in November, 1949, took over most of the branches and functions related to mining of the former Department of Mines and Resources. The Mines Branch, Geological Survey of Canada, and Surveys and Mapping Branch are the three branches of the Department of the most direct interest to the mining industry. Brief reference to the work of the Surveys and Mapping Branch in British Columbia is made in the preceding note headed " Topographic Mapping and Air Photography." A note on the Geological Survey of Canada follows this paragraph and is followed by a note on the Mines Branch.

GEOLOGICAL SURVEY OF CANADA

By an arrangement made at the time the Province of British Columbia entered Confederation, geological investigations and mapping in the Province are carried on by the Geological Survey of Canada. Several geological parties are in the field each year. Many excellent reports and maps covering areas of British Columbia have been issued by the Geological Survey of Canada, and they have made available a great amount of information that has been of much benefit to the mining and prospecting activities in British Columbia.

A branch office of the Geological Survey of Canada is maintained in Vancouver. Maps and reports on British Columbia can be obtained there. J. E. Armstrong is in charge of this office.

FIELD WORK BY GEOLOGICAL SURVEY OF CANADA IN BRITISH COLUMBIA, 1959

H. H. Bostock continued, with a small party, the geological study and mapping of Squamish (92 G, W. ½) map-area.

R. B. Campbell commenced mapping Quesnel Lake West Half (93 A, W. ½) map-area, and completed field work within most of the south half.

H. Frebold made stratigraphic nnd palæontological studies of Jurassic strata within Nelson West Half (82 F, W. ½) and Salmo (82 F/3) map-areas.

H. Gabrielse continued, from 1957 and 1958, the geological study and mapping of Kechika (94 L) and Rabbit River (94 M) map-areas for publication on the scale of 1 inch to 4 miles.

E. C. Halstead commenced a ground-water survey of the eastern coastal lowlands of Vancouver Island between Nanaimo and Campbell River, and completed field work between Nanaimo and Courtenay, including Denman and Hornby Islands.

E. J. W. Irish commenced an investigation of Halfway River (94 B) map-area.

G. B. Leech continued, from 1956 and 1957, field work within Fernie West Half (82 G, W. ½) map-area.

H. W. Little divided the field season between completing the revision of the geology of Kettle River West Half (82 E, W. ½) map-area; examination of properties within, and the revision of the geology of, Kettle River East Half (82 E, E. ½) map-area; and, with the collaboration of Hans Frebold, the revision of the geology of Salmo (82 F/3) map-area and vicinity.

J. E. Muller commenced the geological study and mapping of Pine Pass West Half (93 0, W. ½) map-area.

B. R. Pelletier outlined and studied Triassic rocks in the Foothills of northeastern British Columbia between Toad River and Gathto Creek.

R. A. Price continued, from 1958, the geological investigation of Fernie East Half (82 G, E. ½) map-area.

J. E. Reesor continued, from 1958, his detailed studies within and adjacent to Burton (82 F/13) and Passmore (82 F/12) map-areas as part of his continuing research into the mode of emplacement, origin, and other features of granitic and associated rocks.

J. G. Souther continued, from 1958, his geological investigation of Sumdum (104 F) and Tulsequah (104 K) map-areas.

D. F. Stott extended the study of Cretaceous rocks, begun in 1958, from Red Willow River to Bullmoose Creek.

H. W. Tipper completed field work within Quesnel (93 B) map-area.

J. 0. Wheeler commenced the geological study and mapping of Illecillewaet (82 N, W. ½) map-area.

Publications of the Geological Survey

A total of twenty-four publications of the Geological Survey of Canada relating to British Columbia was received by the British Columbia Department of Mines in 1959. A list of the twenty-four publications will be supplied on request.

MINES BRANCH

The Mines Branch has branches dealing with mineral resources, mineral dressing and process metallurgy, physical metallurgy, radioactivity, and fuels and explosives. A total of twelve publications of the Mines Branch pertaining to British Columbia was received in 1959 by the British Columbia Department of Mines. A list of these publications will be supplied on request. They included tabular pamphlets dealing with coal mines, gold mines, stone quarries, petroleum refineries, and milling plants in Canada.

MINERAL RESOURCES DIVISION

The Mineral Resources Division, which was a division of the Mines Branch, has now been transferred from the Mines Branch to the office of the Deputy Minister of Mines and Technical Surveys.

The Mineral Resources Division publishes studies on mineral resources, mineral economics, mineral legislation, mineral taxation, mining technology, and other miscellaneous mineral-industry subjects. A total of eight publications published by this Division was received by the library. A list of these publications will be supplied on request.

Lode Metals

CONTENTS

GENERAL REVIEW

The average price of copper in Canadian funds for 1959 was substantially better than the 1958 price. The average Canadian prices for silver and zinc were fractionally up and those for gold and lead were fractionally down. The prices were not aided by the fact that the average discount on United States funds was 4.09 per cent, the second highest in recent history. The United States price for copper showed a variation in the year between a low of 26 cents per pound in July and a high of 31.581 at the end of the year. The average United States price was 28.891 cents per pound, an increase of 4.769 cents above 195X. The average New York price for lead was just below that of 1958, a new post-war record low. The average East St. Louis price for zinc was more than 1 cent per pound better than in 1958.

Gold, silver, copper, lead, and zinc produced at British Columbia lode mines in 1959 had a value of $93,442,599. Miscellaneous metals, including iron ore, nickel, tin, and minor metals recovered at the Trail smelter, had a value of $11,424,134. The total quantity of ore mined at all lode mines amounted to 6,990,985 tons and came from sixty mines, of which forty-four produced 100 tons or more. The average number employed in the lode-mining industry in 1959, including mines, concentrators, and smelters, was 7,324.

In 1959, twenty-six mills were operated, fourteen throughout the year and four on a temporary or intermittent basis. One major mill closed, three reopened, and four operated for the first time. Of the intermittent operations, mills at Ainsworth and Sandon accepted custom ore. The Toric mill was shut down when the silver-bearing orebodies were exhausted after ten and a half years of operation. The new mills included a small plant on the Golconda molybdenum-copper property, a 1,000-tons-per-day mill at Phoenix, and two new iron-ore concentrators on Vancouver Island. Britannia, Pride of Emory (Giant Nickel), and Mother Lode (Woodgreen) mills reopened after various degrees of reorganization.

The Trail smelter recorded custom receipts of 3,871 tons of ore from twenty-three properties, 3,026 tons of which obtained a silica bonus in excess of the treatment charge. The smelter also recorded custom receipts of 3,944 tons of lead concentrates and 16,417 tons of zinc concentrates. Totals of approximately 35,296 tons of lead concentrates and approximately 56,103 tons of zinc concentrates were shipped out of the country for smelting. Copper concentrates were shipped to the Tacoma smelter, with the exception of the output from Cowichan Copper and the copper concentrates recovered by Texada Mines Ltd., which went to Japan. Nickel concentrates went to the Fort Saskatchewan refinery. All iron-ore concentrates, amounting to 849,248 tons, went to Japan.

The production of gold was little different from that in 1958, being slightly down. Bralorne and Pioneer amalgamated as Bralorne Pioneer Mines Limited, although they continued to operate as two separate mines. The chief apparent result of the merger was a heightened attention to exploration and a start at providing a better system of ventilation of the lower levels at Bralorne. A moderate amount of interest was shown in gold prospects in various parts, stimulated in some instances by the bonus paid for siliceous ore at the Trail smelter. A shipment of high-grade ore from the Silbak Premier by lessee Tom McQuillan created interest, even though it came from an old surface working. The original Cariboo Gold Quartz mine was abandoned in September. after twenty-six years of continuous operation. The future for the company now appears to lie in the ground north of the Aurum mine area.

With the closing of the Toric the Province lost its largest and one of its few remaining mines that operated primarily for the silver content of its ore. After recording the loss of silver producers in the past few years, it is heartening to note that although the Highland-Bell has abandoned the original upper mine, which had approximately forty-five years of profitable operation, it is opening new horizons in the lower mine, which is in a faulted segment of the upper ore zone.

The production of copper improved very considerably from the record low reached in 195X. Britannia resumed milling in February, 1959, following a reorganization, after having been closed for nearly a year. A reorganized Consolidated Woodgreen Mines Limited resumed operations after a shut-down of more than a year. Phoenix Copper Company Limited, a Granby subsidiary, commenced an open-pit operation on ground left by Granby in 1919. Copper was produced as a by-product of nickel-mining at the Giant Nickel operation.

In the development field, Bethlehem and Craigmont came a step nearer to production. At the former property the 4600 exploratory adit was completed and a considerable amount of diamond drilling was done underground. At Craigmont the ore zone was outlined on the 3500 level and a second adit was driven, at the 3000 level.

Exploration for copper continued in the general copper-bearing belt that extends from near Ashcroft to Copper Mountain. A great deal of money has been spent in this region in the last five years, during which time staking was done and scientific prospecting was carried on at a scale never before experienced in British Columbia. In 1959 it became obvious that the continuing cost of exploration was becoming too high for some companies. The potential of the copper belt is by no means exhausted. but the pace of exploration has slowed somewhat.

It is interesting to note that an airborne magnetometer and EM survey was made of the old Greenwood-Phoenix camp. Results of this survey were not available at the end of 1959.

The production of lead and zinc was about normal, with little change in the rate of output of the major producers. In the Slocan district activity was reduced, and Western Exploration Company Limited, which had been doing development work on the Mammoth. suspended operations. Exploration was rather limited. but work hy Consolidated on Duncan Lake has demonstrated the existence of a substantial tonnage. This property. for some pears named the J.G., has received attention for more than thirty years, most development work having been done since 1951. Recently the application of geological knowledge has led finally to the recognition of important quantities of ore in this part of the Kootenay arc. and underground work was started.

The deposits of magnetic iron ore in the coastal regions assumed greater importance than ever before. Two new producers, the Nimpkish and Hualpai mines on Vancouver Island, doubled the number of mines shipping concentrated iron ore to Japan. Exploratory work was done on two properties on Vancouver Island, one near Vancouver, and one near Kitimat. 4 deposit on Moresby Island was being developed for production. The annual value of production has passed the S-million-dollar mark and is destined to increase.

Some surface exploration was done on the magnetite-bearing peridotite near Tulameen, and the Department of Mines made a geological field study of the occurrence.

A more than usual amount of attention was directed to molybdenite. Exploratory work at the Boss Mountain property on Takomkane Mountain was continued, some additional work was done at Glacier Gulch near Smithers, and other deposits were investigated at Usk, near Telegraph Creek. and near Alice Arm.

In mining practice, one of the largest underground blasts in the world was set off in the Sullivan mine. Fifty-seven tons of powder was used to break 1 ,060,000 tons of ore in one of the mine's largest pillars. Production from the pillar at an initial rate of 3,000 tons per day began two days after the blast. The ore was drawn through I OS drawholes to eight slusher-drifts. At Bralorne the high temperatures encountered at deoth durine the past few years have necessitated the installation of a new ventilation system. To this end, an entirely new raise 12 feet in diameter and 3,000 feet long was driven between the surface and No. 25 level. The raise will deliver cool air directly to the lower levels and was almost completed at the end of 1959.

In the summer of 1959 an airborne magnetometer survey was made by the Department of Mines of a part of Moresby Island. Maps resulting from this survey were made available to the public early in 1960. The results of two seasons' field work were compiled as an interim map with accompanying notes and were issued in April, 1960, as "Preliminary Geological Map, Southern Queen Charlotte Islands." Field work in the area is continuing.

NOTES ON METAL MINES

ALSEK RIVER*

During the past two seasons, Frobisher Limited has had a prospecting party working west of the Haines Road in the vicinity of the Alsek and Tatshenshini Rivers. In the summer of 1959 the party was serviced with a Hiller 12E helicopter and a pontoon-equipped Super Cub. A large number of mineral occurrences have been found and two mineral deposits have been located. A gypsum deposit of large size and high quality was located near the head of the O'Connor River about 10 miles west of the Haines Road. A large replacement in greenstone consisting of pyrrhotite, pyrite, and chalcopyrite and held as the Windy and Craggy groups was located about 20 miles north of the junction of the Alsek and Tatshenshini Rivers.

TELEGRAPH CREEK*

Information released by the Chief Geologist of the Geological Survey of Canada on January 15th, 1959, in Information Circular No. 2, Field Work, 1958, led to the location in northern British Columbia in late January, 1959, of nearly 200 mineral claims by five major exploration companies and several individuals. Some of the claims were located 2 miles west of the north end of Chutine Lake, in the northern Coast Mountains, over a reported occurrence of molybdenite. The others were near Tachilta Lakes at the head of Tuya River, over a serpentine area reported to contain chrysotile asbestos to a maximum length of 1¼ inches.

The molybdenite occurrence near Chutine Lake was located by Kennco Explorations (Western) Limited and was examined by them, but was not further investigated. The serpentine area was examined carefully when the ground was free of snow, and the consensus of opinion is that the Tachilta Lakes serpentine contains less asbestos fibre than do several other known serpentine bodies that remain unstaked. No surface work was done on any of the Tachilta Lakes groups.

Molybdenum

Balsom

(57° 132° N.E.) In June, 1957, Einar Hagen, of Watson, Lake, located eight mineral claims-the Balsom Nos. 1 to 8 -for Conwest Exploration Company Limited to cover a large and very brilliantly coloured gossan exposed on the north side of Barrington River about 10 miles from its head and about 35 miles due west of Telegraph Creek. The claims extend northward, down hill from the top of the ridge at 6,000 feet to the valley at about 3,000 feet. In 1958 the property was under option to American Metal Climax, Inc., and in 1959 to Kennco Explorations (Western) Limited.

The rocks exposed in the vicinity of the mineralization are grey slate, green hornblende schists and hornblendites, and hornfelsic sedimentary and volcanic rocks striking about west and dipping steeply northward. The older rocks are intruded by light-c&wed syenite which extends for about 3,500 feet along a ridge-top. The syenite extends for 300 feet down the south face of the ridge and about 1,000 feet down the north face, where it is cut off and intruded by porphyritic quartz monzonite which forms dykes elsewhere in the vicinity. The syenite is cut by a few narrow dark-greenish fine-grained lamprophyre dykes trending northeastward.

Toward its western edge the syenite is crossed by a 500- to 600-foot zone of fracturing striking north 30 degrees east. In this zone the syenite is closely fractured and intensely altered. The fractures are occupied by narrow vuggy quartz

* By Stuart S. Holland

veinlets one-eight to one-quarter inch wide, accompanied by pyrite, molybdenite, and hematite mineralization. The rock is highly silicified and pyritized. The pyrite on surface is oxidized and produces a brilliant yellow to red-brown gossan. In places the pyrite appears to have been leached but little or none of the molybdenite. There is no indication of copper.

A large number of samples taken by American Metal Climax, Inc., from the altered and mineralized zone indicates that the molybdenum content ranges from 0.01 to 0.09 per cent.

Copper

Bird

(57° 130° SW.) The Bird Nos. 1 to 4 claims were located in August, 1957, by N. Bird, of Wells, for Silver Standard Mines Limited to cover copper mineralization exposed at 4,500 feet elevation on the ridge between Mess Creek and Schaft Creek and about 7 miles southwest of Mess Lake. In 1959 these claims were under option to Kennco Explorations (Western) Limited, and in August, 1959, forty-two additional claims (Bird Nos. 5 to 46) were located for that company.

The copper mineralization is exposed in natural outcrops and in about 3,000 lineal feet of trenching spaced at 100-foot intervals between elevations of 4,000 and 4,500 feet on the top and steep west slope of a north-south ridge. The rocks are grey and brown Permian rhyolitic flows and tuffs cut by northerly striking dykes of dark andesitic porphyry. At the north end the mineralized rhyolite is overlain unconformably by unmineralized volcanic breccia.

Mineralization consists of pyrite, chalcopyrite, and a little molybdenite disseminated through the rock and along joint fractures in the rhyolite and the dark dykes. There is a considerable amount of secondary malachite in the surface exposures and trenches.

The trenching done by Silver Standard Mines Limited indicates that the highest grade of surface mineralization, assaying as much as 0.4 per cent copper per ton, lies in an area 500 feet wide and extending 1,000 feet along the ridge. No work has been done to indicate what the grade of the unoxidized mineralization may be.

UNUK RIVER*

Copper

Granduc (Granduc Mines, Limited)

(56° 130° S.E.) Company office, 1111 West Georgia Street, Vancouver 5. L. T. Postle, president. The property is on the south fork of the Leduc glacier, 25 miles northwest of Stewart, at an elevation of 4,500 feet. Work during the 1959 season was carried out by a crew of six men under the direction of G. W. H. Norman. The work consisted of geological mapping at and around the property. Transportation to the property was by aircraft from Stewart.

[References: Bacon, W. R., Preliminary Map, Granduc Area, *B.C. Dept. of* Mines (1956); Minister of Mines, *B.C.*, Ann. Repts., 1956, pp. 15-17; 1957, p. 6; 1958, p. 6.]

PORTLAND CANAL*

SALMON RIVER (56° 130° S.E.)

Gold-Silver-Lead-Zinc

Silbak Premier Mines Limited

Company office, 844 West Hastings Street, Vancouver 1. A. E. Bryant, president; Hill Stack and Associates, consulting mining engineers. Starting on September 26th, 1959, a small leasing operation was carried on for about six weeks by

* By W. C. Robinson.

a crew of five men headed by T. J. McQuillan. Sixty-two tons of high-grade ore, which had been sorted and cobbed, was shipped to the smelter at Trail. It is reported that the work also involved the construction of one-quarter of a mile of road.

AMERICAN CREEK (56°129° S.W.)

Copper-Gold

Red Cliff

This property is near the mouth of American Creek on the west slope of the valley. A number of Crown-granted claims are held by Orofino Mines Ltd. under option from Yale Lead &Zinc Mines Limited. The property has been described in the 1908 Annual Report, page 56, and the 1909 Annual Report, page 67. Work which began on September 20th and ended on November 2nd was directed by F. L. James. Two men were employed, and it is reported that a tractor, which was under contract, did some road work between American Creek and the lower tunnel. Transportation to the lower tunnel was by truck or jeep. The property was not visited.

ALICE ARM*

Silver-Lead

Toric (Torbrit Silver Mines Limited)

(55° 129" N.W.) Registered office, 309 Royal Bank Building, Vancouver; executive office, 44 King Street West, Toronto; mine office, Alice Arm. R. W. Burton, manager; H. Bapty, mine superintendent; G. K. Sutherland, mill superintendent. Capital: 3,000,000 shares, $1 par value. The Torbrit mine camp and mill are on the west bank of the Kitsault River, 17 miles by road from Alice Arm. Production between January lst, 1959, and September 27th, 1959: Ore milled, 93,577 tons. Total concentrates produced amounted to 1,280 tons, containing 675,185 ounces of silver and 891,633 pounds of lead. In addition, the total bullion produced was 175,442 fine ounces.

A summary of mining operations follows:—

Ore broken—	Tons
Stopes	25,000
Stope raises and stope drifts	1,551
Total	26,551
Development in linear feet—	Ft.
Stope drifts	39
Stope raises	341
Longhole drilling with tungsten carbide bits	16,569

No safety officer was employed, but a mine safety committee carried out regular monthly inspections of the mine and mill and held monthly meetings.

On the surface no new construction was undertaken. The access trail to the hydro plant was maintained and, with the exception of the bridge at Trout Creek, the main bridges are in satisfactory condition.

The adit which was driven in 1958 on the North Star claim was driven an additional 412 feet in 1959 and an additional 7,940 feet of diamond drilling was done. It is reported that the silver mineralization outlined in the course of this work was not extensive enough to warrant the separate mining operation that would be required.

Production from the mine ceased on September 23rd, 1959, and production from the mill ceased on September 27th, 1959.

* By W. C. Robinson.

The property has been described in the Annual Report for 1948, and subsequent developments have been described in the Reports from 1949 to 1958, inclusive. A historical summary follows.

The original Toric group, which lies cast of the Kitsault River, consisted of the Anglo, Toric, Moose, and Lamb Crown-granted claims. Silver occurrences were explored by trenches starting about 1916, and the results obtained indicated that the occurrences were on two main zones of mineralization. Of these, the lower one was considered to be more attractive, and it was explored, starting in 1924, by an adit level originally called the 1900 but later called the 1150 level, corresponding approximately with the elevation above sea-level. The workings on this level exposed a replacement deposit more. than 100 feet wide, and in 1926-27 a mill designed to treat 50 tons per day was built. The efficiency of this mill in recovering the silver was less than expected. In 1928–29 the ore milled amounted to 1,540 tons, containing 32,040 ounces of silver and 32,445 pounds of lead.

In 1929 the property was acquired by Rritannia Mining and Smelting Co. Limited, and Torhrit Mining Co. Ltd. was formed to develop the Toric group. In 1929 and 1930 the property was explored by additional underground workings and by diamond-drill holes. This exploration showed that the replacement deposit extended above and below the 1150 level. Work was suspended in 1930, and the property remained idle until 1946, when Torbrit Silver Mines Limited, a new company controlled by Mining Corporation of Canada, acquired the Toric group and started to build a road up the valley from Alice Arm. This road, constructed most of the way along what had been the right-of-way of the Dolly Varden railway line, was completed in 1948 to the camp-site. A camp was built and a mill, designed to have a capacity of 300 tons per day, was completed early in 1949.

About 5 miles up the Kitsault Valley from the camp, near the mouth of Clearwater River, a 1,600.horsepower hydra-electric plant was installed and a transmission-line built to the camp. The mine camp and power-house were connected by the construction of a tractor-trail. A dam built at Clearwater Lake raised its level and stored water for use in periods of low run-off. In 1948 a new adit level was driven, the 1000, which became the main haulage level and was connected with the mill by a narrow-gauge railway 3,200 feet long.

The ore, which was found mainly on the Toric claim, occurred in shoots in a quartz-harite-hematite-jasper replacement deposit within a country rock consisting of agglomerates and tuffs of the Hazelton group. The oreshoots as a rule apexed abruptly below the surface. a definite indication that they were formed from ascending solutions and not descending solutions. The original discovery was one of the few shoots that extended to the surface.

During the last years of operation considerable exploration work was done on the Moose and Lamb claims of the Toric group. A number of open-cuts, contemporary with the original work on the Toric claims, were examined and further prospecting located continuations of the silver-bearing veins. On the Moose and Lamb claims. 9,680 feet of surface diamond drilling was done, but the results were unfavourable and the project was abandoned in September, 1957.

During the first part of mining operations two systems of stoping were practised, depending on the size and plunge of the particular ore section, In flat-lying sections, open stoping. using scrapers to pass the broken material to draw points, was used. In steeper sections shrinkage stoping was employed. Ground for the most part stood up well, and long blast-hole drilling was used extensively. The longhole drilling was done with leyner machines and tungsten carbide bits attached to sectional steel. Above the 1000 level the ore was scraped from draw points to an ore-pass. and on the 1000 level and below the ore was loaded by mucking-machines at the draw points. Material from the 900 and 800 levels was hoisted by means of a shaft which had been initially raised from the 1000 level to the surface and eventually sunk to the 800 level. Material below the 800 level was brought to that level by means of a 16-degree winze which had been driven in the footwall for a distance of approximately 500 feet to the 700 level.

The mill commenced operation on February 4th, 1949, and averaged about 300 tons per day during the first year. During the first four months of operation all the ore was treated by cyanidation. During this period it was found that recovery in the plant did not equal that of the original test work. It was found that much of the silver was present in silver sulphides, mostly ruby silver, and was not recoverable by cyanidation. The important ore minerals were galena, ruby silver, and native silver. After trying several combinations of cyanidation and flotation it was found that the best recovery was obtained by grinding the ore, floating off the bulk of the silver minerals, and passing the flotation tailings to cyanidation. Most of the silver was thus recovered with galena and sphalerite in a bulk concentrate which was shipped to the lead plant at the Trail smelter. The native silver recovered by cyanidation was refined and shipped as bullion.

Mill capacity was increased through the years. During 1950 it averaged about *355* tons per day and by 1954 was 400 to 450 tons per day.

Production between the commencement of milling in February, 1949, and the cessation of operations at the end of September, 1959: Ore milled, 1,374,832 tons; silver produced in concentrate and bullion, 18,614,015 oz.; lead produced in concentrate, 10,700,428 lb.

Molybdenum

Alice (Kennco Explorations (Western) Limited)

(55" 129" SE.) Head office, 25 King Street West, Toronto 1. C. J. Sullivan, president; C. S. Ney, in charge of property. A total of forty-five claims are held-twenty-six by record and nineteen by option. The property is on Lime Creek about 5 miles south of Alice Arm. It is reported that the mineralization consists of molybdenite in the form of thin selvages in quartz veinlets which form a stockwork in a small granodiorite plug, intrusive into greywacke. Work between July 10th and August 28th was done by a crew of seven men. Ten X-ray drill-holes totalling 1,021 feet were drilled. About 300 lineal feet of trench and open-cut was excavated and sampled.

Transportation was mainly by helicopter, with some help from back-packing. A drilling programme is planned for 1960. The property was not visited.

OBSERVATORY INLET*

copper

Double Ed (The Consolidated Mining and Smelting Company of Canada, Limited)

(55" 129" S.W.) G. A. Derry, development superintendent. This property of fifteen recorded claims is on Bonanza Creek, 3 miles west of Anvox. Work commenced June 1st. 1959. The access road was rehabilitated and a camp was con&ted on the property. A thirty-man bunk-house, cook-house, warehouse-office, dry, compressor and power house, shop, and magazine were built. Equipment includes a 600-c.f.m. diesel-driven compressor, a diesel-electric generator, a h-ton 38-horsepower diesel locomotive, and a 3,980.c.f.m. ventilation fan.

An adit was driven at about 500 feet elevation from the west bank of Bonanza Creek to investigate further the surface showing of copper mineralization which is

* BY W.C. Robinson.

about 500 feet higher than the adit. The adit measures 9 by 9 feet, and at the end of 1959 was 1,898 feet long.

A crew averaging twenty-five men was employed. Coastal boats and aircraft were. used for transportation to Bonanza Creek Landing and trucks were used on the road.

MORESBY ISLAND*

Iron

Harriet Harbour (Silver Standard Mines Limited) (52” 131” S.E.) Company office, 808, 602 West Hastings Street, Vancouver 2. H. B. Gilleland, manager; A. C. Ritchie, general superintendent. The magnetite. bodies presently under investigation occur at an elevation of approximately 1,000 feet above sea-level close to Harriet Harbour on the southeast coast of Moresby Island, Queen Charlotte Islands. Access is by air or sea to Harriet Harbour and by foot-trail from the shore to the outcrops. The climate is temperate, with negligible snowfall and temperatures rarely below 20 degrees above zero. Harriet Harbour is a good sheltered harbour, suitable for entry by moderately large cargo vessels.

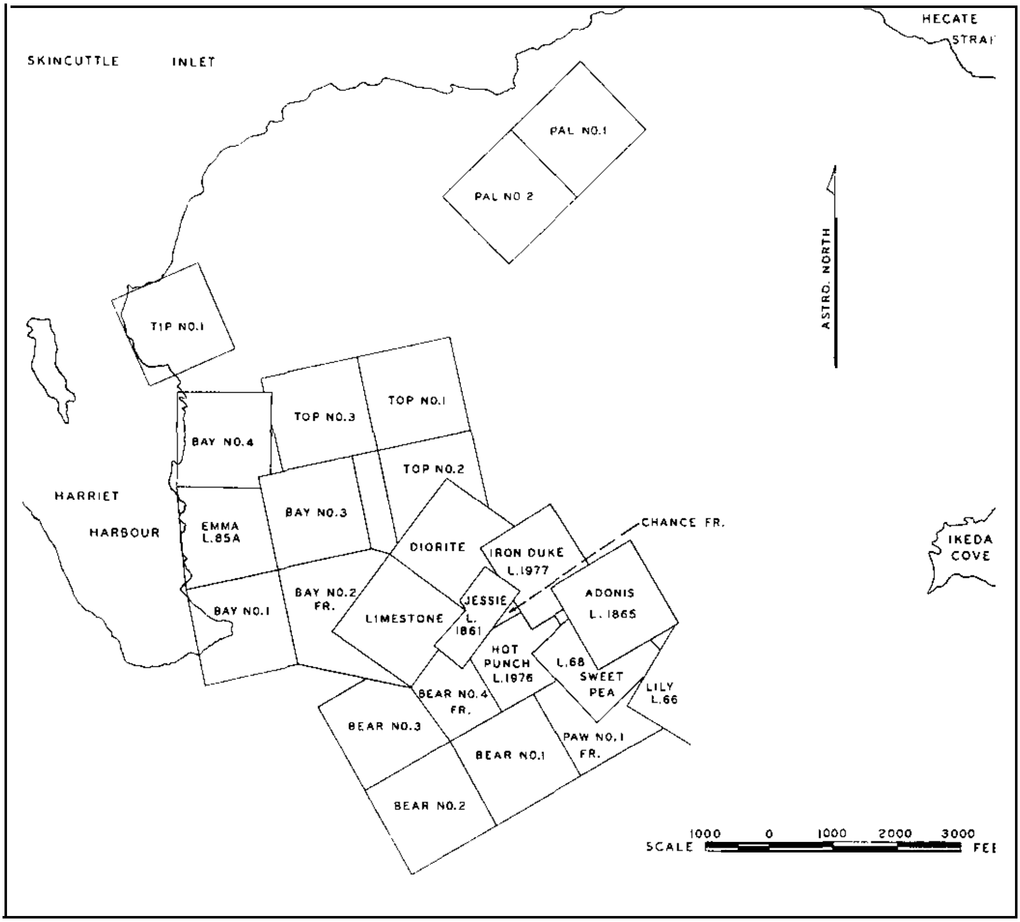


Figure 1. Mineral claims near Harriet Harbour, Moresby Island.

* By W. G. Jeffery

The main ore zone is on the Jessie Crown-granted claim (Lot 1861), which is held under option from Consolidated Exploration Company Ltd., 1133 Melville Street, Vancouver (*see* Fig. 1). Adjacent claims controlled by the company include the following: Limestone, Diorite, and Chance fraction recorded claims held under option from Western Canada Steel; Iron Duke (Lot 1977) and Hot Punch (Lot 1976) reverted Crown-granted claims comprising retention lease R30B optioned from J. M. Black; the Adonis (Lot 1865) Crown-granted claim. In addition, about twelve claims and fractional claims are held by record in the same general area.

Mineral occurrences in the vicinity have been known since 1863, but the magnetite deposits on the Jessie claim have been previously described only in "The Iron Ores of Canada," Volume I, Economic Geology Series 3, published by the Geological Survey of Canada (1926).

The writer spent four days in August examining the property and preparing a geological map at a scale of 1 inch to 40 feet (*see* Fig. 2). Elevations were obtained by barometric readings based on sea-level. Outcrops are scarce as the deposits are on a heavily timbered slope, but stripping has exposed parts of all the magnetite outcrops and some of the more evident rock exposures.

In the vicinity of Harriet Harbour a thick sequence of basic volcanic rocks is overlain by Upper Triassic limestone and thin-bedded argillites. Jurassic sedimentary and volcanic rocks occur near by. All these rocks are cut by post-Middle Jurassic granitic rocks, and these in turn are cut by late basaltic dykes.

The magnetite, associated with variable amounts of skarn rock, replaces the basic volcanic flows of pre-Upper Triassic age. These flows are amygdaloidal fine-grained green rocks, mainly composed of plagioclase feldspar and green hornblende. The amygdules. which are irregular in shape, average about 6 or 7 millimetres across and are almost entirely filled with a dark-green chlorite. Disseminated magnetite in the rock notably occurs as more concentrated haloes or aureoles around the amygdules.

Massive finely crystalline limestone with little indication of bedding overlies the volcanic flows and is exposed along the eastern margin of the magnetite showings. The limestone in turn is overlain by thin-bedded black and brown argillites.

The volcanic and sedimentary rocks have been invaded by a swarm of fine-grained greenstone dykes and sills. These intrusive rocks are the local representatives of an extensive suite of Lower or Middle Jurassic volcanic rocks. The dykes are typically volcanic in appearance and texture. Their uniformity of grain size and colour makes identification in the field difficult, but microscopic examination classifies most dykes as andesites or basalts, with some lamprophyric types. One fine-grained basaltic dyke cuts through magnetite, but most of the dykes in this swarm are pre-ore. At some distance from the ore zone an altered andesite dyke was seen to cut diorite, and some of the dyke swarm could also be post-diorite in age.

Diorite is exposed along the western margin of the ore zones and is intrusive into the volcanic rocks. Dioritic dykes extend from the intrusive mass and cut the volcanic flows. At least one diorite dyke has a general trend northwest and dips approximately 30 degrees northeast. All evidence is that these dykes are pre-ore.

In the examination of the Jessie claim very little indication of structure was obtained, but it is known from regional evidence that the volcanic and sedimentary rocks are at least gently folded, and that the district volcanic-limestone contact strikes about north 75 degrees east and dips from 40 to 55 degrees to the north.

The spatial relationships of these various rock types are characteristic of other magnetite occurrences in the southern coastal region of British Columbia. The possible importance of adjacent limestone and intrusive rocks in the genesis of the

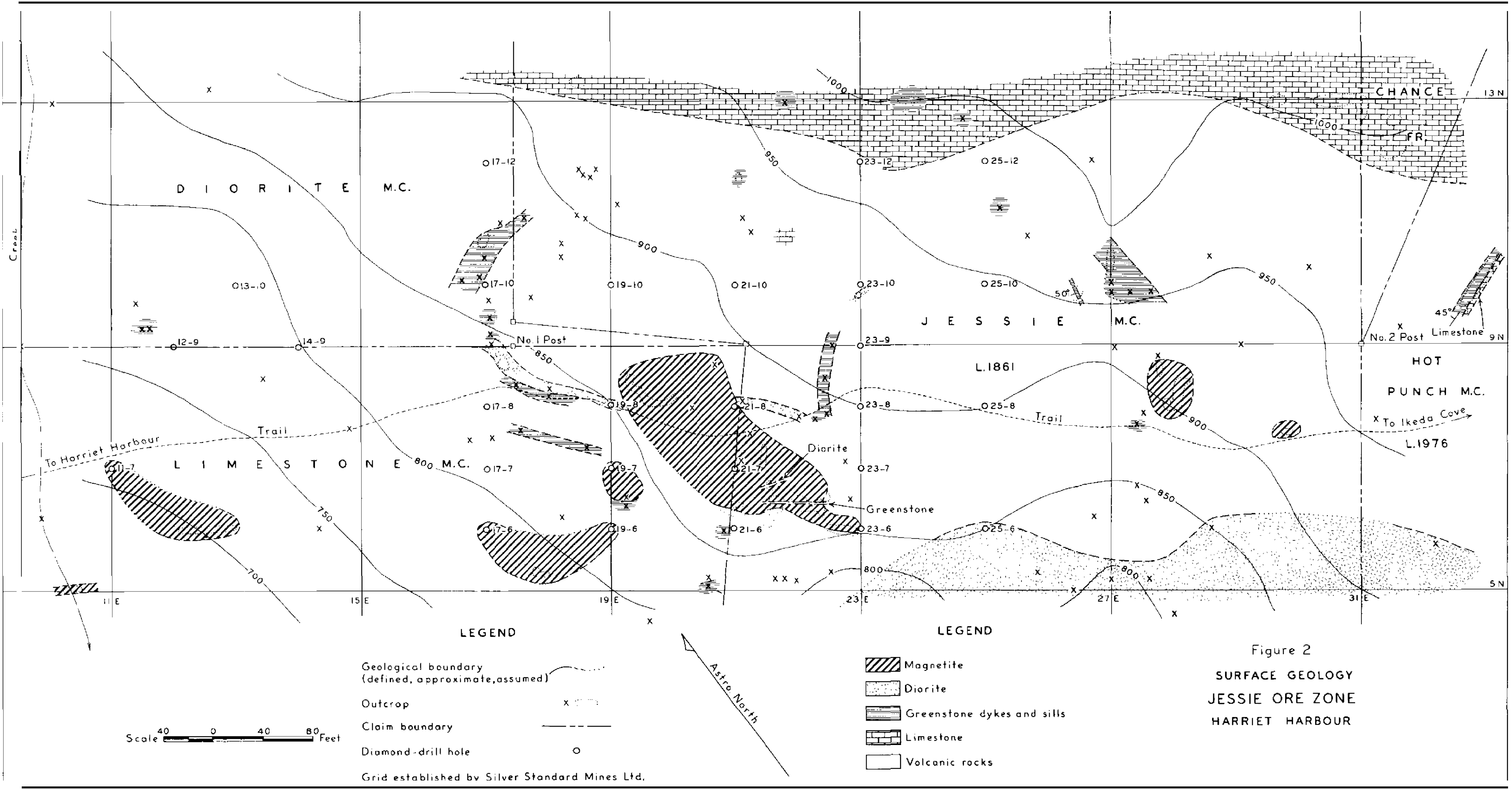


Figure 2
SURFACE GEOLOGY
JESSIE ORE ZONE
HARRIET HARBOUR

Looking westward along Buck Channel, northwest Moresby Island.
Taking a dip-needle reading.

View northward from Harriet Harbour, southeast Moresby Island. Silver Standard iron property is in right middle distance.

magnetite deposits has been discussed by W. R. Bacon in the Annual Reports for 1952 and 1956.

The magnetite forms tabular or lenticular bodies striking southeast and dipping about 20 to 30 degrees northeast. The amount of magnetite is erratic, varying from weakly disseminated to massive, hence continuity of ore. is only proved by closely spaced diamond drilling. Mineralization in a section low in iron is in places represented by skarn consisting essentially of an orange-brown garnet with minor epidote. In addition to skarn which occurs along magnetite contacts and with disseminated magnetite, skarn also occurs in isolated masses with negligible amounts of magnetite. Throughout the region of the magnetite deposits and within the volcanic flows there has been a major redistribution of carbonate. Calcite is abundant as disseminations, pods, lenses, and coarse-grained veins and veinlets.

From the early descriptions the magnetite outcrops prior to stripping were of the order of 10 feet across, although it would appear that there was considerable float on the hillside below the outcrops. A rough estimate made in 1926 indicated a tonnage ranging from 25,000 tons to perhaps 200,000 tons. Stripping has increased the size of the exposures of continuous mineralization to distances as great as 40 or 50 feet (see Fig. 2). Silver Standard Mines commenced operations with a ground magnetometric survey. The zone lying mainly on the Jessie claim was indicated by an anomaly to be roughly 500 by 300 feet in size. A subsidiary area 200 by 80 feet with anomalous values occurs to the west on the Limestone claim. Diamond drilling on 100-foot centres with some intermediate holes for greater detail has proceeded since June, 1959.

To September 30th, 1959, the development programme on the Jessie zone has revealed about 1,100,000 tons of ore grading: Iron, 49.4 per cent; copper, 0.025 per cent; sulphur, 0.78 per cent; titanium, 0.09 per cent; phosphorus, 0.035 per cent. The tonnage of ore outlined has since been increased by continued diamond drilling.

Work done on the smaller magnetic anomaly on the Limestone claim has proved about 100,000 tons of ore grading: Iron, 50.9 per cent; copper, 0.018 per cent; sulphur, 0.42 per cent; titanium, 0.08 per cent; phosphorus, 0.048 per cent.

Approximately 1,500 feet east of the Jessie claim and on the opposite side of the ridge between Ikeda Cove and Harriet Harbour is the Adonis claim. A magnetite outcrop on this claim was reported in 1926 and is now being investigated by Silver Standard Mines Limited. The mineralization is similar to that on the Jessie claim and occurs in similar volcanic rocks underlying the limestone. The limestone beds cover the volcanic rocks on the ridge and between the outcrops of magnetite on the Jessie and Adonis claims. Whether there is a continuous magnetite zone between the two areas, extending under the limestone, remains to be ascertained by further development. A preliminary magnetometer survey on the Adonis claim has shown anomalous readings over an area of 1,000 by 300 feet.

On the west side of Harriet Harbour are two more magnetite deposits controlled by Silver Standard Mines Limited, the Magnet (Lot 79) and Dingo (Lot 87) Crown-granted claims. Previous work in 1956 and 1958 on these properties has indicated magnetite deposits estimated by the company totalling 750,000 tons with a grade in the surface exposures of 54.2 per cent iron.

KITIMAT*

Iron

Iron Mountain (Quebec Metallurgical Industries Ltd.)

(54° 128° S.W.) Company office, 602, 88 Metcalfe Street, Ottawa. N. B. Davies, president; Alex. Smith, engineer in charge. The property is on Iron Mountain, about 6 miles north of Kitimat. It consists of four Crown-granted claims and six recorded claims. The mineral occurrences consist of a magnetite-pyrite-chalcopyrite-bearing zone in greenstones near the eastern contact of a body of quartz-diorite. The greenstones in the mineral-bearing zone are epidotized and some garnet skarn is present.

Work on the property commenced in June and was suspended in December. Three to four men were employed, and twenty packsack-drill holes averaging about 60 feet long were completed. Three EX holes, averaging about 550 feet long, were also completed.

Transportation to the camp, which was near the Wedeene River crossing of the Terrace-Kitimat branch of the Canadian National Railway, was by rail. Further drilling is planned for 1960.

[Reference: Minister of *Mines,* B.C., Ann. Rept., 1929, p. 72.]

KITSUMKALUM LAKE*

Gold

Beaver Group

(54° 128° N.W.) This property, held by Conwest Exploration Company Limited, consists of fifteen recorded claims—the Beaver No. 1, optioned from S. R. Ling, and Beaver Nos. 2 to 15. The property is at an elevation of about 4,000 feet, on a ridge of a mountain north of Mayo Creek, 7 miles west of Kitsumkalum Lake. The showings are reported to consist of a ribboned quartz vein which is contained in a strong northeasterly striking shear. The vein shows sulphide mineralization, including in order of abundance pyrite, arsenopyrite, galena, sphalerite, and chalcopyrite. Values are principally in gold.

Work from June 1st to August 15th was done by two men. It involved the digging of fourteen pits and trenches totalling about 118 cubic yards of excavation and the clearing of about 6 miles of trail. Back-packing for a distance of about 9 miles was required to service the property. The property was not visited.

USK

Molybdenum

Huestis Molybdenum Corporation Ltd.†

(54° 128° N.E.) The Huestis Molybdenum Corporation Ltd., 810, 402 West Pender Street, Vancouver 3, holds eighty-seven claims and fractions located as the J.B., O Molly, and H.M. groups. The claims extend westward from the Skeena River on both sides of a small creek, locally called Bell Creek, 1 mile north of Pitman station. The original claims were located by J. Bell, of Usk, to cover molybdenite mineralization seen along the creek bottom.

Pitman is close to the eastern margin of the Coast intrusions, where andesitic fragmental volcanics and flows of the Hazelton formation are intruded by granitic rocks. Along the lower stretch of Bell Creek dark andesitic volcanic rocks are intruded by grey porphyritic granodiorite which appears to have a flat upper (western) contact. The volcanics lie in a gently west-dipping and thinning wedge between the granodiorite and pink quartz monzonite, about one-half mile west of the railway track. All of these rocks are cut by younger dykes of granite porphyry

* By W. C. Robinson.
† By Stuart S. Holland.

Exposure of magnetite on Rose mineral claim, Ikeda Cove, Moresby Island (1907 photograph).

One-man diamond drill set up on Silver Standard property, Harriet Harbour.

and andesite. For 2,000 feet upstream (westward) from the wedge of volcanics the pink quartz monzonite is exposed in the creek bottom. Its upper contact with other rocks of the Hazelton formation dips 30 to 40 degrees northwestward. Near its lower contact the quartz monzonite is altered and has a noticeable light-brown colour; near its upper contact it is jointed and silicified. Feldspathization of the rock extends outward from siliceous veinlets.

Molybdenite is present in the altered quartz monzonite but has not been observed in the grey granodiorite.

The molybdenite occupies narrow shears in the quartz monzonite, is in quartz veins a few inches to a few feet wide, and occurs as disseminations. Disseminated molybdenite *is* associated with narrow silicification veinlets which appear to occupy a definite system of joint fractures. The molybdenite is accompanied by disseminated pyrite and a small amount of specular hematite.

During the summer of 1959 a small crew was occupied in geological mapping in the vicinity of the mineralization, in putting in open-cuts along the creek bottom to expose the mineralization, and in a thorough sampling.

The best molybdenite mineralization is exposed in a trench 150 feet long just downstream (east) of the upper (western) quartz monzonite-volcanic contact. In this trench the quartz monzonite is intensely silicified and feldspathized and is crossed by numerous joint fractures occupied by narrow quartz veinlets. The rock contains finely disseminated molybdenite and pyrite, and is cut by several shears well mineralized with molybdenite across widths of a few inches.

A road was bulldozed from Pitman station to the vicinity of the upper trench preparatory to further exploration by diamond drilling.

Copper-Silver-Lead-Zinc-Gold

Grotto*

(54° 128° N.E.) The Grotto group, owned by Huestis Molybdenum Corporation Ltd., consists of six recorded claims. The property is about 1 mile west of Pitman. The main rock type is dark green, somewhat chloritized andesite traversed by several feldspar porphyry dykes from 4 to 15 feet wide. No major granitic bodies occur near the workings, but what may be the southern edge of the main stock occurs in granitic bluffs that form the rim of the valley some 1,500 feet north of the workings. The mineral deposits include quartz veins containing values in gold and silver and copper and silver-lead-zinc mineralization in the surface showings.

A preliminary examination was made in 1959 and the underground workings were mapped. Repair work was done on the 1 M-mile road connecting the camp with Pitman. A camp was originally set up near Pitman, but the Grotto camp, serviced by jeep, was in use by the end of the season. This camp was used by those doing work either on the Bell Creek prospect or the Grotto prospect.

[References: Minister of Mines, B.C... Ann. Rept., 1937, pp. C 4-7; Kindle, E. D., *Geol. Surv.*, ***Canada,*** Mem. 212, 1937, pp. 3X-40.1

SMITHERS*

Molybdenum

Glacier Gulch (American Metal Climax, Inc.)

(54” 127° N.E.) British Columbia office, 908, 718 Granville Street. Vancouver 2. J. Payne, Jr., president; J. W. Hoadley, British Columbia manager; W. W. Moorhouse, geologist in charge at property. The property consists of sixty-one claims held by option agreement on the eastern flank of Hudson Bay Mountain about 6 miles northwest of Smithers. The property

* By W. C. Robinson.

has been described in the 1958 Annual Report, pages 10 and 11. In 1959 six weeks of geological mapping was done by two men. The option was later dropped.

Silver-Lead-Zinc

Cronin (New Cronin Babine Miner Limited)

(54" 126" N.W.) Company office, 844 West Hastings Street, Vancouver I L. C. Creery, president; Hill Starck and Associates, consulting mining engineers. The property is on the east slope of Cronin Mountain, about 30 miles by road from Smithers. P. Kindrat, lessee, operated the mine and mill during part of 1959. It has been reported that 82 tons of lead concentrates and 66 tons of zinc concentrates were produced and shipped to the Trail smelter.

[References: Minister of Mines, B.C., Ann. Repts., 1949, pp. 94-98; 1956, p. 27.]

BABINE LAKE*

copper

McDonald Island (Granisle Copper Limited)

(54" 126" N.E.) Head office, 1111 West Georgia Street, Vancouver 5. L. T. Postle, president. This property of forty-six recorded claims is on McDonald Island (also known as Copper Island) in the northern section of Babine Lake at the mouth of Hagan Arm. Work in 1959 began soon after break-up in May and continued through the summer. Thirty holes were drilled, with a total length of 11,262 feet. Prospecting was done over near-by islands and the mainland of the east shore of Babine Lake. At the end of the season all drill equipment was removed. The property was serviced by boat from Topley Landing.

[References: Minister of Mines, B.C., Ann. Repts., 1913, pp. 113-114; 1927, pp. 149-150; 1929, pp. 180-181; 1940, p. 78; 1946, p. 89; 1955, p. 29; 1956, p. 29.1

OMINECA*

Mercury

Snell Group (Bralorne Pioneer Mines Limited)

(55" 125" N.E.) Company office, 320, 355 Burrard Street, Vancouver 1. F. R. Joubin, president; E. Bronlund, engineer in charge. The property is on Silver Creek, 9 miles south of Omineca River, and consists of thirty claims held by record. The showings are reported to be mercury deposits along the Pinchi fault zone. Work from June 26th to November 13th was done by an average crew of seven men. Thirteen holes totalling 2,548 feet were drilled, and a total of 27,300 cubic yards of overburden was removed by hydraulic stripping. A bridge and a number of culverts were replaced and some grading was done on the access road from Germansen Lake. The camp was supplied by truck and tractor. The property was not visited.

KECHIKA RIVER*

Lead

West Group

(58" 127" S.E.) This property, held by Conwest Exploration Company Limited, consists of thirty-two recorded claims. It is about 140 miles south-southeast of Watson Lake, at the head of an eastward-flowing tributary to the Frog River. It has been reported that massive galena float has been found in an area underlain by sericite schists. Work in 1959, from May 28th to September 15th, involved trenching and cutting trail. An average crew of five men was employed. Transportation was by charter aircraft

* By W. C. Robinson.

from Watson Lake to a small lake 14 miles east of the property. Pack-horses were used from this lake to the claims. The property was not visited.

ALASKA HIGHWAY*

Copper

Toad, Toad River, and Beaver Lake (Fort Reliance Minerals Limited) (58° 125° N.W.) Reports brought in by Indian hunters of the occurrence of copper-bearing float on the west side of the Toad River led to the location of the first claims in the area by Oscar Macdonald, of Mile 442, Alaska Highway, and Hans Kvikstad, of Fort St. John, in May, 1956. The claims are south of the highway on the west side of the Toad River, about 1,200 feet above it at about 4,200 feet elevation, and are reached by about 21 miles of pack-horse trail which makes four crossings of the Toad River.

In 1958 and 1959 the claims were under option to Fort Reliance Minerals Limited, 2810, 25 King Street West, Toronto 1. Work done on the property was under the supervision of A. D. Wilmot.

In the vicinity of the mineralized showings the rocks consist of grey slate and silty argillite. They are pre-Silurian in age (possibly late Precambrian or early Palæozoic) and are part of a succession of metamorphic rocks that occupies a fairly extensive area south of the Alaska Highway and extends from the Toad River eastward to Mounts Churchill and Stalin. The rocks have a regionally developed flow cleavage. Numerous dark greenish-black diabase dykes a few tens to a few hundreds of feet wide are intruded parallel to the regional cleavage. On the property the rocks strike north and dip 12 degrees west; axial plane cleavage strikes north 30 degrees west and dips 35 degrees southwestward.

Copper mineralization is on both sides of a diabase dyke which is about 20 feet wide and is parallel to the cleavage. The mineralization lies in a shear which to the south is on the west side of the dyke, crosses it without perceptible offset of the dyke, and extends for several hundred feet on the east side of the dyke. The shear strikes about 10 degrees east of north and dips 70 degrees west.

Copper mineralization, consisting essentially of chalcopyrite and a little quartz, occurs in the shear across widths ranging from 3 to 14 feet. In the outcrop and surface trenches the chalcopyrite is altered to malachite, and it is estimated that one-quarter to one-half the copper occurs as secondary malachite.

In 1958 nine trenches were put in on the shear along a length of 640 feet to the south of the shear-dyke intersection. The average copper content of the exposed mineralized shear is about 6 per cent across an average width of almost 8 feet. In the trenches it is apparent that secondary malachite has migrated along the shear planes and occupies a greater width than does the primary chalcopyrite. About 1,500 feet of diamond drilling done in 1958 disclosed that at a depth of about 100 feet mineralization in the shear consisted essentially of chalcopyrite and included little secondary malachite.

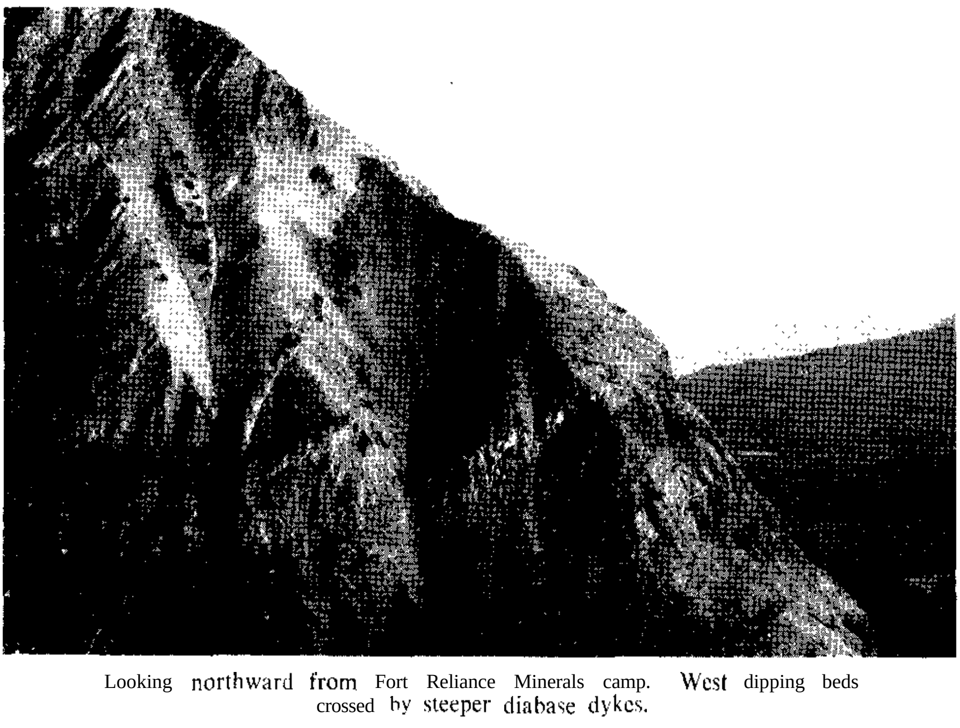
The shear was traced for a few hundred feet north of the shear-dyke intersection, but the widths were narrow and the grade low, and consequently no further exploration was done along that section.

In 1959 five drill-holes totalling 1,509 feet were put down using a BXF bit, to enable a high core recovery to be obtained. For the most part the shear was found to extend to depth and to maintain its width, but the average content of the primary copper mineralization was considerably less than that obtained in surface sampling.

Drilling stopped in August, 1959, and all equipment was removed from the property.

* By Stuart S. Holland.

Looking southward to the head of the Toad River from Fort Reliance Minerals property.



Looking northward from Fort Reliance Minerals camp. West dipping beds crossed by steeper diabase dykes.

Al, Caribou, Canyon, Don (Magnum Copper Limited)

(58° 125" N.E.) Copper mineralization was found on his trap-line at the head of Delano Creek about fifteen years ago by Albin Larson, of Mile 408, Alaska Highway. Larson, and William Lembke, of Mile 408, located the showings in September, 1957, as the Al 1 to 3, Caribou 1 to 5, and Canyon 1 to 3 mineral claims. These claims in 1958 and 1959 were under option to Magnum Copper Limited, 700 Burrard Building, Vancouver, who subsequently located the Don I to 48 mineral claims in the same area.

The copper mineralization is at an elevation of about 6,000 feet at the head of the north branch of Delano Creek, about 2% miles southwest of the Yehde Lakes and 5½ miles northwest of Mount Roosevelt. A tent camp was established at an elevation of 5,500 feet close to the showings, and in 1959 was serviced by helicopter and by about 40 miles of pack-horse trail. The trail leaves the Alaska Highway at Mile 402, crosses MacDonald Creek. and runs southwestward to cross Wokkpash (Devil's) Creek about a mile above its mouth. The trail then crosses to the west side of Racing River, along which it follows to the mouth of Delano Creek and thence up Delano Creek, mostly on the north side,

In the vicinity of the mineralization the rocks are pre-Silurian in age, possibly late Precambrian or early Palæozoic black slate, limestone, and interbedded black slate and grey calcareous siltstone. Folding about northwesterly trending axes has developed southwesterly dipping axial plane cleavage. The rocks are intruded by northeasterly striking and steep southeasterly dipping diabase dykes having a width of 25 feet or more.

The copper mineralization is in veins which lie between two faults which strike north 60 degrees east and which are 100 to 200 feet apart. The southernmost fault is along the northern contact of a diabase dyke. Movement along the faults has produced in the intervening rock shear and tension fractures, which are occupied by mineralized veins. The attitude and competency of the folded slate and calcareous siltstone in the zone between the two faults greatly influenced the character and persistence of the fractures in them. The siltstone is visibly more fractured and mineralized than is the interbedded slate.

The veins comprise quartz-ankerite fissure fillings and replacement masses mineralized essentially with chalcopyrite. Lenses of massive chalcopyrite were observed which might contain 10 to 15 per cent copper across widths of as much as 10 feet. The veins in plan are discontinuous and occupy shear fractures trending northeastward and tension fractures having a northerly strike; in width they range between 4 and 14 feet and may have a length of 100 feet or more. The structure has an explored length of about 2,500 feet.

In 1958 the company did some surface trenching and sampling and drilled six deep holes with an aggregate length of 3,485 feet that demonstrated the persistence of the major structure and of vein mineralization to a depth of almost 700 feet. In 1959 the diamond drilling was continued, and five AX holes totalling 3.451 feet were drilled. Vein intersections in the drill-holes were almost completely unoxidized. Secondary malachite and azurite occur in small amounts at depth but are more abundant in the surface exposures of the veins. Vein assays from drill intersections were significantly lower than surface assays.

Vein behaviour at depth can be expected to continue to relate to the distribution of black slate and grey siltstone, and the same pattern of discontinuous veins undoubtedly will persist.

Geological mapping of the property was completed before work was terminated in early August and all equipment removed.

Work at the property was under the direction of A. Allan.

McLEOD LAKE*

Gold

Tudyah Lake

(55° 123° S.E.) A small amount of work has been done to expose a showing on the east side of the Hart Highway near Mile 95 from Prince George. The showing is 2 miles north of the road leading to Melville Lodge on Tudyah Lake, about 25 feet above road-level and about 150 feet east of the Hart Highway. Elevation of the showing is 2,310 feet, approximately 125 feet above the level of Tudyah Lake.

Reports of 4- and 6-ounce gold assays from several samples obtained near Tudyah Lake led to a brief examination being made in June, 1959. The showing is an exposure of grey gritty quartzite which is silicified and only sparsely mineralized with pyrite. Two samples selected from the most pyritic material assayed: Gold, *nil.*

UPPER FRASER RIVER†

HANSARD (54° 121° S.W.)

Copper

Lucky (Noranda Exploration Company, Limited)

Company office, 202, 2256 West Twelfth Avenue, Vancouver 9. B. O. Brynelsen, manager, Vancouver. This property comprises a group of nine claims held under option agreement with Martin Caine and associates, of Prince George. The claims are on the Fraser River about 3 miles southwest of Hutton station on the Canadian National Railway. The copper showings, which were discovered many years ago, are on the west bank of the river. Some stripping and other work was done on the property in 1956 by Rio Canadian Exploration Ltd.

The present company established a line grid and carried out a preliminary electromagnetic survey. The work was done over a period of three weeks in October and November. Five men were employed under the supervision of Walter Nelson, Jr.

CARIBOO†

WELLS-BARKERVILLE (53° 121° S.W.)

Gold

Aurum and Cariboo Gold Quartz (The Cariboo Gold Quartz Mining Company Limited)

Company office, 1007 Royal Bank Building, Vancouver; mine office, Wells. W. B. Burnett, president; M. Guiget, general manager; J. J. Stone, mill superintendent. The Cariboo Gold Quartz and Aurum mines operated by this company are adjacent to the town of Wells, which is 51 miles by road from Quesnel. Due to the mining-out of available reserves, operations at the Cariboo Gold Quartz mine were suspended after twenty-six years of continuous production, and equipment was withdrawn from the No. 1 shaft workings. The shaft was abandoned on September 30th and the old workings allowed to flood. Production is thus now confined to the Aurum mine, the portals of which are at the foot of the east side of Island Mountain.

The ore deposits in the Aurum mine are tabular sulphide replacement bodies and irregular quartz veins. The irregular quartz orebodies are mined by a cut-and-fill method, while the replacement orebodies are developed by inclined drifting and are mined by slashing the ore on a retreating system. The mine is developed from a main haulage adit at the 4000 level. Eleven levels have been developed from the Aurum shaft, which is a three-compartment internal shaft 1,450 feet deep and

* By Stuart S. Holland.
† By A. R. C. James.

collared at the 4000 level. In 1959 mining was carried out mainly in stopes between the 3250 and 2700 levels. Important development work was done at the 3000 level, where a major programme of exploration&is being carried out in a structurally favourable area approximately 3,000 feet northwesterly from the Aurum shaft in the Mosquito Creek area. The 3000-l west drift has now been driven 3,500 feet from the Aurum shaft following the contact area between the Rainbow and Baker members of the Richfield formation. At a distance of 3,000 feet this drift crossed a northerly striking easterly dipping fault since named the Burnett fault. A total of 650 feet of drifting and crosscutting was done in this area, together with extensive diamond drilling. As a result of this work, replacement ore extending both above and below the level was discovered near the fault on the west side. A stope was developed in this ore, and by the end of the year 2,000 tons had been mined.

The following is a summary of development work done at the mine in 1959:—

	Feet
Drifting	2,308
Crosscutting	223
Raising	1,532
Diamond drilling	11,344
Ribbon steel test-holes	14,977

At the end of the year a crew of 117 men was employed, of which seventy-nine were underground. The accident experience at the mine has been extremely unfortunate in 1959. Ten compensable accidents were reported, two of which were fatal. On September 3rd Carl E. Weber was fatally crushed while operating a battery locomotive on the 4000 level. On December 30th Peter Vraa was killed as a result of a fall of rock in the 2850-24A stope. Accounts of these accidents are contained elsewhere in this Report. The accident rate for all lost-time accidents was twice as high as in 1958, although only about one-third of the average rate for the past five years. A full-time safety director is employed at the mine, and regular safety meetings and inspections are carried out.

A total of 46,586 tons of ore was milled.

WILLIAMS LAKE*

McLeese-Cuisson Lakes Area (52° 122° S.E.)

Copper

Sunset (Major Miner Limited) Company office, 744 West Hastings Street, Vancouver 1. R. L. Clothier, president. Capital: 5,000,000 shares, 50 cents par value. This company controls seventy-two claims formerly held by Kimaclo Mines Limited. The property is in the area of Cuisson Lake about 5 miles north of McLeese Lake on the Cariboo Highway, and 30 miles north of Williams Lake. Exploration work in 1959 was concentrated on the Sunset Nos. 14, 15, 16, and 17 claims. These lie about a mile northeast of the north end of Cuisson Lake and are reached by following for 6 miles a back road which branches to the north 2 miles alone the McLeese Lake-Beaver Lake road.

The claims appear to be underlain mainly by granodiorite, part of a large body or bodies of intrusive rocks which extend north and south of Granite Mountain for many miles. The Sunset showings and adit are on the lower part of Granite Creek at an elevation of 3,200 feet. An outcrop of schistose granodiorite, mineralized with disseminated pyrite and chalcopyrite, occurs on the creek. The schistosity or foliation strikes approximately north 60 degrees west and dips 30 to 40 degrees south. On the south bank of the creek an adit has been driven 110 feet south

* By A. R. C. James.

35 degrees east, following a local shear. The shear contains lenses of quartz and is mineralized with pyrite, chalcopyrite, and chalcocite.

The work done in 1959 has been directed to investigating the grade and extent of copper mineralization in the zone of schistose granodiorite. Ten holes totalling 3,000 feet were diamond-drilled. A crew of three men was employed to operate and service one diamond drill, and R. E. Chaplin was employed on geological mapping. Work was started on April 1st and continued until September 30th.

[Reference: Minister of Mines, *B.C.,* Ann. Rept., 1957, p. 17.1

LAC LA HACHE*

TAKOMKANE MOUNTAIN (52” 120” S.W.)

Molybdenum

Boss Mountain (Southwest Potash Corporation) Company office, 61 Broadway, New York, N.Y.; British Columbia office, 718 Granville Street, Vancouver 2. British Columbia manager, J. W. Hoadley. This company, a subsidiary of American Metal Climax. Inc., continued the exploration work on this property begun in September, 1956. The property includes eleven Crown-granted claims and forty-two recorded claims. all of which are optioned from H. H. Huestis and associates. The claims are on the east side of Takomkane (Big Timothy) Mountain at the headwaters of Molybdenite Creek. about 50 air miles due east of Williams Lake.

Until this year, the property was serviced by aeroplane, but early in 1959 construction was begun on a road to the showings. The property may now be reached by following the road up the valley of Horsefly River for 25 miles from the community of Horsefly. From this point a forestry road (a continuation of the public road) is followed for 13 miles to a point about midway between Tisdall and Elbow Lakes, where the new mine road begins. The mine road is 12% miles long and follows a general southerly direction along the western side of the valley of Molybdenite Creek. A considerable amount of difficulty was met with in the construction of this road due to mud, and at the end of the season it was reported that the road was still only passable by heavy four-wheel-drive vehicles.

The showings are near the headwaters of Molybdenite Creek in a large cirque on the eastern side of Takomkane Mountain at an elevation of 5,500 feet. A description of the mineralization and geology of the area was given in the 1957 Annual Report. The work done by the present company has been concentrated mainly on the lower or creek showings, where molybdenite mineralization occurs in a northwesterly striking brecciated zone in quartz diorite. The molybdenite mineralization is associated with numerous narrow quartz stringers, which form part of ths breccia zone.

In addition to the road construction, a programme of diamond drilling, trenching, and geological mapping was done. Twenty holes, totalling 12,074 feet, were diamond-drilled. One hundred and twenty trenches were dug. A crew of twenty men was employed under the supervision of D. L. Chapman. Work on the road was begun in March, and the crew was withdrawn from the property on November 3rd.

[Reference: *Minister of Mines, B.C.,* Ann. Rept., 1957, pp. 18–22.]

* By A. R. C. James.

CLINTON*

POISON MOUNTAIN (51° 122° S.W.)

Copper

Copper Nos. 1 to 4 (New Jersey Zinc Exploration Company (Canada) Ltd.) Vancouver office, 905, 525 Seymour Street, Vancouver 2. This property comprises four recorded claims (Copper Nos. 1 to 4) held by H. Reynolds of Lillooet, and sixteen recorded claims held by the present company: The claims are mainly on the southwest side of Poison Mountain, about 40 miles northwest of Lillooet near the headwaters of Yalakom River and Churn Creek. Access is by 36 miles of jeep-road from Big Bar ferry on the Fraser River.

The showings include low-grade copper mineralization, predominantly chalcopyrite, occurring as disseminations and fracture-fillings in a body of intrusive diorite porphyry. The property was intermittently prospected from 1935 to 1956. In 1956 the Granby Consolidated Mining Smelting and Power Company optioned the Copper group of claims and located thirty-nine additional claims in the area. A jeep-road was then completed to the property and stripping and diamond drilling was done. Since then the property has remained inactive until work was resumed by the present company this year. A magnetometer and soil-sampling survey was made over a 400- by 100-foot grid which was cut out and surveyed. This grid covered 14% miles of line, and 750 soil samples and magnetometer readings were taken. The work was begun on July 15th and continued until September 4th. A crew averaging four men was employed under the supervision of R. C. MacDonald.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1956, pp. 35-37; 1946, pp. 101–102.]

LILLOOET*

BRIDGE RIVER (50° 122° N.W.)

Gold

Ace Mining Company Ltd. Company office, 404, 510 West Hastings Street, Vancouver 2. Ernest Howard, president. This company holds fifty-one claims on the north side of Bridge River between Minto and Gold Bridge. The property includes the Congress mine, where a considerable amount of underground development and exploration work was done in the years 1934 to 1938 and 1945 to 1947. A small amount of work was done in clearing away rotten sets around the main portal of the mine and in levelling out an area extending 100 feet in front of the portal. This is to provide room for storage and mine buildings when the valley is flooded behind the Mission dam. Prospecting was also done on the property and some open-cuts were made on the Ace claims. One man was employed in this work.

At the end of 1959 it was reported that promising new surface showings had been found about 3,000 feet west of the Congress mine. An agreement was made with Bralorne Pioneer Mines Limited for that company to participate in the further exploration of the property.

[References: *Minister of Mines, B.C.,* Ann. Rept., 1948, pp. 106-112; Cairnes, C. E., *Geol. Surv., Canada,* Mem. 213, 1937, pp. 102–104.]

Bralorne Pioneer Mines Limited Company office, 355 Burrard Street, Vancouver 1; mine office, Bralorne. F. R. Joubin, president; J. E. McMynn, general manager; C. M. Campbell, Jr., resident manager; J. S. Thomson, superintendent of mines; C. D. Musser,

*By A. R. C. James.

superintendent of mills. In 1959 the two companies of Bralorne Mines Limited and Pioneer Gold Mines of B.C. Limited were amalgamated under one management, the two mines being organized as separate divisions within the company.

Bralorne Division.-The Bralorne mine is on Cadwallader Creek, a tributary of the Bridge River. It is reached by 51 miles of road from Shalalth or 75 miles from Lillooet, both stations on the Pacific Great Eastern Railway. The property was described in some detail in the 1958 Annual Report. The extensive workings are in a generally northwesterly trending vein system which is now being mined at depths of between 3,000 and 4,000 feet below the surface, with development work proceeding well over 4,000 feet below the surface.

The workings are approached by a main haulage adit at No. 8 level. There are three internal shafts: the Crown shaft, approximately 2,600 feet deep, from No. 8 to No. 26 level; the Empire shaft, approximately 3,280 feet deep, from No. 3 to No. 26 level; the Queen shaft, 1,734 feet deep, from No. 26 to No. 37 level. The major portion of present production is mined in cut-and-fill stopes between No. 26 and No. 32 levels, the 77 vein being the most productive. The ore is hoisted in the Queen shaft to No. 26 level and then is trammed to the Crown shaft and hoisted to No. 8 level, the main haulage level of the mine, whence it is hauled by trolley locomotive to the mill. In the mill the ore is treated by amalgamation, blanket concentration, and flotation. A sulphide concentrate made by flotation is shipped to the Tacoma smelter. In 1959, 140,972 tons of ore was milled.

Development work comprised 5,317 feet of drifting, 144 feet of crosscutting, 652 feet of raising, and 13,487 feet of diamond drilling. The Queen shaft was sunk from a point 5 feet below No. 36 level to a point 91 feet below No. 37 level, a total distance of 234 feet. Stations were cut at Nos. 36 and 37 levels. Crosscuts were completed to the 79 vein on Nos. 24 and 34 levels and to the 77 vein on Nos. 34 and 35 levels during the year. Drifting on the 77 and 79 veins continued to develop ore of good grade on the lower levels.

Control of temperature and atmospheric conditions presents difficult problems at the deeper levels of the mine. In the working places and development drifts below No. 26 level, temperatures range between 80 and 90 degrees, with relative humidities ranging from 80 to 90 per cent. The mine is ventilated by mechanical means.

The intake air enters the mine via the main adit at No. 8 level and other surface openings. Two Aerofoil G.E.C. 48-inch dual-duty fans operating in parallel on No. 25 level draw this air downward from the upper workings at a rate of approximately 85,000 cubic feet per minute. It passes through a set of cooling-coils and then down the Queen shaft. During the year the airways in the Queen section were improved, and booster fans were installed at Nos. 32, 33, and 35 levels, resulting in an increased circulation of air in these workings. The exhaust air from the mine is controlled by two fans. A Jeffery fan on No. 26 level is used as a booster fan to the main exhaust fan that is located in the 300 adit at the top of the Empire shaft.

In order to provide cooler air for the present workings and future deep-level developments, the company commenced in the summer of 1957 to drive an entirely new ventilation raise from the surface down to No. 25 level, a vertical distance of about 3,000 feet. A pilot raise was driven and was later slashed to the full size of 12 feet in diameter. By the end of 1959 the raise had been slashed to full size over all but 350 feet of the total length. The ventilation raise connects with the surface at the old Blackbird portal at No. 4 level. A blowing-fan is to be installed at the surface to force cool air down the raise to No. 25 level. When this system is in full operation, it should produce a marked improvement in atmospheric conditions on the deeper levels.

The number of men employed was 305, of whom 244 were employed underground. A total of twenty compensable accidents were reported during the year, of which two were fatal. On August 18th Victor E. Warren was killed as a result of a fall of rock in the Queen shaft sinking. On October 14th Willi W. Greiser fell to the bottom of the Crown shaft from No. 26 level, following a misinterpretation of a shaft signal, causing the cage to be raised as Greiser was stepping out. The circumstances of these accidents are described in detail elsewhere in this Report. The general rate for all lost-time accidents shows an 11.8-per-cent decrease on the 1958 rate.

A safety organization is maintained at the property, and regular safety meetings and inspections are carried out.

Pioneer Division.-The Pioneer mine is on Cadwallader Creek 2 miles southeast (upstream) from Bralorne. It is 78 miles by road from Lillooet. Production from Pioneer has come mainly from two veins-the Main vein, which was mined from the surface down to No. 26 level at a depth of 3,216 feet below the surface, and the 27 vein, which is a blind vein and does not extend far above No. 16 level. The bulk of production since 1948 has come from the 27 vein, which at present is being mined in stopes from No. 25 to No. 29 level.

The mine is worked from three shafts. The No. 2 shaft extends from the surface to No. 26 level, the No. 3 shaft from the surface to No. 25 level, while the No. 5 shaft is an inclined three-compartment winze extending from No. 25 to *No. 30* level.

The following is a summary of development work: Drifting, none; crosscutting, 2,120 feet; raising, 612 feet; diamond drilling, 18,180 feet. The No. 5 shaft was deepened a distance of 92 feet to No. 30 level. A horizontal slot pocket 56 feet in length was excavated at this level, and a short crosscut was driven to intersect the 27 vein. The majority of the crosscutting was done on No. 29 level for the purpose of establishing diamond-drill stations. Extensive exploratory drilling was done from this level.

Ore is mined mainly by cut-and-fill stoping methods, the stopes being backfilled with sands from mill tailings. In the mill the ore is treated by cyanidation. In 1959, 79,652 tons of ore was milled.

The mine is ventilated by a 48-inch-diameter Jeffrey Aerodyne fan which delivers 70,000 cubic feet of air per minute from surface down a ventilation raise to the top of No. 5 shaft and from there down the shaft to No. 29 and No. 30 levels. Air is circulated through the mine workings and is upcast through No. 2 and No. 3 shafts. Although most of the active workings in Pioneer are between 3,000 and 3,600 feet below the surface, the air temperatures are much lower than in the Bralorne workings. In the stopes they range from 60 to 70 degrees, while the average relative humidity in the stopes is 85 per cent.

The number of men employed at the mine was 228, of whom 138 are employed underground. A total of twenty-two compensable accidents were reported in 1959. A fatal accident occurred on January 20th when Karl Kronseth was killed by the accidental discharge of his rifle while patrolling the company electric-power lines. A report on this accident is given elsewhere in this Report. The general rate for all lost-time accidents shows a 25-per-cent increase over the 1958 rate. A safety organization is maintained at the property and regular safety meetings and inspections are held.

[Reference: *Minister* of Mines, *B.C.*, Ann. Rept., 1958, pp. 15–21.]

Bridge River United Miner Ltd.

Company office, 301, 744 West Hastings Street, Vancouver 1. Raymond R. Taylor, president and engineer in charge. Capital: 4,500,000 shares, no par value. This company controls twenty-one Crown-granted claims and fractions on the lower reaches of Hurley River, extending for a distance of 2 miles up the river from a point 1% miles above Gold Bridge. The property includes the Ural, Forty Thieves, and Why Not claims, which were first located in 1896 and 1897. Intermittent exploration work, both surface and underground, has been done for many years on these claims, which lie on the east side of the deep and rugged canyon of Hurley River. The claims are underlain mainly by andesite and diorite of the Bralorne intrusives, bounded on the west by an outcrop of serpentinized pyroxenite. Quartz-filled fractures occur in the andesites and diorites, some of which have been traced for over 900 feet. These veins in places contain gold values, but the vein matter has hitherto not generally been found to be of ore grade. A number of adits have been driven at various points at the foot of the canyon bluffs to explore the Forty Thieves, Why Not, Jewess, and other veins which outcrop either close to or on the canyon bluffs. Until the present company began work this year, the property had been dormant since 1946.

The road from Gold Bridge up the Hurley River to the Ural tunnel was rehabilitated, and the road was extended a further three-quarters of a mile along the bottom of the river canyon to the foot of the Why Not bluffs. A total of 700 feet of bulldozer stripping was done on the Ural and Why Not claims. It is reported that the surface showings of the Why Not vein were extended 350 feet to the north, that the " B " vein was uncovered in a cut 12 feet deep in the northeast corner of the Ural claim, and that the Forty Thieves hangingwall vein was exposed in a trench 8 feet deep on top of the Ural bluffs.

Geological examinations were made. Two men were employed in addition to sub-contractors. Further work is contemplated next year.

[References: Minister of *Mines, B.C.,* Ann. Rept., 1946, pp. 106–112; Cairnes, C. E., *Geol. Surv., Canada,* Mem. 213, 1937, pp. 88–91.]

Gold-Antimony

Hurley River Miner, Ltd.

Company office, Box 305, Lillooet. President, Paul Polischuk, Bralorne. Capital: 250,000 shares, 10 cents par value. This company controls two properties in the Bridge River area. The first comprises a group of fifty-six claims in the general area northwest of Hurley River about 2½ miles west of Bralorne. The claims extend on either side of Gwyneth Lake and for 1% miles southwest of the lake. The other property comprises fifteen claims on Truax Mountain, 5 miles northeast of Bralome.

The Gwyneth Lake claims are approached by the road from Bralorne by way of the Alma prospect and the Hurley damsite. The claims are largely underlain by argillaceous, limy, and volcanic rocks of the Hurley formation, with some granitic intrusives immediately to the east of Gwyneth Lake. The showings include a lode heavily mineralized with stibnite two-thirds of a mile south of the south end of Gwyneth Lake and a number of quartz veins, the most promising of which is three-quarters of a mile southwest of Gwyneth Lake.

The claims on Truax Mountain were located on June 27th; the showings are reported to comprise a shear zone mineralized with stibnite and a quartz vein carrying some gold values.

Two men worked steadily on these properties from April 15th to October 30th. Additional men also worked part time. Approximately 9,000 feet of stripping was done with a bulldozer and over 300 feet of trenching was done by hand. Trail-building, general prospecting, and mapping were also done. The work was under the supervision of V. M. Polischuk.

HIGHLAND VALLEY *

Copper

Trojan Consolidated Mines Ltd. (50° 120" N.W.) Company office, 809, 837 West Hastings Street, Vancouver 1. T. H. Wilkinson, president. This company holds about 100 claims and fractions north and east of the south peak of Forge Mountain. From January until April the property was optioned to Newmont Mining Corporation of Canada Limited. Work done by this company consisted of dewatering the shaft, installing a temporary bulkhead 20 feet above the bottom, and drilling three diamond-drill holes from the shaft bottom. A crew of thirteen me" was employed.

In August the property was optioned by Rio Tinto Canadian Exploration Limited. Work done by this company was supervised by L. B. Gatenby and included geological, geochemical, and geophysical surveys. A crew of three to six me" was employed.

Bethlehem Copper Corporation Ltd. (50° 120" S.W.) Company office, 814, 402 West Pender Street, Vancouver 3. H. H. Huestis, president; W. C. Nancarrow, mine manager. This company holds about 155 claims and fractions immediatelv east of Ouiltanton, (Divide) Lake, about 30 miles by road southeast of Ashcroft. A programme of underground exploration begun in 1958 was completed in September. A" adit driven due east at 4,600 feet elevation penetrated the Jersey and East Jersey zones at average depths below bedrock surface of 260 and 350 feet respectively. These zones were further explored by drifts to north and sooth, by crosscuts parallel to the adit, and by percussion and diamond-drill holes at 50-foot intervals from the drifts. All muck from underground was sampled in ten-car (15-ton) lots in a sampling plant of 250 tons daily capacity. Three samples were obtained from each lot by crushing and riffling of (i) a large shovelful from each car, (ii) two pieces of rock from each car, and (iii) the total contents of nine of the ten cars, the other carload being placed on a separate ore dump for future metallurgical testing. The sludge from the percussion holes was passed through a rotating splitter, and about one-fifth of the resulting sample from each 4-foot length was retained for assay. To afford comparison between the results of the sampling methods, a percussion hole was drilled ahead of each face. Work done underground during the year included 3,277 feet of crosscutting, 3,706 feet of drifting, 22,766 feet of long-hole percussion drilling, and 941 feet of diamond drilling. Less than half the workings is timbered. Up to September, about fifteen me" were employed by Bethlehem and thirty-five by Intermountain Construction Ltd., which held the tunnelling contract. I" November the company published estimates by its consulting engineers, giving the Jersey zone 48,500 tons per vertical foot of material grading 0.70 per cent copper and the East Jersey zone 15,890 tons per vertical foot of material grading 1.15 per cent copper.

The property is in the Guichon batholith. The Jersey zone is about 1,100 feet west of the East Jersey zone, and both zones are close to a large mass of younger (Bethlehem) quartz diorite that occupies the hill to the south. An arm of younger quartz diorite extends northward between the zones and swings westward into and around the north part of the Jersey zone.

* BY J. M. Carr.

The Jersey zone is roughly circular and, on the 4600 level, is about 800 feet wide as outlined by a pyrite halo. In east-west section through the centre of the zone, older (Guichon) quartz diorite is enclosed by a goblet-shaped mass of porphyry whose stem continues beneath the deepest drilling at about 4,000 feet elevation. Breccia occurs at some of the porphyry contacts and is believed to have formed explosively due to high fluid pressure in quickly cooled, semi-solid porphyry. A west-dipping fault trends north through the western part of the zone, which is heavily fractured throughout. The rocks are kaolinized, sericitized, silicified, and chloritized. Chalcopyrite. and bornite are disseminated in the rock and occur in fractures and quartz veins.

The East Jersey zone is about 1,100 feet long on the 4600 level and has a width ranging from about 60 to 250 feet. It strikes north with a gentle westward concavity, approximately parallel to the adjacent younger quartz diorite. Few of the surface diamond-drill holes extend below the level, so that the zone is not well known in depth. Apparently it dips steeply west. Mineralization is principally in older quartz diorite and breccia, which is associated with irregular porphyry sheets of no great thickness. The later of two other porphyry phases has caused a widespread introduction of orthoclase. Other minerals developed prior to the sulphides include tremolite-actinolite, epidote, chlorite, quartz, and tourmaline. Bomite and chalcopyrite chiefly occur on or near faults, as veins and lenses with specular hematite and calcite. Most mineralized faults and veins strike northeastward and dip more or less steeply. The northern part of the zone is approximately bounded on the. east by a prominent, poorly mineralized fault which strikes north and dips west.

Cadamet Mines Limited

(50° 121" S.E.) Company office, 601,250 University Avenue, Toronto. H. E. Martin, president. This company holds about seventy-four claims and fractions in the Lucy-Louise and Divide groups, which are west and south of Quiltanton Lake respectively. The property was formerly held by Graham Bousquet Gold Mines Limited, which did geophysical and geochemical work and trenching in 1956. The property was then optioned to M. A. Cooper, who did bulldozer trenching across all the favourable magnetic anomalies. Small amounts of sulphide were exposed by the trenching, particularly in the eastern part of the Divide group south of the Bethlehem property, but copper sulphides were extremely rare and sampling gave poor results.

Minex-Amador (Kennco Explorations (Western) Limited)

(50" 120" S.W.) Company office, 1111, 1030 West Georgia Street, Vancouver 5. J. A. Gower, manager. In 1959 this company optioned about seventy claims and fractions held jointly by Minex Development Ltd. and Amador Highland Valley Coppers Ltd. The property surrounds the summit of Gnawed Mountain, which is 4 miles south of Bethlehem Copper property. The option was dropped before the end of 1959. Work done included geological and geochemical surveys and electrical prospecting, together with trenching and 148 feet of diamond drilling. An average crew of six men was employed from June to August, inclusive, under the supervision of R. W. Stevenson.

In the Gnawed Mountain area Bethsaida granodiorite intrudes Skeena quartz diorite or granodiorite, and is marginally chilled to quartz porphyry. Breccia bodies up to 2,000 feet in length occur in both the older and younger rock, mostly near their contacts. Porphyritic quartz monzonite forms small intrusive bodies in Skeena quartz diorite, though apparently not in Bethsaida granodiorite, and is cut by quartz porphyry dykes. Copper minerals occur in small amounts in much of the area, partly in quartz veins which cut the breccia and adjacent rocks.

MERRITT*

Summary.†—Preliminary geological mapping was done in 1959 of an area of about 24 square miles, extending south and west from the Craigmont mine. The following account summarizes the main geological features so far recognized in this area.

The Craigmont orebody is in stratified rocks of the Nicola group (Triassic) adjacent to the Guichon batholith, whose margin strikes westward in contact with Nicola rocks for a distance of about 2 miles from Craigmont, then west-southwestward for a similar distance to the limit of mapping on Indian Reserve No. 9. At this point, volcanic rocks of the Spence Bridge group overlie the Nicola rocks and probably also the batholith. Beyond this point the margin of the batholith is believed to trend northwestward. Stratified Nicola rocks outcrop widely about 1 mile to the southwest of Craigmont, nearer to which are volcanic rocks that overlie part of the orebody and are assigned to the Kingsvale group.

The Nicola rocks include limestone, limy tuff, argillite, greywacke, lithic and vitric tuffs, agglomerate, and andesite. They dip predominantly steeply and possess a regional strike which varies in accordance with the strike of the margin of the batholith. Marker beds have not been identified and fossils were seen at only two localities. The limy rocks mainly occur in as many as seven belts which extend across the outcrop area and are parallel to the regional strike. The apparent average width of each of the predominantly limy belts is as much as 500 feet. Whether the belts are structural repetitions of one or more stratigraphic units is unknown. Another parallel belt of distinctive lithology consists of red feldspathic tuff and agglomerate about 2,000 feet wide. This broad belt encloses several much narrower belts of andesite. Two of the liiy belts lie to the north and the others lie to the south of the red feldspathic tuff.

Correlation of the rocks at Craigmont with those mapped elsewhere is quite uncertain. The regional strike pattern suggests that correlatives of the mine rocks may exist to the north of the belt of red feldspathic tuff and agglomerate, whose northern margin passes 2,000 feet to the south of Lookout Point.

Craigmontt (Birkett Creek Mine Operators Ltd.) (50" 120° S.W.) Head office, 700, 1030 West Georgia Street, Vancouver 5. R. G. Duthie, superintendent, Merritt; C. C. Rennie, resident geologist. This company controls ninety claims and fractions owned by Craigmont Mines Limited. The Craigmont orebody is on the Merrell Nos. 7 and 8 claims and the McLeod Nos. 5 and 6 claims, and is south of the north fork of Birkett Creek at surface elevations between 3,800 and 4,200 feet.

By November, 1959, the total work completed at Craigmont since the discovery of the orebody in 1957 included about 8,000 feet of drifting and crosscutting, 50,000 feet of surface and underground diamond drilling, and stripping of 100,000 cubic yards of overburden. In 1959 seventy-two men were employed, including diamond drillers on contract. The 3500 level adit was continued to a distance of 3,446 feet from the portal. At about 1,325 feet the direction of the adit was changed from north 70 degrees west to north 82 degrees west, which is the principal strike of the orebody. Six crosscuts totalling about 1,350 feet in length were driven southward at ZOO-foot spacings, except in the case of the extreme easterly and westerly ones, which were spaced at 400 feet (Fig. 3). Four were scraper crosscuts which penetrated the orebody and two were terminated at its north wall. In June a second adit was started on a bearing north 50 degrees west from a portal-

* BY David Smith, except as noted.
† By J. M. Carr.

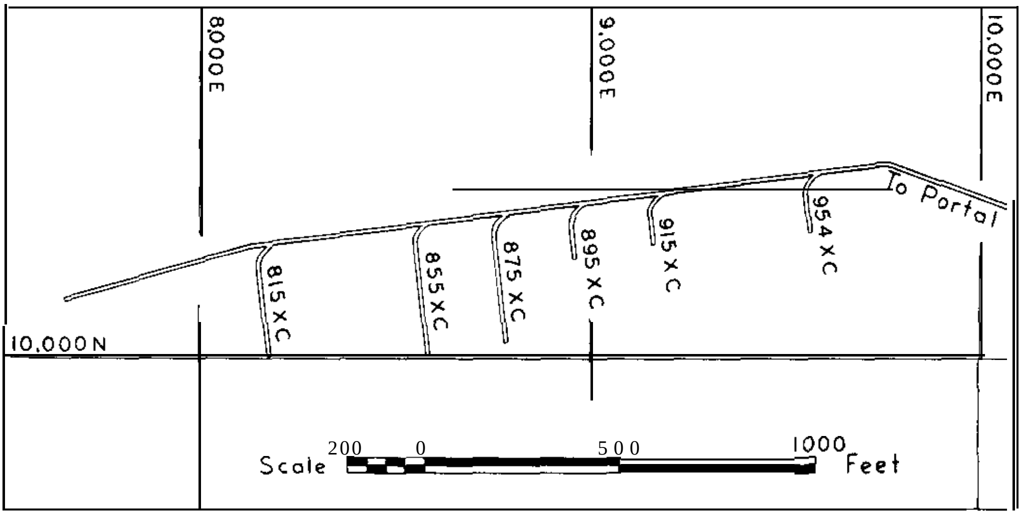


Figure 3. Part of 3500 level, Craigmont mine.

site at 3,046 feet elevation at the junction of the north and south forks of Birkett Creek. The direction of this adit was changed to more westerly at a distance of about 2,250 feet from the portal. By the end of the year the adit was about 3,700 feet long, with the face approximately abreast of the panel containing No. 895 crosscut. Exploratory diamond drilling was done from both levels and from the surface. To aid drilling, the overburden was stripped to depths which in places exceeded 20 feet.

Exploration from the surface and the 3500 level has shown that the Craigmont orebody possesses a very irregular outline both in plan and vertical cross-section. The present lack of an accepted stratigraphic sequence for the rocks at the mine hinders structural interpretation and makes correlation of mineralized sections somewhat uncertain. On the 3500 level, copper mineralization is virtually continuous for a length of 2,200 feet, with widths ranging from less than 10 feet to more than 200 feet. The strike is principally about north 82 degrees east, but becomes northerly at the extreme east end of the orebody on this level. The hook-like shape of the east end of the orebody is reflected in the plan of the magnetic anomaly above the orebody. For a distance of 500 feet from the east end on the 3500 level, the orebody is narrow. Thereon it widens westward and achieves a maximum width in the vicinity of No. 875 crosscut. At its west end on this level, the orebody appears to split or to consist of two separate sections. Work on the 3000 level is reported to suggest a possible splitting of the orebody on that level. In vertical sections the orebody appears to narrow toward the surface. Above the 3500 level its dip is mainly southerly at steep angles.

Successively from the portal, the 3500 level adit intersected glacial drift, dark-green tuffs, and 570 feet of quartz diorite. Skarn containing the hook-like east end of the orebody was then intersected at a point east of the bend in the adit. The skarn is in faulted contact with quartz diorite and is intersected for a length of about 110 feet. This length includes about 42 feet of magnetite-rich skarn, part of which contains an estimated 1 per cent copper. Thereafter, westward, the adit intersected variously greywacke, quartz eye tuff, and quartz diorite. These rocks form the north wall of the skarn zone and are mineralized in places with small amounts of pyrite and chalcopyrite. They are succeeded in the adit by a mineralized section of skam which is part of the west end of the orebody. The section is about 40 feet long and is 200 feet from the face of the adit. It is succeeded by unmineralized beds which strike north of west and dip steeply, mostly to the north. The beds include banded limestones with dragfolds.

In the crosscuts on the 3500 level, the above-mentioned rocks on the north wall are separated from the orebody by skarn whose width ranges from zero to 30 feet. Wallrocks on the south include andesite, quartzofeldspathic tuff, banded siliceous rocks, and, to the east, quartz diorite and skarn.

Within the orebody, sections predominate which are heavily replaced by iron oxides. The original rocks are recognizable only in places. They include garnet- and epidote-rich skarns, rocks rich in hornblende and chlorite that may be andesite or skam, dark limy tuffs, non-limy rocks which are probably quartzofeldspathic tuffs, and quartz diorite. Some irregularly banded, non-limy, crystalline rocks of uncertain origin are rich in quartz and pink feldspar. Banding and lamination in the rocks are mostly subparallel to the strike of the orebody and the dips are mostly steep. In some heavily mineralized sections, disconnected lenses of quartzofeldspathic composition occur in trains which appear to preserve resemblances of complex crumples or dragfolds. Such lenses are commonly impregnated with pink feldspar, similar to greywacke in parts of the north wall of the orebody.

The principal metallic minerals are specularite, magnetite, and chalcopyrite. Pyrite is rare and bornite has been observed in small amounts only near the eastern end of the orebody. Because the specularite also is partly magnetic, the amount of magnetite present is difficult to estimate underground, except in the eastern part of the orebody, where it visibly exceeds specularite. The magnetic susceptibility of the iron-rich skarn varies even within distances of a few inches, and in several places was observed to increase near lenses of chalcopyrite. The texture of the iron-rich skarn lacks uniformity, mainly because of changes in the prevailing size of the specularite crystals. These range from fine grained to as much as one-half inch in diameter. Chalcopyrite is partly or wholly later than the iron oxides. It forms lenses, pods, blebs, and disseminations. Some lies in or near small faults, but the remainder is less clearly related to fractures. In places the chalcopyrite occurs preferentially in or along orthoclase-enriched relics of the original rock. Rocks not heavily replaced by iron minerals, and showing banding, may contain chalcopyrite partly as lenses and streaks which are parallel to the banding. The gangue consists principally of unreplaced rock and skarn, together with small amounts of white crystalline calcite, some of which occurs as veins predating chalcopyrite. Chlorite is abundant in some rocks and also on fractures containing metallic minerals. Only a few conspicuous faults were seen on the level, none of which were in contact with the ore. Faults which pre-date the iron mineralization are diicult to identify in the heavily replaced sections. Of many small faults which preceded and followed chalcopyrite mineralization, those with northeasterly strikes are the most numerous.

The 3000 level adit penetrated 230 feet of glacial or fluvioglacial deposits, 420 feet of volcanic and pyroclastic rocks assigned to the Kingsvale group, and 1,200 feet of dark-green tuffs of the Nicola group, followed by quartz diorite. By the end of 1959 the adit was reported to have intersected obliquely a mineralized section before entering andesite.

In August, removal of overburden on the south wall of the western part of the orebody had exposed bedrock intermittently in an area about 800 feet long in an easterly direction and 90 feet in maximum width. Exposures resulting from later stripping were not examined. The area seen is directly above the four most westerly crosscuts on the 3500 level, at elevations decreasing from approximately 4,200 to 4,000 feet from west to east. The exposed rocks are mainly quartzo-feldspathic tuffs. They contain low-grade mineralization consisting of specularite veins, with some malachite, and disseminated chalcopyrite and malachite. Exceptionally deep overburden was encountered about 140 feet to the east of a point vertically above the most westerly crosscut, and may indicate the position of a low-angle fault suspected to occur in surface diamond-drill holes Nos. 22 and 24. This fault may dip east of south. Approximately above No. 855 crosscut the quartzofeldspathic tuffs are dissected by numerous barren veins of coarsely crystalline white calcite, most of which strike eastward with steep dips, To the north of this zone are rocks which include slightly mineralized andesite, skarny tuff, and crystalline quartzofeldspathic rocks containing orthoclase. About 100 feet to the east of the projected position of the same crosscut, wide veins of specularite with malachite were exposed for distances of 40 feet easterly and up to 20 feet northerly. The host rock is skarn or andesite. About 110 feet to the east-northeast of these exposures, and almost vertically above No. 875 crosscut on the 3500 level, a dark, iron-stained, well-jointed tuff containing small amounts of malachite and some thin seams of specularite was exposed. About 110 feet farther east this non-limy rock is succeeded by limy tuff at a contact which probably strikes east of north. Except for veinlets of specularite, no mineralization was seen in the exposed 20-foot section of limy tuff. The most easterly exposures examined were about 150 feet to the east-northeast of this section, and are of skarn, or possibly altered andesite, containing disseminated chalcopyrite.

Betty Lou and Lou* (Canex Aerial Exploration Ltd.)

(50° 120° S.W.) Company office, 700, 1030 West Georgia Street, Vancouver 5. J. D. Simpson, president. Thii company holds twenty-nine claims and fractions in the adjoining Betty Lou and Lou groups at Lookout Point in the Promontory Hills. Work in 1959 consisted of prospecting and geological mapping. A small crew was employed during September and October under the supervision of Clive W. Ball.

Copper

Aberdeen Group (Torwest Resources Limited)

(50° 120° S.W.) This property on Broom Creek, 11 miles north of Lower Nicola, consists of the Aberdeen and the Westlock Crown-granted claims and the Crown 21 to 28 recorded claims. The Aberdeen is an old property on which mining was carried out many years previously. A 250-foot vertical shaft had been sunk, and upward of 1,800 tons of copper ore mined and shipped. In 1959 Torwest did some surface excavation by bulldozer, exposed the old workings, and drilled several holes in the immediate vicinity of them.

The underground workings were pumped out, manways were retimbered, and the workings surveyed. Channel samples were taken where possible, and 20-foot test-holes were drilled into the walls of the drifts to obtain sludge samples. The mine has since been allowed to flood.

Electromagnetic and self-potential surveys were carried out on the property. Two surface diamond drills drilled a total of 5,024 feet. An average of twelve men was employed under the supervision of M. K. Lorrimer.

* By J. M. Carr.

Vimy Ridge (Vimy Explorations Ltd.) (50° 120° S.W.) Company office, 400, 837 West Hastings Street, Vancouver 1. W. Garnett, president. This property includes the old Vimy Ridge showings and consists of the following claims: Bomite 7 to 20 (inclusive), Bornite 34 to 39 (inclusive), Bomite 40, 41, and 42, Jot Fraction, Vimy Fraction, H.C.S. Fraction, and H.C.R. Fraction. It is a short distance north of the Aberdeen, and is reached by the same road. Work on the property consisted of trenching and a limited amount of diamond drilliig, under the supervision of W. Taylor.

Noranda Exploration Company, Limited.-British Columbia office, 202, 2256 West Twelfth Avenue, Vancouver 9. B. 0. Brynelsen, manager. In 1959 this company held by record or by option a large number of claims in the Merritt area and did work on the following groups:-

(a) AX *and Shirley.-(50” 120° S.W.)* This property consists of twenty-four claims held by option from E. M. Chase and partners and includes the AX 1 to 16 and the Shirley 1 to 8 claims. It is 1 mile northeast of Merritt and extends uphill from the highway. Three men were employed during the months of June and July under the supervision of W. I. Nelson, Jr. The work included magnetometer and electromagnetic surveys and the preparation of a geological map. The option was dropped.

(*b*) Merritt *Property*.—(50° 120” S.W.) This property consists of 135 claims and fractions held by Noranda and adjoins the Craigmont property on the south and southeast. Assessment work in the form of road construction, trenching, and a magnetometer survey was carried out in 1959. One vertical diamond-drill hole was drilled 200 feet on the Chip No. 8 claim.

(*c*) *H.W.D.*—(50° 120” S.W.) This property consists of twenty claims held by option from H. W. Darling. The claims, the H.W.D. 1 to 20, lie just north of the Lower Nicola Indian Reserve on the Mamit Lake road. Some trenching was done by bulldozer.

(*d*) *Hoo*.—(50° 120° S.W.) This property consists of the Hoo 1 to 4 claims, 1 mile north of Garcia Lake, 6 miles from Merritt on the Princeton Highway. An electromagnetic survey was carried out on the property.

(*e*) *Quilchena Property*.—(50° 120° S.W.) This property consists of fifty-five claims located by Noranda and lying midway between Courtney and Minnie Lakes. Three men were employed during the months of April, May, and June. An electromagnetic survey was carried out, some soil sampling was done, and several trenches were dug by bulldozer.

(*f*) *Mano Property*.—(50° 120° N.E.) This property consists of the Man and Mano group of claims and lies 1½ ‘miles northwest of Shumway Lake. A diamond-drill hole investigating an air-borne electromagnetic anomaly intersected a low-grade coal deposit which was assumed to be responsible for the anomaly.

(*g*) ***Aspen*** Grove ***Property.-(49”*** 120” N.W.) This property consists of a large number of claims held by the company and by option from G. S. Eldridge. It extends south of Courtney Lake in the general vicinity of Tule Lake, east of the highway about 15 miles southeast of Merritt. Electromagnetic and magnetic surveys carried out in January, February, and March indicated a large anomaly. Subsequent diamond drilling encountered thin coal beds which were believed to be responsible for the anomaly. Further diamond drilling was done and some trenching and stripping.

Salem (The Consolidated Mining and Smelting Company of Canada, Limited). — (49” 120” N.W.) This property is 2 miles north of Kingsvale on the south side of Salem Creek. It consists of thirteen claims-the Salem 1 to 12 held by record, and the Pine 1 optioned from W. J. Larsen. Five men were employed in doing 1,150 feet of diamond drilling. D. W. Heddle was geologist in charge.

SWAKUM MOUNTAIN*

Copper

Torwest Resources Limited (50° 120" S.W.) Company office, 400, 837 West Hastings Street, Vancouver 1. W. E. Garnett, president; W. H. Taylor, resident manager. The property is at the top of Swakum Mountain, 12 miles north of Nicola, and is reached by a motor-road up Clapperton and Shuta Creeks, It consists of Mineral Leases 3 and 4, the former Crown-granted Alameda group; Mineral Lease 5, the former Crown-granted Corona group; and Mineral Lease 6, the former Crown-granted Complex group; and 176 claims held by record. The property includes a number of old showings, chiefly the Lucky Mike, Thelma, Alameda, Last Chance, and Gold Gozzan, upon which work has been done intermittently since the first discovery in 1916. In 1958 extensive trenching and diamond drilling in the area north of Swakum Peak was done by the present company, which acquired the property in 1958.

References to previous work are contained, under the old property names, in the Annual Reports for 1917, 1924-26, 1928-30, 1934-35, and 1958, and in Memoir 249 of the Geological Survey of Canada.

The rocks are lavas, tuffs, and conglomerate. The section, as exposed in trenches and outcrops northwest of Swakum Peak, shows an older andesite porphyry exposed for a thickness of 150 feet, overlain by 450 feet of basalts, overlain in turn by lithic and crystal tuffs with minor intercalated limestones. This last member is faulted, but it is at least 300 feet thick and probably is considerably thicker. At the top of Swakum Mountain and to the east of it the tuffs are overlain by a conglomerate. The map accompanying Memoir 249 (Nicola Sheet) indicates only rocks of Nicola age, but the conglomerate bears some lithologic resemblance to the Lower Cretaceous Kingsvale conglomerate exposed west of Guichon Creek. Although quartz porphyry dykes have been reported, no definitely intrusive rocks were recognized. Garnet-epidote skarn is developed in limy tuffs near limestone lenses and as localized patches in many other tuff beds.

The beds immediately north of Swakum Peak strike about north 5.5 degrees east and dip southeastward. The dips steepen from about 30 degrees at 2,000 feet northwest of the peak to 80 degrees immediately east of it. From about 2,500 feet north of the peak to the end of the trenching, which is some 5,000 feet north, the structure is anticlinal, illustrated by the distribution of bedding attitudes and of rock types in drill cores. The axis strikes about north 10 degrees east and passes immediately west of the old Last Chance workings.

To explain this sudden northward change in structure, a fault is postulated striking about north 80 degrees east and crossing about 2,500 feet due north of Swakum Peak. The only direct evidence of such a fault are crushed zones in the cores of two drill-holes, the distribution of limestone on surface and in drill cores, and anomalous bedding attitudes in the vicinity. The horizontal shift would necessarily be at least 3,000 feet, with the southeast side moving southwest. No flow rocks were recognized in exposures north of this presumed fault. A prominent fault striking north 40 degrees east and dipping steeply southeast is exposed in four trenches for a distance of 1,700 feet. It is a strike fault and follows a bed of carbonaceous tuff. The direction and amount of movement on this fault are not known. On the west side of the trenching a sudden change on strike from andesite

* By N. D. McKechnie.

porphyry to basalt takes place across a gully which possibly represents a fault striking north 25 degrees east.

Mineralization is chiefly pyrite, pyrrhotite, and chalcopyrite, with local sphalerite, galena, and scheelite, and occurs either with quartz in small shears and fractures or disseminated in skarn and limy tuffs.

At the west side of the trenching 1,500 feet northwest of the peak, two narrow quartz veins in shears have been opened by an adit and a 15-degree inclined shaft in the face of a cliff. One shear strikes north 75 degrees west, dips 80 degrees north, and contains quartz, pyrite, chalcopyrite, and a little magnetite over a width of about 2 feet. The other, 150 feet to the north, is a thin, drusy quartz stringer striking north 50 degrees east and dipping 20 degrees northwest, and contains pyrite, chalcopyrite, and galena. The wallrocks are basalt. On the east side of the trenching, on the boundary between the Old Alameada and Old Alameada No. 1 claims, the Alameada shaft was put down many years ago on a northerly striking mineralized shear or fracture dipping about 45 degrees to the west. The shaft and surrounding pits have been caved for many years. Spoil on the dump is quartz with pyrite, galena, sphalerite, and chalcopyrite. The shaft is reported to have followed a 2-foot

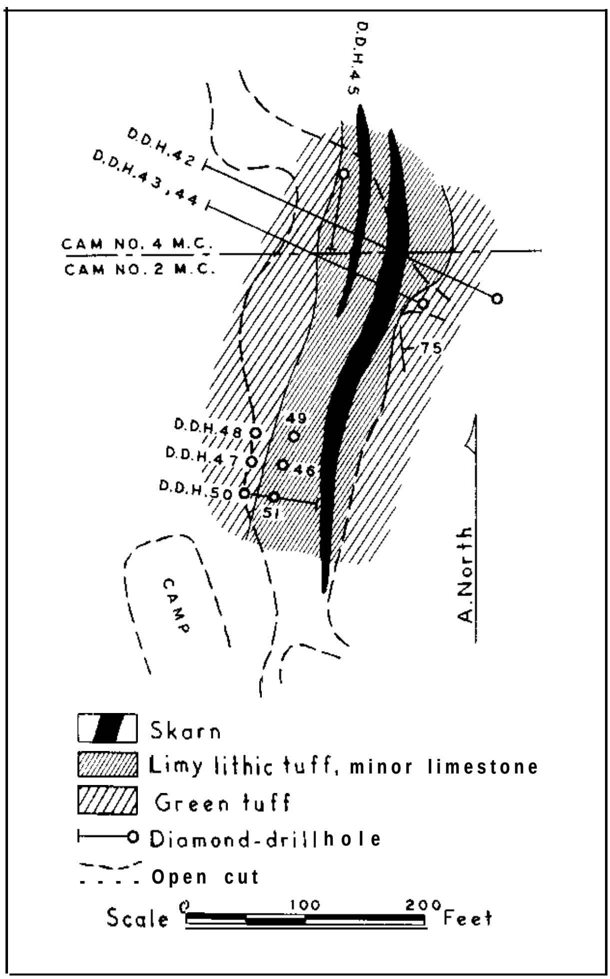


Figure 4. Last Chance showing, Swakum Mountain.

vein to a depth of 125 feet in limy tuffs. A hole drilled by Torwest intersected a quartz stringer containing abundant pyrite and some sheared rock 140 feet to 150 feet below the shaft, about on the reported dip of the vein. There was no limestone in the drill core.

The principal showing is the one known for many years as the Last Chance. It is 4.000 feet on a bearing of north 15 degrees east from Swakum Peak and is on (he boundary between-the CAM No. 2 and CAM No. 4 mineral claims. Scheelite occurs in the skarn in small quantities and is usually not recognizable without the aid of an ultraviolet lamp. Sampling for tungsten content was done by diamond drilling in 1943 (Memoir 249) as a part of the national programme to obtain tungsten supplies. The geology, with the holes drilled since the sampling drilling, is shown in Figure 4. The occurrence consists of two lenses of skarn enclosed in limy tuffs and limestone, striking a little east of north and dipping 50 to 75 degrees east. The skam consists chiefly of red garnet and is erratically mineralized with pyrite, pyrrhotite, and chalcopyrite. Repetitions of tuff beds in holes 42, 43, and 44 indicate that the showing is on the east limb of an anticline, the axis of which is about at the west side of the trench. Though local concentrations of chalcopyrite occur, much of the skarn is very sparsely mineralized and the showing as a whole is not impressive. No drilling has been done along strike to north or south of the exposure.

About 700 feet south and west of the Last Chance showing a limy tuff, altered in patches to skarn, contains disseminated chalcopyrite. It is 10 to 15 feet thick, strikes north 10 degrees west, and dips 20 degrees southwest. Similar mineralization was encountered in a l-foot drill intersection about 200 feet along the strike and at what is probably the same horizon.

A self-potential survey made in 1958 indicated a series of high readings which appear to correspond to the trace of the faulted carbonaceous tuff bed. This method is sensitive to carbonaceous material.

All of the present showings appear to be limited in extent. If more exploration is contemplated, consideration might be given to delimiting the tuff-limestone horizon and testing it by geophysical and geochemical methods.

MEADOW CREEK*

Copper

Vanex (Vanex Minerals Limited) (50” 120” SW.) Company office, 902, 718 Granville Street, Vancouver 2. This property consists of 120 claims held by record in the Meadow Creek area, 25 miles north of Merritt. The claims are in the vicinity of Dupont and Homfray Lakes and are reached from the Guichon Creek–Kamloops road. A limited amount of surface work was done under the direction of H. Leach, geologist in charge, and preliminary geological mapping was carried out. Some diamond drilling was done to check a magnetic anomaly indicated by a survey made in 1958. An average crew of five was employed.

CHERRY CREEK*

Copper

Matt (Kennco Explorations (Western) Limited) (50° 120” N.W.) Company office, 1030 West Georgia Street, Vancouver 5. J. A. Gower, manager. The Matt group of twenty-eight claims is on the north slope of Greenstone Mountain. It is 6 miles due south of Cherry Creek siding on Kamloops Lake, and is reached by road from the highway 10 miles west of Kamloops. Five men were employed for one month,

* By David Smith.

under the supervision of C. S. Ney, doing surface prospecting and a limited amount of diamond drilling.

KAMLOOPS*

Copper

D.M. (Cadamet Mines Limited) (50° 120° N.W.) Company office, 601,250 University Avenue, Toronto. H. E. Martin, president. This company holds Efty-eight claims and fractions extending south from the Trans-Canada Highway about 10 miles west of Kamloops and surrounding the old Pothook mine and the Cliff and Gift Crown-granted claims. Work done consisted of three vertical diamond-&ill holes totalling 797 feet. The holes were spaced about 1 mile apart to the northwest, northeast, and southeast, respectively, of the Cliff and Gift claims. The property is partly underlain by rocks of the Iron Mask batholith. Recent geological mapping by E. Livingston, of New Jersey Zinc Exploration Company (Canada) Ltd., has shown this batholith to be intruded by feldspar porphyries with associated breccias. The northeasterly drill-hole is reported to have encountered subcommercial copper mineralization in porphyry and breccia.

[References: Minister of Mines, B.C., Ann. Repts., 1952, p. 115; 1956, p. 48; 1957, p. 31; 1958, p. 29.]

BIRCH ISLAND†

Fluorite-Celestite-Uranium

Rexspar Uranium & Metals Mining Company Limited (51° 119° N.W.) Head Office, 550 Sherbrooke Street, Montreal; mine office, Birch Island. J. W. Scott, manager. The Rexspar property is in the Red Ridge area, 3 miles south of Birch Island, a station on the Canadian National Railway 81 miles north of Kamloops. Activity on the property in 1959 was limited to several drill-holes placed to test the continuity of and to sample a zone of fluorite mineralization.

[References: Minister of Mines, B.C., Ann. Repts., 1957, pp. 31-32; 1958, p. 30.]

TULAMEEN‡

Iron

MAGNETITE IN LODESTONE MOUNTAIN STOCK

Magnetite has been known for many years to occur in the Lodestone Mountain stock. In 1959 most of the stock was reconnoitred to locate areas in which magnetite is most abundant, and two areas were explored in some detail to obtain indications of grade. Craigmont Mines Limited kindly supplied a copy of a magnetometric map of part of Tanglewood Hill.

The stock is 15 miles due west of Princeton. The north part is reached by the Tulameen River road above the community of Tulameen. The central and southern parts are reached by logging-roads extending from the old road to Blakeburn.

The stock mostly underlies high country, though it is incised deeply by the valleys of the Tulameen River and Britton Creek in the north and of Badger Creek in the south. The highest point is Lodestone Mountain, elevation 6,218 feet, to the northwest, west, and south of which a rolling upland, here called the Lodestone Plateau, lies between 5,500 and 6,100 feet elevation. Other eminences are Olivine Mountain, elevation 5,900 feet, and Grasshopper Mountain, 4,900 feet, facing each

* By J. M. Carr.
† By David Smith.
‡ By G. E. P. Eastwood.

other across the Tulameen River, and Tanglewood Hill, 5,500 feet, a rounded summit on a ridge extending east-northeast from Lodestone Plateau. The lowest point is 2,800 feet in elevation at the Tulameen River.

The central and southern parts of the stock are thickly mantled with glacial drift, and outcrops are generally small and widely scattered, The north part of Lodestone Plateau and the crest of Lodestone Mountain are fairly well exposed. The northwest face of Olivine Mountain is bluffy, but exposures on its flanks are scattered. Near the Tulameen River, bedrock is obscured by gravel terraces, but the actual channel exposes an almost continuous section across the stock. The south and west slopes of Grasshopper Mountain are fairly well exposed, but on the north slope, as on the north slope of Mount Britton, large areas are completely covered. Away from the river and Britton Creek, outcrops on Mount Britton are thinly scattered. Most of the area is fairly thickly timbered, but Lodestone Plateau and Mountain have extensive grassy meadows.

General Geology

The geology of the Tulameen area, including the northern two-thirds of the stock, was mapped by Charles Camsell in 1909–10.* The geology of the Princeton area, including the whole of the stock, was mapped by H. M. A. Rice in 1939–44.*

The stock was observed in contact only with rocks of the Nicola group, which it intrudes, and with small patches of conglomerate which overlies it. The Nicola group here consists predominantly of greyish-green pyroclastics and laws which Locally contain coarse feldspar phenocrysts; here and there some limestone or black phyllite and argillite is intercalated, As shown in Figure 5, the stock extends from the northwest base of Grasshopper Mountain to Arrastra Creek, a distance of 11 miles. It is 4 miles wide through Lodestone Mountain, narrowing to 2 miles through Grasshopper Mountain and to 1% miles near Arrastra Creek.

In general terms the stock consists of a large body of pproxenite enclosing one or possibly two bodies of peridotite-dunite, with feldspathic rocks occurring generally along the northeast edge and locally on the southwest edge. Peridotite and dunite were found to grade to pyroxenite in some parts of the stock and to be intrusive into it in other parts. Both pyroxenite and peridotite-dunite are intruded by the feldspathic rocks, and all three general rock types are cut by many diverse small dykes. The bulk of the magnetite is in the pyroxenite.

In more detail the distribution of the major rock types is irregular; therefore, to facilitate description the pyroxenite *is* arbitrarily considered as being in six bodies, referred to by number as designated in Figure 5. True pyroxenite is generally fine grained and rather dark in colour, but scattered outcrops were found of light-green pyroxenite and of medium-grained pyroxenite. Coarse amphibole, both light greyish-green and dark green to black in colour, is scattered through the pyroxenite and is locally concentrated into small lenses or bands of hornblendite. The pyroxenite in places also contains some black and white mica or vermiculite, especially within lenses of massive magnetite. Pyroxenite body No. 4 has been largely crushed and serpentinized, producing a dense rock which is mostly black but is locally green. Some familiarity with the rocks is required before the various manifestations of the pyroxenite can be confidently distinguished from Nicola volcanics, gabbro, or certain of the many dykes cutting the stock. Rarely, however, is the pyroxenite as fine grained as the volcanics or the same shade of greyish-green. Although normally coarse grained and containing pale-green feldspar, the gabbro is locally medium grained and contains bright-green feldspar, which is difficult to distinguish in the

* *Geol.* SW"., *Canada*, Mem. 26, pp. 32–88, 168; Mem. 243, pp. 33–34.

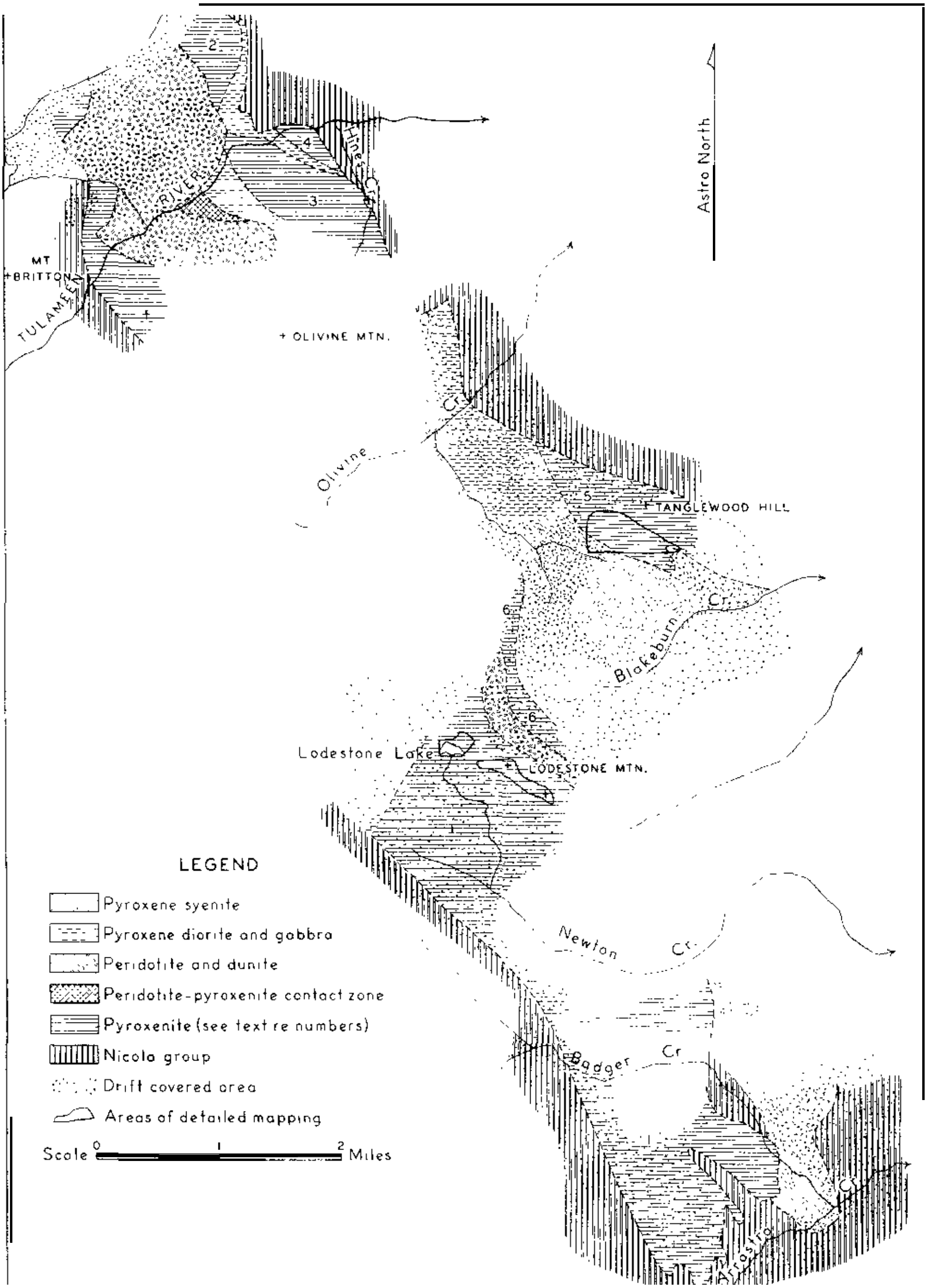


Figure 5. Lodestone Mountain stock, Tulameen.

field from bright-green pyroxene. This pyroxenite-like gabbro is, however, distinguished by the presence of grooved and polished hematitic coatings on slip surfaces and by very low magnetite content. Small bodies of pyroxenite and amphibolite occurring here and there in Nicola rocks may or may not be genetically related to the stock, but in any case they do not contain appreciable magnetite.

One large body of peridotite and dunite crosses Grasshopper Mountain and the Tulameen River and forms the steep northwest face of Olivine Mountain; it is here termed the Grasshopper peridotite. The peridotite and dunite are normally massive and fine grained to dense rocks, black, brownish-black, or bluish-black in colour. Usually they have a weathering rind about 2 inches thick which grades from grey within to yellowish-brown on the exposed surface. Usually the contact between rind and fresh rock is sharp. Along the river and Britton Creek the peridotite-dunite is variably altered to serpentine, both along fractures and between grains, releasing some secondary magnetite. Over the greater part of Grasshopper Mountains, however, the peridotite is generally fresh. At the river the contacts with pyroxenite are gradational in two respects. The pyroxenite acquires a little intergranular olivine as the main body of peridotite is approached, and it is laced with dykes, lenses, and innumerable fine wisps of peridotite. The northeast contact zone is well exposed, broad, and pronounced; the southwest contact is poorly exposed and exhibits fewer lenses and wisps of peridotite in pyroxenite. Elsewhere the contacts of this body of peridotite with pyroxenite were not seen in outcrop, but the outcrop pattern suggests they are fairly sharp.

A long narrow body of peridotite is sporadically exposed along the northeast slope of Lodestone Plateau and Mountain, and is here termed the Lodestone peridotite. It may or may not be continuous with the Grasshopper peridotite. It is pyroxenic almost everywhere observed and has broad gradational contact zones with the enclosing pyroxenite. The more southerly exposures are medium grained and mottled green and brownish-black; these grade southwest and northeast to pyroxenite by a gradual increase in pyroxene at the expense of olivine; no evidence of intrusive relationship was found. Off the northeast corner of Lodestone Plateau the peridotite is generally darker and finer grained, reflecting a lower pyroxene content, and in so far as can be determined from small scattered outcrops the contact zones are narrower.

The feldspathic rocks range from pyroxene syenite to gabbro and are generally coarse grained. They consist of large grains of plagioclase feldspar, generally pink or pale to light green in colour, and somewhat smaller grains of medium- to dark-green pyroxene and amphibole. In general, the bodies at the river and on Grasshopper Mountain are gabbro, whereas the large body between Lodestone Mountain and Tanglewood Hill ranges from fairly light-coloured pyroxene syenite on the ridge to dark pyroxene diorite down toward Olivine Creek. Near the Nicola contact and locally elsewhere on this Olivine Creek slope the diorite is medium to tie grained and contains lenses of still finer-grained diorite. Across the mouth of Badger Creek the feldspathic rock is somewhat darker than by Tanglewood Hill and is distinctly gneissic.

On Tanglewood Hill a band of feldspathic pyroxenite practically bisects pyroxenite body No. 5 and appears to mark the northeast limit of magnetite concentration. It consists of normal-looking pyroxenite containing white feldspar grains which are conspicuous but too thinly scattered to make the rock a gabbro. The contacts are in general gradational and irregular; but locally there is a development of extremely coarse amphibole where feldspar disappears.

On Lodestone Mountain three small areas of modified pyroxenite likewise appear to mark the approximate northeast limit of magnetite concentration. They may be segments of a continuous zone which has been disrupted by cross-faulting. One area is on the northeast slope of the main peak, and exposes small fragment-like bodies of feldspathic rock with shells of black amphibole enclosed in pyroxenite.

The outer parts of the area consist only of bands and scattered coarse crystals of black amphibole in, pyroxenite. Locally the rock resembles a banded gneiss. The second area is on the summit and northeast slope of the south peak. It consists predominantly of crystals of black amphibole scattered through pyroxenite, with only a very few small bodies of feldspathic rock. The third area is on a hill south of the south peak. It consists of pyroxenite enclosing crystals, bands, and ragged areas of black amphibole, within which are wisps and lenses of feldspathic rock. The areas are about 150 feet wide.

Many small faults have been inferred in various parts of the stock, and there may be some larger ones. None of the small faults or shears could be related to the occurrence or possible concentration of magnetite, but rather they appear to have dislocated or disturbed country rock and magnetite alike. On Lodestone Mountain several northeast-striking faults are inferred from marked linear saddles and draws, along which sheared pyroxenite contains narrow bands of coarsely crystalline white or buff carbonate. Direction and amount of movement could not be estimated.

Magnetite Occurrence in General

Appreciable magnetite has been found only in pyroxenite and in scattered very small patches in peridotite-dunite. Because these patches are small, sparsely scattered, and low in grade, no further work was done on them, and the peridotite-dunite was not systematically prospected,

The pyroxenite varies somewhat in its magnetite content from place to place; two areas in which the content seemed to be above average, on Lodestone Mountain and Tanglewood Hill, were mapped in detail and are described below. Knowledge of the distribution of magnetite in the central and southern parts of the stock is limited because of the extensive overburden; the section between Lodestone Plateau and Olivine Mountain was not studied. It can be stated, however, that south of Badger Creek and north of the Tulameen River (excepting two small areas), magnetite in pyroxenite is generally less abundant than it is in pyroxenite in the remainder of the stock. It appears further that there is no appreciable magnetite within at least 500 feet of the Lodestone peridotite. In short, the known favourable or potentially favourable areas appear to be restricted to the greater part of pyroxenite body No. 1 between Badger Creek and the river, the southeast half of body No. 3, and the southwest half of body No. 5, together with two small areas on Grasshopper Mountain mentioned above.

The central part of pyroxenite body No. 1 is described below, under Lodestone Mountain. A short distance to the southeast and on the ridge between Newton and Badger Creeks, scattered outcrops of pyroxenite contain magnetite in amounts that are appreciable but probably somewhat less than on Lodestone Mountain. On the flanks of Olivine Mountain, magnetite in bodies Nos. 1 and 3 generally increases away from the river, but higher-grade rock is patchy and no detailed work was done. One small area on the crest of Grasshopper Mountain, about 300 feet east of the peridotite-dunite contact, consists of an exposure of sheared pyroxenite, measuring about 5 by 30 feet and giving very high dip-needle readings, along the south contact of a small syenite dyke. Surrounding pyroxenite outcrops give lower but still above average dip-needle readings, but neither in them nor in the exposure of sheared pyroxenite were hand-magnet tests impressive. A second small area is on the northwest angle of Grasshopper Mountain at about 4,200 feet elevation, just north of the peridotite contact. Small scattered outcrops outline an area at least 100 by 700 feet in which dip-needle readings are moderately high and are amply confirmed by visual observation and hand-magnet tests, These tests suggest that magnetite concentration in this area is comparable with the average concentration on Lodestone Mountain. At the river a small patch in the northeast corner of body No. 4 contains some appreciable disseminated magnetite and four or five tiny lenses of massive magnetite; the over-all grade of the patch is probably low.

Large quantities of placer magnetite are doubtless contained in the terrace gravels along the Tulameen River, but the possible grade is unknown.

The magnetite occurs in two general ways-as individual grains disseminated through the rock and as lenses or vein-like bodies which consist largely of magnetite though containing some mica and (or) pyroxene. The lenses of massive magnetite were found only between Newton Creek and the Tulameen River. and are of medium to large size only on Tanglewood Hill. Elsewhere no single lens is larger than a man could carry out, and the average weight is probably between 1 and 5 pounds.

The massive magnetite is readily seen, even where the outcrop is largely covered with lichen, for lichen does not seem to grow well on magnetite. The disseminated magnetite is in many places difficult to see, and its grade cannot be estimated visually with any consistency. Coarse grains of magnetite, as much as 1 millimetre across, are relatively easy to see and are subject to overestimation. Fine grains of magnetite are easily confused with fine flakes of mica or missed entirely. and generally are underestimated. Three instrumental methods were therefore employed. All rocks were tested until it became clear that in general only the pyroxenite contains appreciable magnetite. Tests on other rocks were then restricted to occasional checks.

A small horseshoe magnet suspended on a string serves to distinguish pyroxenite of the stock from all other rocks save peridotite. Feldspathic rocks, dykes, Nicola volcanics, and small pyroxenite bodies in the Nicola group all fail to deflect the magnet when it is brought up to the side of an outcrop, whereas pyroxenite of the stock will deflect it every time. The reaction of peridotite is variable, possibly depending somewhat on the degree of serpentinization and the consequent release of secondary magnetite. This sensitive test is useful in some places in mapping rock types, but was found to be unnecessary in prospecting for magnetite ore. Over certain areas the pyroxenite contains sufficient disseminated magnetite to be attracted to the magnet with a pull that can be felt with the fingers. At a higher concentration of disseminated magnetite the attraction beween a fist-sized chunk of rock and the magnet is equal to the weight of the magnet. In the following description, detectable, appreciable, and notable magnetite mean, respectively, that the outcrop will deflect the magnet suspended on a string, that the outcrop exerts a pull on the magnet which can be felt, or that a sizable piece of rock will suspend the magnet. A fist-sized piece of pyroxenite which would just suspend the particular magnet used assayed 16.56 per cent acid-soluble iron and 19.78 per cent total iron. By interpolation between two other assays it is known that "appreciable" magnetite corresponds to 12 per cent or more total iron. The method is fast, simple, convenient, and positive, and would seem to be generally free of extraneous influences, but the deposit itself poses the following uncertainty. The pull is found to vary considerably over a given outcrop, noticeably different values being obtained within distances of 2 to 5 feet. although no change in magnetite concentration can be seen. No pattern to the variation was determined, and its cause is not known.

The dip-needle and magnetometer tend to smooth out these variations and to some extent give information on covered ground, but they are subject to such extraneous influences as local topography and local attraction from the operator. The magnetometer is also slower and rather delicate, requiring considerable care

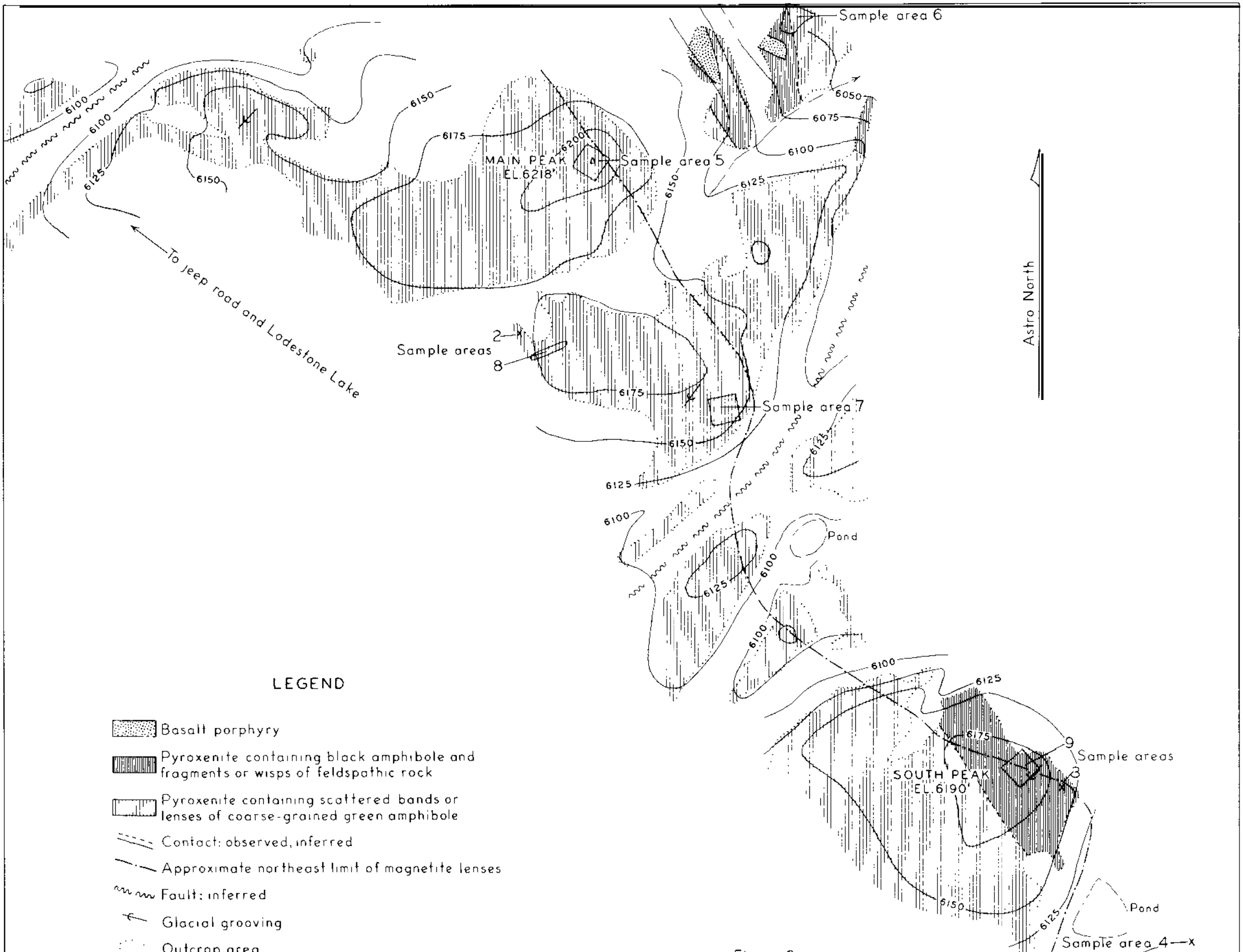


Figure 6

GEOLOGY OF PART OF
LODESTONE MOUNTAIN

and vigilance. The dip-needle used on reconnaissance was a simple Harrison model held in the plane of the magnetic meridian and read on the swing at eye-level. It was found that the needle would swing freely enough in the horizontal position to determine the magnetic meridian within 10 degrees. No attempt was made to pre-calibrate it.

A " Sharpe " model Dl-M high-sensitivity tripod-mounted dip-needle was used for magnetic surveying on Lodestone Mountain and Plateau, where it was set up on plane-table stations and points. Deflection readings were converted to coil current values by using a calibration curve, and these in turn were converted to gammas by multiplying by a constant of the instrument. Check readings at a fixed station were regularly taken at start and end of the day's work. Halfway through the survey a fall of the instrument changed its characteristics; therefore, readings northeast of Lodestone Lake and west of the main peak are no more accurate than readings taken elsewhere in the stock with the simpler dip-needle.

Readings with the two types of dip-needle were not correlated, and readings with neither instrument could be correlated with hand-magnet estimates where lenses of massive magnetite were present. The dip-needle reading gives some measure of the total attraction of both massive and disseminted magnetite within a certain range, whereas the magnet can indicate the attraction only of rock immediately beneath it. Over disseminated magnetite only, no consistent relation was found between readings and estimates. Readings with the Sharpe instrument on Lodestone Mountain varied particularly widely in relation to magnet estimates, but may be too few to be significant. Readings with the Harrison dip-needle in most places showed a rough correlation with magnet estimates, but some striking exceptions were found. Over some outcrops appreciable magnetite gave dips as small as 35 degrees, notable magnetite dips as small as 45 degrees, whereas serpentinized pyroxenite in body No. 4 at the Tulameen River yielded dips as large as 60 degrees without sensibly attracting the magnet. A sample of this serpentinized pyroxenite assayed only 5.5 per cent total iron. The highest reading with the Sharpe instrument corresponded to 8,600 gammas; the lowest corresponded to some negative figure off the calibration curve. With the Harrison dipneedle the normal dip over Nicola volcanics and feldspathic intrusives was 15 to 25 degrees. Somewhat lower dips, including two reversals, were obtained over a few peridotite exposures. Over pyroxenite, dips generally ranged from 25 to SO degrees, with one extreme reading of 80 degrees.

Magnetite on Lodestone Mountain

Magnetite was known prior to 1906 to occur on Lodestone Mountain. Over the years the ground has been staked many times, and more than two dozen small open-cuts have been made. A reconnaissance dipneedle survey was conducted by United States Steel Corporation in 1954 and 1955 and some sampling was done. The area is mentioned in the Annual Report for 1956.

The general geology of part of the mountain is shown diagrammatically in Figure 6. Lodestone Lake is northwest of the area depicted. The outcrop areas shown are mostly covered with 2 to 3 feet of rubble, locally mixed with glacial drift. Outside the outcrop areas the drift may be 10 feet and more in thickness. Disseminated magnetite is appreciable in most outcrops on the mountain and plateau and is somewhat concentrated along the axis of the mountain ridge. Northeast of Lodestone Lake it decreases gradually northeast toward the peridotite, but on the mountain appreciable magnetite is generally limited on the northeast by the areas of modified pyroxenite. On the south peak appreciable magnetite extends well into one of these areas, and on the hill to the southeast notable disseminated magnetite actually occurs in a cut on the northeast side of another such area, but between this cut and the peridotite the pyroxenite contains little magnetite. Estimations and one group of assays indicate the magnetite content is somewhat, though variably, lower around the lake than it is to the northeast or along the mountain crest.

Small lenses of almost massive magnetite are scattered through pyroxenite containing disseminated magnetite to form an ill-defined zone a few hundred feet wide extending from northeast of the lake southeast along the mountain crest. The more regular lenses may consist entirely of magnetite or may contain some included pyroxene crystals and sparse white mica. An approximate northeast limit of this zone is shown in Figure 6. The southwest limit is even harder to place, partly due to lack of outcrop, it would seem to pass close to the east end of the lake. This zone overlaps an area of modified pyroxenite on the south peak but is west of a similar area by the main peak. Right-hand offsets in the northeast boundary were noted at two marked draws, at least one of which is inferred to follow a fault. Lenses arc generally scarce southeast of the area mapped in detail, and any continuation of the zone northwest of the plateau is covered. The lenses are all small and widely variable in form. The largest observed, on the south slope of the main peak, is 6 by 24 inches. Some are straight-walled veins an inch wide and 3 or 4 feet long. Some are mere films of magnetite on joint surfaces. Many are irregular, with an over-all vein-like form but interrupted and sinuous in detail, and send small lobes out into pyroxenite. An unsuccessful attempt was made to relate lenses to jointing. The rubbly nature of outcrops restricted observations to open-cuts and a few small well-glaciated exposures. In one cut magnetite was found to occupy one of the most prominent joints and send tongues out along other joints, but in a small glaciated knob veins and lenses of magnetite did not follow any of seven directions of jointing. Magnetite in other exposures exhibited varying relations to joints. The contribution of the lenses to the over-all magnetite content of the zone is probably not large. Most of the outcrops are so rubbly that it is difficult to find all the lenses, but in the majority of the better exposures there are no more than five lenses, totalling about 2 square feet, per 100 square feet. Also, there is a vague suggestion that disseminated magnetite decreases somewhat where the lenses are more abundant.

The readings with the Sharpe dip-needle are difficult to interpret. Somewhat more than half correlate with visual or hand-magnet observations, but the remainder are either higher or lower than was expected, some surprisingly so. The only general pattern to emerge is of low readings in the more marked draws, some of which are inferred to follow faults, and high readings on hills or knolls, where rubbly bedrock is either exposed or within a very few feet of the surface. One factor in producing this pattern is undoubtedly depth of overburden, but some groups of readings indicate that parts, at least, of the pattern reflect real variations in the magnetic properties of bedrock. For example, on the lower part of the steep northwest face of the south peak, on bedrock or coarse talus derived from bedrock, negligible readings were obtained. The relation between magnetic properties and magnetite content is uncertain.

Forty samples were taken in nine groups, eight of which are indicated on Figure 6 and one is on the south side of the lake. The first four groups were designed to obtain as accurate samples as possible from small areas, the remaining five to get more general samples over somewhat larger areas. Group 1 is from rather low-grade disseminated magnetite south of Lodestone Lake, group 4 from a pocket of relatively high-grade disseminated magnetite northeast of an area of modified pyroxenite, and group 6 from low-grade rock northeast of a similar area. The remaining groups were taken from the zone of lenses. For each of the first four groups a patch of outcrop was stripped of loose material, swept clean, and marked off into

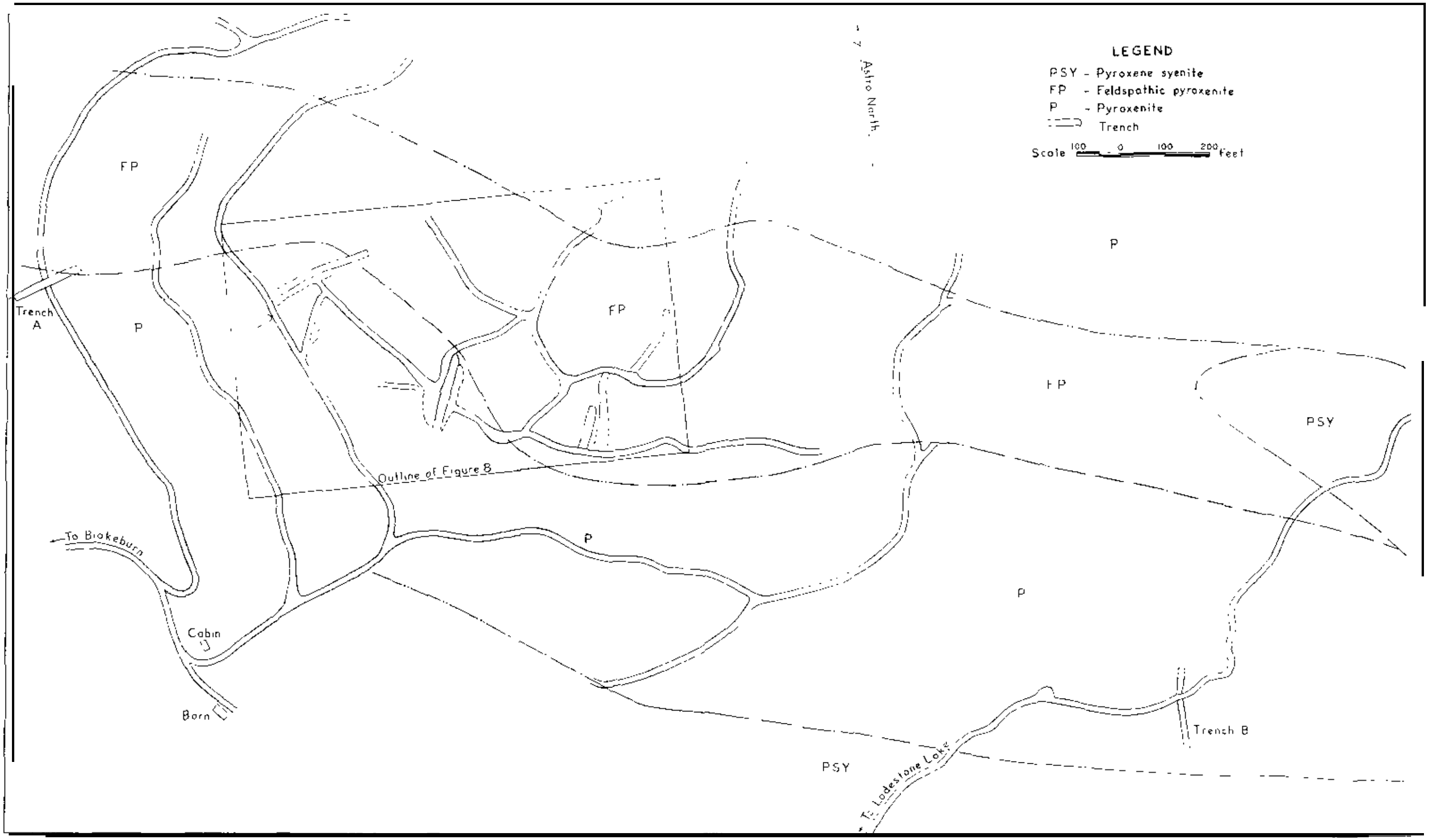


Figure 7. Geology of part of Tanglewood Hill, near Lodestone Mountain.

100 one-foot squares. Chips as nearly equal in size as possible were taken from the corner of each square. The large square yielded several times too much material for one sample bag; therefore, several samples were collected on a geometric plan and assayed separately in order to show up any variability. In calculating the group averages, individual assays have been weighted according to the number of chips represented. Samples in the last five groups comprise chips taken every 5 feet in lines which are normally 50 feet long. Groups 5, 7, and 9 each comprise three such lines of chips, 25 feet apart. In group 6 scarcity of rock necessitated running the third line across the ends of the other two. Group 8 is a single 80-foot line of chips, split into SO- and 30-foot segments. Since stripping of these larger areas was not feasible, a considerable part of each sample is from rubble, some chips had to be obtained off line, and a few scattered positions had to be skipped entirely.

The assays are tabled with those from Tanglewood Hill on pages 50 and 51, and evaluation is reserved for a following section. It may be noted here that the iron content is nowhere high, and that the variations indicated visually and by the hand-magnet are not large. In a general way the relative magnetite content indicated visually and by hand-magnet is confirmed, in places in opposition to readings with the Sharpe dip-needle. The most promising area would appear to be the main peak with the broad hill to the south and the ridge to the west.

Magnetite on Tanglewood Hill

The general geology of part of Tanglewood Hill is shown in Figure 7, and details of the area most intensively explored are shown in Figure 8. The essential features are two bands of pyroxenite and an intervening band of feldspathic pyroxenite, all enclosed between Nicola rocks and pyroxene syenite. In natural outcrops the rocks are hard and compact, but in trenches and one road cut most of the pyroxenite and some of the feldspathic pyroxenite has disintegrated to a sand. A diamond-drill hole passed through 45 feet of this sand, including a few solid chunks, before entering solid pyroxenite.

Magnetite is rather sparingly disseminated through pyroxenite and feldspathic pyroxenite. Of principal interest are some two dozen lenses of almost massive magnetite that are generally much larger than any found elsewhere in the Lodestone Mountain stock. Most of them are within the area of Figure 8, and eight are shown thereon. All of these lenses have been found in the south band of pyroxenite or in the feldspathic pyroxenite, most of them in pyroxenite sand. Lenses A and B in the two trenches shown on Figure 7 are the farthest out known. From the limited extent of exploration, it is not at all certain that similar lenses do not exist in the north band of pyroxenite or in extensions of the south band to the east and west. However, a dip-needle traverse across the south band along the road to Blakeburn, west of the area of Figure 7, yielded only low readings.

The magnetite lenses exposed range in width from a few inches to 18 feet; most of them are 2 to 4 feet wide. A diamond-drill hole passed through 7 feet of one lens and through eleven other lenses or veinlets ranging in width from one quarter inch to 1 ½ feet. Length and depth can rarely be estimated, yet each is probably at least ten times the width. The common strike is west or northwest, though one lens strikes northeast. The over-all dips are not certainly known. Observed dips of all but one lens in the trench walls are vertical or nearly so; many lenses appear to have been steepened by vertical slips. There are suggestions from the drilling that some of the lenses may on the average dip south or southwest at moderate angles, and that the steep dips near surface may not be representative.

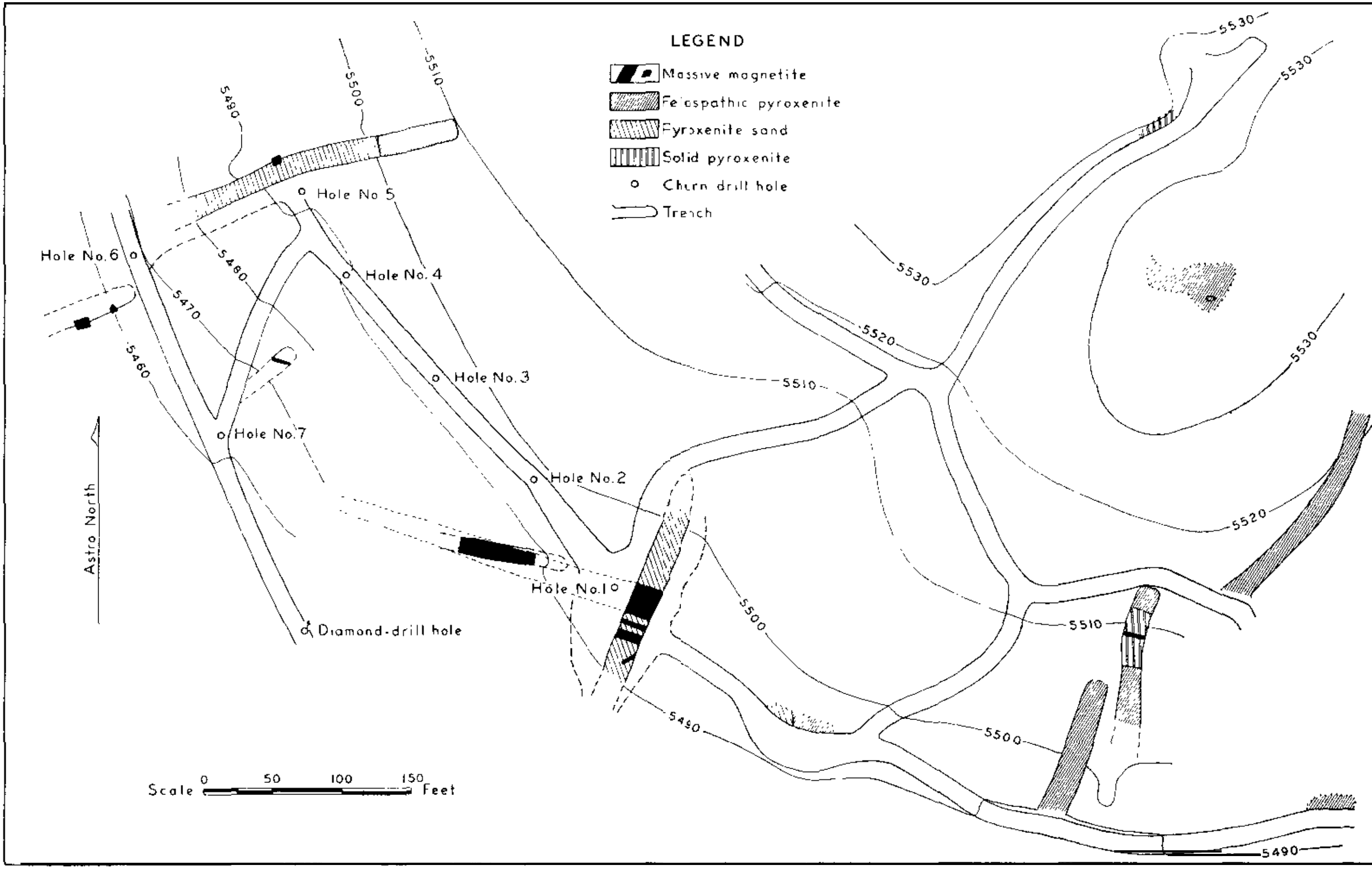


Figure 8. Detail of Figure 7, Tanglewood Hill.

Information from the diamond-drill hole suggests, but does not prove, that the feldspathic pyroxenite contact also may dip south. In the trench by chum-drill hole 5, on the other hand, a J-foot-wide lens dips almost vertically near surface, but 6 feet below surface it shows drag to the southwest on top of a flat shear. No continuation of it could be found beneath the shear.

All but two of the lenses are 5 feet or less wide, and all are more or less scattered through pyroxenite containing disseminated magnetite, resulting in an average grade roughly comparable with that on Lodestone Mountain. Of the two larger lenses, one is 8 feet wide but is exposed only in one wall of the trench below chum-drill hole 6. The other larger lens is 18 feet wide in the trench by churn-drill hole 1 and is probably continuous with massive magnetite exposed in the trench below hole 2. If the 7 feet of massive magnetite intersected in the diamond-drill hole can be regarded as a further extension of this lens, it can be estimated to be 300 feet long, averaging 10 feet wide. Assuming a depth of half the length and a factor of 7.5 cubic feet per ton, the lens is estimated to contain 60,000 tons of magnetite of a grade indicated by samples 954 and 1000.

Samples were taken in three groups-No. 10 from the trench by churn-drill hole 1, No. 11 from the trench by hole 5, and a group of picked samples from the diamond-drill core. The trench samples approximate to continuous samples along one wall, close-chipped across magnetite and compact pyroxenite, and channelled with pick point across pyroxenite sand. In group 10, sample 1000 was taken across the large magnetite lens discussed above, samples 1151 to 1153 were taken successively to the south, and sample 1154 was taken to the north of 1000. In group 11 the samples were taken successively from the mouth of the trench to the east contact of the largest lens, the one mentioned above as being displaced on a flat shear. Each group of samples crosses all magnetite lenses observed in the trench. From the drill core, type samples were taken respectively of the 7 feet of massive magnetite, of the most attractive disseminated magnetite, and of pyroxenite which failed to sensibly attract the hand-magnet. The assays are tabled below.

The 18 feet of massive magnetite of the large lens in the trench near churn-drill hole 1 can be augmented by 33 feet of combined pyroxenite sand and smaller lenses from the hangingwall to give a weighted average across 51 feet of somewhat better than 40 per cent iron. On the other hand, visual inspection of diamond-drill core from above the 7 feet of massive magnetite is not encouraging; the aggregate width of five lenses or veinlets of massive magnetite is only about 27 inches. If the large lens, estimated above to contain 60,000 tons, were diluted during mining with hangingwall rock containing magnetite lenses to yield an over-all grade of 40 per cent iron, the reserve might be increased to 150,000 tons.

TABLE OF ASSAYS

Group No.	Sample No.	Iron	Titanium	Remarks
Lodestone Mountain		Per Cent	Per Cent	
1	957	16.78	1.05	
	958	16.99	1.09	
	959	15.00	1.03	
	960	12.55	1.12	Band of crumbly black amphibolite, probably along a shear.
	961	15.35	1.14	
	962	16.75	1.05	
	963	14.70	1.16	
	964	14.10	......	Crumbly black amphibolite.
	965	14.20	0.87	Mostly rubble.
Group average	....	15.26	1.08	

TABLE OF ASSAYS—*Continued*

Group No.	Sample No.	Iron	Titanium	Remarks
		Per Cent	Per Cent	
2	966	18.80	0.96	
	967	22.15	1.11	
	968	24.70	1.16	
	969	21.70	1.03	
	970	19.35	0.93	
	971	19.00	0.98	
Group average	......	21.05	1.03	
3	972	49.03	1.98	High-grade magnetite cobbed from group 2 stripping.
	973	15.65	0.80	
	974	12.05	......	Crumbly black amphibolite.
	975	12.25	0.80	
	976	15.00	0.86	
	977	15.50	0.80	
	978	14.65	0.80	
	979	15.50	0.89	
Group average	......	14.61	0.82	
4	994	17.80	0.21	Chips cover one-third of 14- by 11-foot rectangle.
	995	16.50	0.36	
	996	17.95	0.27	
Approximate average	......	17.44	0.28	
5	980	21.40	......	Mostly rubble.
	981	19.95	......	Half rubble.
	982	17.50	......	Mostly rubble.
Group average	......	19.62	......	
6	983	12.75	......	Mostly solid bedrock.
	984	14.55	......	Mostly rubble and talus.
	985	14.50	......	Mostly rubble.
Group average	......	13.93	......	
7	986	19.05	......	Mostly solid bedrock.
	987	24.65	......	Mostly rubble.
	988	23.25	......	Mostly rubble.
Group average	......	22.32	......	
8	989	21.45	......	Rubbly outcrop and float south of group 2.
	990	20.05	......	
Group average	......	20.75	......	
9	991	15.90	......	Half outcrop, half rubble, northwest of group 3.
	992	15.15	......	
	993	14.05	......	
Group average	......	15.03	......	
Tanglewood Hill				
10	1000	53.00	1.89	18 feet across nearly massive magnetite.
	1151	35.50	1.37	Across 2½ feet magnetite, 8 feet of pyroxenite.
	1152	47.35	1.64	8½ feet impure magnetite.
	1153	34.10	1.28	Across 12 feet pyroxenite and 2 feet magnetite.
Average of first four	......	43.23	1.57	Across 51.0 feet.
	1154	21.30	0.97	Across 24 feet of pyroxenite sand next to sample 1000.
11	1155	20.75	1.05	Across 41 feet pyroxenite sand, 4 feet magnetite.
	1156	27.25	1.27	4 feet magnetitic pyroxenite.
	1157	19.45	0.96	13 feet pyroxenite sand.
	1158	60.80	2.07	7 feet magnetite.
Drill core	954	59.53	2.12	Massive magnetite.
	955	17.75	0.84	Appreciable disseminated magnetite.
	956	10.76	0.80	Does not sensibly attract magnet.

PHOSPHORUS AND SULPHUR

	Sample No.	Phosphorus	Sulphur
		Per Cent	Per Cent
Lodestone	972	0.02	0.08
Tanglewood Hill	1000	0.02	0.04
"	1158	0.04	0.05

Evaluation of Assays

The tabulated assays include a small amount of iron introduced during crushing and grinding, and a larger amount of iron contained in pyroxene, amphibole, and biotite. The figures must therefore be reduced to obtain the percentage of rock that is iron in magnetite. The correction for iron in silicates decreases as the grade increases.

Comparison tests on another set of samples had indicated negligible iron introduced by the jaw crusher. Four samples taken in 1959 were crushed and split, part of each sample being ground in the pulverizer and part by hand in a mortar. The following assays indicate a variable, erratic amount of iron introduced by the pulverizer:—

Sample No.	Pulverized Iron (Per Cent)	Hand-ground Iron (Per Cent)
957	16.78	16.18
958	16.99	16.74
972	49.03	48.70
1000	53.00	52.15

It would appear safe to assume, however, that introduced iron is generally less than 1 per cent of the sample.

The relative amounts of iron contributed by the magnetite and the rock silicates is not known with certainty. G. A. Gross, of the Geological Survey of Canada, suggested that an average of 7 per cent of the rock is iron combined in silicates, the balance of the total iron being in magnetite. However, a double determination on one sample gave the following results:—

	Per Cent
Total iron	19.78
Acid soluble iron	16.56
Presumed iron in silicates	3.22

A third estimate was obtained by separating the hand-ground fractions of samples 957 and 958 with a hand-magnet then assaying the magnetic concentrate. The figures were considerably below the theoretical percentage of iron in magnetite; therefore, it was assumed that separation was incomplete and silicates were still present in the concentrate. A double calculation indicates that 5.8 and 5.6 per cent of the original samples was iron combined in silicates. This correction decreases to a fraction of 1 per cent as the total iron in the sample rises to 50 per cent. Iron in ilmenite appears to be but a small fraction of 1 per cent of the sample; therefore, it has not been considered.

Combining the figures for iron introduced by the pulverizer and iron combined in silicates, it appears that the total iron assays of rock containing appreciable disseminated magnetite should be reduced by from 3.5 to 8.0 per cent to arrive at the iron content contributed by magnetite. A further small correction might have to be made for iron contained in ilmenite.

Of elements likely to pose difficulties in the production of iron from the magnetite, spectrochemical analyses disclosed only titanium and zinc. The zinc, like phosphorus and sulphur, appears to be negligible, but titanium is seen from the assays to be significant in every sample. Although the samples were not studied under a microscope, some hints of the possible mineralogy of the titanium can be gained from the following titanium-iron ratios:—

Sample	Iron	Titanium	Ti/Fe
	Per Cent	Per Cent	
957—raw, hand ground	16.18	1.05	0.065
958—raw, hand ground	16.74	1.09	0.065
957—magnetic concentrate	56.36	1.27	0.023
958—magnetic concentrate	55.36	1.46	0.026
972—machine ground	49.03	1.98	0.040
954—machine ground	59.53	2.12	0.036
1000—machine ground	53.00	1.89	0.036
1158—machine ground	60.80	2.07	0.034

A complete calculation confirms the relatively high ratio in low-grade magnetitic rock. The figures would suggest that at least a third of the titanium in low-grade rock is combined in silicates. Ilmenite has not been identified, but is suggested by the lower ratios in the magnetic concentrates. Carefully controlled grinding and magnetic separation might be able to eliminate further ilmenite and so reduce the titanium content of the concentrate below 1 per cent.

B Group

(49” 120” S.W.) The B group comprises seventeen claims located by E. and R. J. Mullin in 1957, extending from the summit of Tanglewood Hill south to Blakeburn Creek. It is reached by 6 miles of logging-road from the coal strip mine at Blakeburn, which is 5½ miles from Coalmont. A jeep-road leads a further 3 miles west-southwest to Lodestone Lake. The general geology is outlined and the magnetite occurrences are described on pages 47 to 50.

In 1957 part of the property near the crest of the hill was surveyed with a magnetometer. In 1958 some of the more promising anomalies were tested by a dozen bulldozed trenches and by sampling, under the direction of R. E. Renshaw. In June and July of 1959, N. H. McDiarmid had some ten holes churn drilled and one hole diamond drilled. The chum-drill holes were sunk to depths ranging from 50 to 150 feet, with the average rather less than 100 feet. The diamond-drill hole was put down at -45 degrees for about 525 feet. R. B. Stokes supervised the drilling and took sludge samples.

Gold

El Alamein

(49” 120” N.W.) The mine and a pilot mill are on the Wildcat Crown-granted mineral claim, which straddles the Tulameen River 4.5 miles above Tulameen and is owned by V. Golden, of Vancouver. In 1958 N. N. MacKenzie, of Vancouver, obtained an option on a group of adjoining claims held by record by J. Paquette, of New Westminster, and diamond drilled 400 feet in three holes. In 1959 he optioned the Wildcat claim, drilled two additional holes, and prospected the adits. Some scattered visible gold was found in the hangingwall of the upper adit near the face. A grab sample from this place of material containing no visible gold assayed: Gold, 0.31 oz. per ton; silver, trace.

[Reference: Minister of Mines, B.C., Ann. Rept., 1949, pp. 124-129.1

SIMILKAMEEN RIVER*

Copper

Deep Gulch Mines Ltd.

(49” 120” S.W.) Company office, 1500 Marine Building, 355 Burrard Street, Vancouver 1. R. Collishaw, president; R. B. Stokes, engineer. This company was formed early in 1959 to explore the property held by the former Deep Gulch

* By J. M. Carr.

Mining Syndicate. It holds about thirty-two recorded claims and fractions on the west side of the Siiilkameen River near the Hope-Princeton Highway 15 miles south of Princeton. The property includes the Eva, Elm, Ash, Oak, Ivy, Gem, and Pat groups and extends between Friday Creek and Deep Gulch Creek. The main showings are at about 4,000 feet elevation close to Deep Gulch Creek, in the vicinity of mineralized outcrops discovered by J. W. Gallagher in 1952. Eastward the ground drops sharply 1,400 feet to the Similkameen River.

Work done in 1958 and 1959 included more than 10,000 lineal feet of bulldozer trenches, together with construction of access roads. One diamond-drill hole 435 feet long and one churn-drill hole were drilled. Some geochemical and geophysical work was done.

The main area explored by trenches measures 2,500 feet in a northerly direction and ranges in width from 400 to 1,200 feet. It is underlain principally by syenogabbro, or syenodiorite, and monzonite of the Copper Mountain stock. These rocks contain veins, streaks, and patches of pink orthoclase feldspar. Biotite occurs as a normal constituent of the rocks and also in fractures. White feldspar-pegmatite which forms a core to the stock is exposed in the northeastern trenches and possesses sharp, irregular contacts against monzonite.

The best mineralization is exposed in the southern part of the area and consists of bornite and some chalcopyrite as lenses, veinlets, and disseminations accompanying pink feldspar. Partial oxidation has produced malachite and limonite. Pyrite is inconspicuous or absent. Numerous low-grade sections of mineralization are haphazardly exposed in trenches, each of a width measurable in feet or tens of feet. Since most of the feldspar and sulphide veins and some faults strike northeast with steep dips, at least some of the mineralized sections may lie in northeasterly zones.

Mineralization is most conspicuous to the west, within about 200 feet of the assumed southern continuation of a major fault. This fault is exposed in the northern part of the area, where it strikes slightly west of north, dips west at 45 degrees, and contains gouge 5 feet thick. It separates syenogabbro or syenodiorite containing some pink feldspar veins and bornite from sheared and sericitized tuffs presumably belonging to the Nicola group. The tuffs are rusty and contain traces of pyrite and malachite. A diamond-drill hole was drilled at -45 degrees westward from the most southwesterly trench with mineralization. Poor recovery was obtained and the hole ended at 435 feet without reaching the expected fault. It intersected some widely spaced lengths of mineralization.

In the north part of the area some trenches failed to reach bedrock. The most northerly trenches expose sheared and rusty monzonite, which is cut by offshoots of white feldspar-pegmatite and by a later quartz-porphyry dyke. Pyrite is disseminated in the porphyry as well as in the monzonite, and traces of malachite are present.

Two other exposures of quartz-porphyry occur in the area, one being pyritized and sheared. Possibly these dykes are comparable to some of the post-ore dykes at Copper Mountain, 2 miles to the northeast, in which case there may be two periods of mineralization represented on the Deep Gulch property. The first would be associated with pink feldspar veins and biotitization, as at Copper Mountain, and the second, more pyritic mineralization, would be subsequent to the intrusion of quartz-porphyry and felsite dykes.

HEDLEY *

Gold

French (French Mines Ltd.) (49° 120° S.E.) Company office, 314, 718 Granville Street, Vancouver 2; mine office, Hedley. W. B. Burnett, president; J. S. Biggs, mine superintendent. The French mine is on the Oregon mineral claim on the east side of Cahill Creek. about 8 miles by road from Hedley. It is at an elevation of 3,900 feet and is reached by a branch from the Nickel Plate road. The property comprises eleven Crown-granted and four recorded claims and fractions.

The structural situation is a steep northeast-trending panel of sedimentary rocks to the east of and above the main mass of granodiorite of the district. A band of limy strata of variable width up to 60 feet occurs between fine-grained dark-coloured tuffs in which bedding is hard to see. In the vicinity of the mine the steeply dipping limestone, about 15 to 20 feet wide, rolls sharply to a flattish structure and is much brecciated along what may be a major thrust zone. The ore is in crumpled limy rocks above the main breccia zone and lies below less competent tuff. The structural detail is highly complex and is difficult to decipher because of non-uniform alteration to skarn. The ore is associated with crumples or " spreads " that need to be mapped in extreme detail. The ore is a gold-bearing skarn consisting of garnet and pyroxene. The gold is not associated with sulphide mineralization but occurs free and in conjunction with bismuth telluride. Determination of ore must be made by assay, as it cannot be recognized. In general, a combination of fine-grained pinkish-brown garnet and fine streaky green pyroxene assays better than coarser garnetite. A peppering of fine gold is in places visible, occurring in garnet or pyroxene. The ore zone dips in general to the north and has not been found below the west-dipping Cariboo fault. Exploration for extensions and possible repetitions of this ore zone is extremely difficult.

The operation averages 45 to 50 tons per day with a mine crew of six men. Ore is trucked to the cyanide mill on the flat east of Hedley. Close sampling must be done at all times, and continuous attention to detail is necessary to stay with the ore. Prior to 1955, when the ore was treated in the Nickel Plate mill, the ore averaged 0.8 ounce gold per ton. Since 1957 under the present company the grade has been somewhat less.

The mine is developed from three adit levels—the 3920 level (Kelowna), the 3835 level (Granby), and the 3785 level (Cariboo). In 1959 mining and development was carried out on all three levels. The ore is mined by open stoping and is slushed to transfer raises. The following is a summary of work done in 1959:—

Drifting	ft.	531
Raising	ft.	82
Crosscuts	ft.	280
Diamond drilling, underground	ft.	4,587
Ore milled	tons	15,952
Gold recovered	oz.	7,430

A crew of twenty men was employed in all operations—nine underground and eleven on the surface. No important changes were made in the present installations.

* By David Smith and M. S. Hedley.

KEREMEOS*

Silver-Gold

Horn Silver (Canada Radium Corporation Limited)

(49° 119° S.W.) Company office, 1024, 85 Richmond Street West, Toronto 1; mine office, Keremeos. W. L. Hodgson, president; H. Parliament, resident engineer. The property includes the Horn Silver and Silver Bell Crown-granted claims, and seven recorded claims-the Silver Bell 1 to 5 and Silver Bell 7 and 8. Work in 1959 consisted of driving 320 feet of crosscut on the 2620 level in preparation for sampling and diamond drilling. A total of 2,056 feet of underground diamond drilling was completed during the year. Operations were suspended in September, 1959. An average crew of ten was employed.

Copper-Molybdenum

Golconda (Keremeos Miner Ltd.)

(49° 119° S.W.) Mine office, Olalla. W. Geminder, manager; G. Thomson, mine foreman. This property consists of the Crown-granted Copper King and seven recorded claims. The property is on the west side of the valley almost directly above Olalla but a distance of 2 miles from it by a road consisting of a series of switch-backs. A mill with a rated capacity of 45 tons per day has been constructed on the property and was in operation at the end of 1959. Electric power is provided by a 100-kva. generator operated by a 280-horsepower diesel. Other construction consists of a 15-ton coarse-ore bin and a 15-ton fine-ore bin. Underground preparation in the old Golconda workings consisted of clean-up, 50 feet of drifting, and 200 feet of raising and slashing in preparation for stoping. An average crew of five was employed. At the year's end about 25 tons of concentrate was stockpiled in readiness for shipment.

FAIRVIEW CAMP*

Silica-Gold

Fairview (The Consolidated Mining and Smelting Company of Canada, Limited)

(49° 119° S.W.) Head office, Trail; mine office, P.O. Box 337, Oliver. G. S. Ogilvie, property superintendent. This property consists of thirty-six Crown-granted claims. The mine lies about 5 miles to the west of Oliver. Quartz is mined and shipped to Trail for use as flux. All production has been from the new stopes on the No. 3 level. Operations were continuous throughout the year, and 26,717 tons of quartz was shipped. Development work included 242 feet of raising and 33 feet of boxholes. A crew of nine men was employed.

CAMP McKINNEY *

Gold

Cariboo-Amelia (H & W Mining Company Limited)

(49° 119° S.E.) Company office, 844 West Hastings Street, Vancouver 1. R. W. Hunstone, president; C. Higgins, superintendent. This property consists of the following Crown-granted claims held under option from W. E. McArthur, of Greenwood: Cariboo, Amelia, Alice, Maple Leaf, Emma, Sawtooth, Okanagan, and Wiarton.

After the workings had been dewatered, a crosscut was driven 240 feet in the hangingwall of the vein on No. 5 level. The faulted vein was encountered and

* By David Smith.

was followed for 60 feet with a drift which showed it to be of good grade. The old shaft was inadequate, so a new shaft was raised from No. 4 level at an angle of 85 degrees, taking advantage of an old stope between No. 4 and No. 3 levels. The raise reached surface east of the old shaft. A cement collar was poured and a 65-foot headframe erected with attached coarse-ore bin. A hoistroom was built and a double-drum hoist formerly at the Giant Mascot was installed. Timbering of the raise was started from surface, and at the year's end was completed to some distance below the No. 3 level. On the surface a dry was built to accommodate twenty-five men. The hoistroom was partitioned and an electrically driven 750-cubic-foot compressor installed. A small modern trailer serves as first-aid room and mine office. An average crew of fifteen men was employed.

BEAVERDELL*

Silver-Lead-Zinc-Cadmium

Highland-Bell (Highland-Bell Limited) (49° 119" SE.) Company office, 604, 789 West Pender Street, Vancouver 1; mine office, Beaverdell. K. J. Springer, president; 0. S. Perry, manager; J. de Yaeger, mine superintendent; R. Ross, mill superintendent. The property consists of thirty-two Crown-granted and four recorded claims. Until July, 1959, two separate sections of the mine mere in operation, referred to as the upper and the lower workings. At the end of July the known ore was exhausted from the upper workings and that part of the mine was closed. All production is now obtained from the lower workings, the main haulage being the 2900 adit.

In 1959 normal production of 70 to 75 tons per day was maintained. This production came chiefly from the 2900 and 3000 levels. Toward the latter part of the year a winze was completed to the 2800 level and some production is anticipated from this area in 1960. The 3100 level was also started: and a small tonnage is being mined from a single stope on this level.

A ventilation and emergency exit connecting the upper and lower workings, a distance of 770 feet, was completed in June.

The following is a summary of mining operations for 1959:—

Drifting	ft.	846
Raising	ft.	514
Sinking	ft.	143
Diamond drilling	ft.	5.294
Ore mined	tons	18,029

The mill operated at capacity throughout 1959, the concentrates being shipped to the Trail smelter.

An average crew of forty men was employed. of whom twenty-five worked underground.

Silver-Lead-Zinc

Bounty Fraction (Sheritt Lee Mines Ltd.) (49" 119" S.E.) Company office, 530,470 Granville Street, Vancouver 2. K. E. Wickstrom, president. This property consists of seven Crown-granted claims and fractions-the Standard, Black Diamond, Bounty, Logan, Reco, Black Bess, and the Bounty Fraction, on which the present work is being carried out. The lower adit was completed for a distance of 300 feet and a connection was made with the shaft. On the same level, 100 feet of drifting was done

* BY David Smith.

on the ore. The ore is being hand sorted on the surface, and shipments are contemplated in 1960. A crew of four men was employed. Supervision of the property was taken over by D. Sheck in November, 1959.

GREENWOOD*

Copper-Gold-Silver

Mother Lode (Consolidated Woodgreen Miner Limited)

(49” 118” SW.) Company office, 204, 569 Howe Street, Vancouver 1; mine office, Greenwood. R. A. Brossard, president; C. W. S. Tremaine, manager. This property consists of the Mother Lode, Primrose, Crown Silver, Florence,’ C.O.D., Sunset, and Sunflower Crown-granted claims. The Mother Lode property was at one time owned by Canada Copper Corporation Ltd. and was the chief source of ore for the Greenwood smelter. In recent years, attention was given to the possible recovery of those sections of the orebody that had been left by the former operators, principally the shaft pillar. It was hoped that additional ore would be uncovered by subsequent exploration. Woodgreen Copper Mines Limited built a 1,000.ton mill in 1956, at the edge of the Mother Lode glory-hole, and commenced milling on January 26th, 1957. Falling copper prices and other factors forced closure in August, and the company went into bankruptcy.

Early in 1959 the company was reorganized, and a bankruptcy settlement approved by the Courts was accented by the creditors. An immediate start was made to resume production, and under the direction of C. W. S. Tremaine the crushing plant was remodelled, the open pit was tidied up, and milling at about 500 tons per day began early in June. Stoppage of operations at the Tacoma smelter due to a strike forced stockpiling at the property for a time, but work proceeded, and milling was at the rate of 650 tons per day at the end of the year. A surface diamond drill was in operation exploring the Sunset ore zone.

In addition to the remodelling of the crushing plant and sheeting-in of all conveyor ways, a mine dry building and a building for storage of mine equipment were put up. A crew of thirty-four men was employed at mill and open pit.

PHOENIX?

Copper-Gold-Silver

Stemwinder (Continental Consolidated Mines Ltd.)

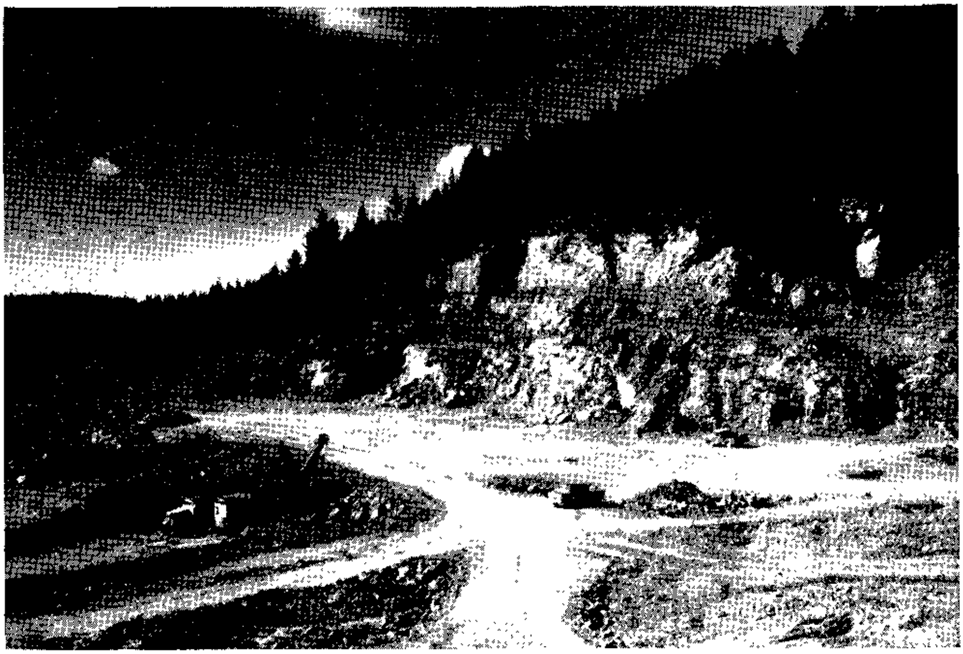
(49” 118” SW.) Company office, 201, 535 Howe Street, Vancouver 1; mine office, Greenwood. F. J. Hemsworth, mine manager; R. N. Peltola, mine superintendent. Work commenced on this old property in September, 1959. The first level was dewatered, the shaft headframe and shaft timbers were repaired, existing mine buildings were renovated, and a mine dry was built at the No. 1 adit. Underground mining commenced the last part of November, and a production of about 100 tons per day was maintained until a temporary suspension of operations on the 15th of December. Ore was hoisted to surface and hand trammed to a surface stockpile. By agreement, it is planned that the ore will be concentrated at the near-by Phoenix Copper Company mill. A crew of twenty men was employed.

Phoenix Copper Company Limited

(49” 118° S.W.) Company office, 1111 West Georgia Street, Vancouver 5; mine office, Phoenix. L. T. Postle, president; J. H. Parliament, manager. This property consists of sixty-two claims, of which twenty-eight are Crown

* By David Smith and M. S. Hedley.

† By David Smith.



Snowshoe pit, Phoenix. Phoenix Copper Company Limited.

Mother Lode pit, Greenwood. Consolidated Woodgreen Mines Limited,
Ore-bins and conveyors partly visible.

granted, twenty-seven recorded, and seven leased. Strikes at the Tacoma smelter from April till June and from August until December held up shipments, but concentrate was stockpiled and milling continued at full capacity. At the year's end nearly 3,000 tons of concentrate was stockpiled at the mine.

In the spring of 1959, mill construction and the installation of machinery were completed, and the plant was put into production on April 16th. The milling rate for the year averaged about 700 tons per day. During November and December a third ball mill and classifier unit was added, increasing the mill capacity to 1,000 tons per day.

Mining was started *in* the Snowshoe pit in the spring and was continued until mid-December. Stripping of waste and mining of ore were started in the Old Ironsides pit in July. In December the Snowshoe pit was closed for the winter and all production was obtained from the Old Ironsides. No diamond drilling or underground mining was done. Some geological and geophysical work was carried out on claims in the vicinity of the mine. During 1959, 288,667 tons of waste was removed and 183,071 tons of ore transferred to the mill. A total of 175,945 tons was milled in 1959.

A total crew of fifty-seven men was employed-twenty on surface, twenty in the open pit, and seventeen in the mill.

ROSSLAND*

Gold-Copper

Velvet (Mid-West Copper & Uranium Mines Ltd.) (49" 117" S.W.) Company office, 201, 535 Howe Street, Vancouver; mine office, Rossland. M. F. Maxwell, president; G. G. Sullivan, superintendent. Capital: 4,000,000 shares, 50 cents par value. This company owns the old Velvet mine on the Rossland-Cascade Highway, 13 miles west of Rossland. A small crew started preparatory work in the middle of May. Mine and mill were rehabilitated, a new powder-house was erected, and the change-house was moved from the upper to the lower portal. A development programme was started at the end of June, and 200 feet of drifting and 136 feet of raising were completed. Diamond drilling on Nos. 2, 3, 4, 5, and 7 levels totalled 1,865 feet. Stoping was carried out in two stopes above No. 7 level. Where encountered, chalcopyrite mineralization was relatively massive, but the walls were indefinite. The ore was mined with jacklegs and slushers, slashing and benching.

The ore on No. 8 level was trammed to the coarse-ore bin, crushed, and conveyed to the fine-ore bin. From the fine-ore bin it was transported by a gravity tram to the 150-ton mill in the bottom of Sheep Creek valley. Milling started on September 22nd on a one-shift basis, five days a week, but was suspended on November 16th due to winter conditions. The mill treated 1,750 tons of ore, producing 67 tons of copper concentrates. The average number of men employed during the production period was thirty-four.

TRAIL*

Gold

W.D. (49" 117" S.W.) This prospect is on the west side of the Columbia River, 3 miles south of Trail, and is owned by E. Wells and F. Donelly, of Trail. It was at one time known as the Casino Red Cap. During the year, mining was carried out on a part-time basis by the owners and three lessees. Mining was done on a small quartz vein which strikes in a southerly direction and is nearly vertical. A small amount of

* By J. D. McDonald.

development work was done, and some stoping. Ore mined was shipped to the Trail smelter, where payment was made on the silica content.

Production: Ore shipped, 265 tons. Gross content: Gold, 126 oz.; silver, 42 oz.

NELSON*

Silver-Lead-Zinc

Big Mac

(49° 117° SE.) This property consists of five recorded claims owned by R. Pond and R. McCandlish, of Nelson. It is on the south side of Selous Creek, about 3 miles south of Nelson, and extends east from the Great Northern Railroad tracks. Trenching has uncovered some high-grade zinc showings in a zone that has been traced over a short distance. Snow prevented further work on the property.

YMIR*

Gold-Silver-Lead-Zinc

Goodenough, Ymir (Americonda Mines Limited)

(49° 117° SE.) Company office, 117 West Broadway, Waukesha, Wisconsin; mine office, Ymir. This company holds under option the Goodenough and Ymir mines on Ymir Creek, 6 miles by road northeast of Ymir. During the summer No. 2 and No. 4 adits were retimbered and track was repaired. A small amount of raising was done on No. 2 level. Two men were employed.

Gold-Silver

Tamarac

(49° 117° S.E.) George Powell and Lewis E. Lunde optioned this property on October 1st to Pacific Western Metals Ltd. Head office, Rodgers Building, 470 Granville Street, Vancouver. D. Humphreys, president. Previous to the option Powell and Lunde retimbered the main shaft. About 200 tons of ore was crushed and beneficiared, yielding $30 per ton in gold. Some stripping with a bulldozer was done, uncovering a new lead.

SALMO*

SHEEP CREEK (49° 117° S.E.)

Gold

Nugget

This mine, which was formerly part of the Reno holdings in the Sheep Creek area, is owned and operated by A. Endersby, of Fruitvale. A small amount of stoping and development was carried on intermittently during the year.

ASPEN CREEK (49° 117° S.E.)

Silver-Lead-Zinc

H.B. (The Consolidated Mining and Smelting Company of Canada, Limited)

Company office, Trail; mine office, Salmo. J. C. MacLean, property superintendent; H. G. Barker, mine superintendent; N. Doyle, mill superintendent. The H.B. mine is on the west side of Aspen Creek, with the main camp located on the north side of Sheep Creek, 7 miles by road from Salmo. Zinc-lead replacement orebodies in dolomite have been developed by two adits connected by an interior two-compartment vertical shaft. The hoistroom is on the 3500 level, and the main haulage is the lowest or 2800 level. Long ore-pass systems extend from the 2800 level to the ore zones. The main orebodies strike north, are steeply dipping, and are roughly parallel to each other, about 150 feet apart; in cross-section they appear lenticular, and the sides are nearly vertical. The

* By I.D. McDonald.

average width is 50 feet, and the maximum height is 350 feet. Development work over a period of years has outlined the No. 1 or east orebody for a length of 1,400 feet. The main production has been from this orebody. The No. 2 or west orebody was being mined over a length of 600 feet. Additional ore was being mined in two flat-lying ore zones-the X-l zone adjacent to and west of No. 1 orebody and the X-2 zone below and south of X-l. Another zone, No. 4, being developed, lies between No. 1 and No. 2 zones and dips at varying angles to the east from the top of No. 2 zone to the bottom of No. 1 zone.

Stoping in No. 1 and No. 2 ore zones is by blast holes and slusher drifts. The other zones are mined by conventional jackleg stoping methods and scraping to ore-passes. Some difficulty was encountered in No. 1 zone due to sloughing at the top of the ore zone, causing dilution. Corrective measures have been taken to arch the back of the stope in the blast-hole layouts. Development: Drifting, subdrifting, and crosscuts, 4,860 feet; raising, 3,467 feet.

The milling rate averaged 38,625 tons per month, with a total production of 463,504 tons, the highest in the Nelson district. The number of men employed as of December 31st was 118, of whom fifty-four were employed underground.

The mine-rescue team trained regularly underground and competed in the West Kootenay competition. An outstanding record in the mining industry was achieved, with no lost-time accidents of more than six days' duration during 1958 and 1959. At the end of 1959 this property had gone 630 days without a single lost-time accident. This performance won for the mine the Dominion and Regional John T. Ryan Safety Trophies for 1958 and 1959.

[Reference: B.C. *Dept.* of Mines, Bull. No. 41, 1959, pp. 101–103.]

Aspen (Salmo-Malartic Miner, Limited)

This property consists of ten Crown-granted and three recorded claims. It is on Aspen Creek, 3 miles by road north of the H.B. mine. The deposit is a zinc-lead replacement in the Reeves limestone. The property was optioned by The Consolidated Mining and Smelting Company of Canada, Limited, who completed 1,774 feet of surface diamond drilling and 1,596 feet of underground diamond drilling. The option was dropped in November.

Gold-Silver-Lead-Zinc

Double "B" Group

This property consists of ten recorded claims owned by F. W. Cartwright and Son, of Nelson. It is on Hedgehog Creek, east of the H.B. mine. Approximately 1 mile of road leads to the present workings. In 1959, 550 feet of diamond drilling was done and some open-cuts and stripping were prepared for further drilling. The cores of finely banded graphitic argillaceous rock show disseminated pyrite, pyrrhotite, sphalerite, galena, and minor chalcopyrite, and are reported to contain values in gold and silver. The mineralization is apparently extensive.

IRON MOUNTAIN (49° 117° S.E.)

Lead-Zinc-Tungsten

Jersey, etc. (Canadian Exploration Limited)

Head office, 700 Burrard Building, Vancouver; mine office, Salmo. G. A. Gordon, general manager; J. D. Little, assistant general manager; C. M. McGowan, plant superintendent; R. G. Weber, mine superintendent; H. A. Steane, general mill superintendent; E. A. Erickson, superintendent, lead-zinc concentrator. This company is a wholly owned subsidiary of Placer Development Limited. The Emerald, Feeney, Dodger, and Jersey mines, the tungsten concentrator, and the main camp are located on the summit between Sheep Creek and Lost Creek. The property is reached by two roads which leave the Nelson-Nelway Highway 4 and 5½ miles respectively sooth of Salmo. The lead-zinc concentrator is alongside the Nelson-Nelway Highway and is served from the mine by a series of conveyors.

There was no tungsten production in 1959. The Emerald was the last tungsten mine to close on July 31st, 1958.

All production came from the Jersey lead-zinc mine. The ore zones occur in dolomitized limestone along folds which plunge gently to the south. Seven ore zones are now recognized. From west to east they are: A, B, C, D, E, F, and G. Track mining is being used in A, C, and D zones and trackless in A, D, E, F, and G zones. Much of the ore now being developed is in relatively thii, steeply dipping beds, and is mined by conventional open-stoping with jacklegs and slushers. About 35 per cent of the ore is being mined by trackless methods, 40 per cent with jackleg stoping in the trackless section, the remaining 25 per cent comes from the track section of the mine. Trackless haulage is via the 4200 adit to the ore-pass to the underground crusher on the Emerald 3800 level. The main haulage in the track mine is on the 4000 level, where a diesel-electric locomotive transports the ore to the ore-pass system to the underground crusher.

Development of ore in the south "A" zone, below 4000 level, was carried out by sinking a winze, the south "A" winze, 6 by 9 feet at -32 degrees for 240 feet. A 2-ton modiied Granby-type car is being used as a skip, dumping into a bii above the track on the 4000 level.

The ventilation system was improved by the completion of a new drift, 74G, and connecting raise to it from the 4400 Dodger level. This will increase the efficiency of the rated 150,000-cubic-feet-per-minute capacity of the ventilation system. The flow of this system is reversible.

The concentrator treated 325,564 tons of ore during 1959, an average of 27,130 tons per month. Tailings were impounded in the tailings pond near the Saimo River.-

A mine-rescue team practises regularly in the mine, and competed in the West Kootenay Mine Rescue Competition. The property had an excellent safety record, with only one lost-time accident. The average number of men employed was 154, with fifty-nine working underground.

Tungsten King — This property, comprising eighteen Crown-granted mineral claims and fractions, is adjoined on the north by the Emerald and Jersey holdings of Canadian Exploration Limited and on the south by the Truman holdings of American Zinc, Lead and Smelting Company. The claims are owned by L. R. Clubine, of Salmo, and R. 0. and E. Oscarson, of Spokane, Wash. The property is 2 miles from the Nelson-Nelway Highway by way of the Lost Creek road. Stripping with a bulldozer was done during the summer, exposing some new showings.

[Reference: B.C. *Dept. of Mines,* Bull. No. 41, 1959, pp. 152–154.]

NELWAY *

Silver-Lead-Zinc

Reeves MacDonald Miner Limited — (49° 117° S.W.) Company office, 413 Granville Street, Vancouver 2; mine office, Remac. W. L. Zeigler, Metaline Falls, Wash., general manager; L. M. Kinney, Metaline Falls, Wash., general superintendent; F. R. Thompson, property

* By J. D. McDonald.

superintendent; J. Kozar, mine superintendent; J. S. Steele, mill superintendent. Capital: 3,000,000 shares, $1 par value. This company owns the Reeves MacDonald mine on the Pend d'Oreille River, on the Nelway–Waneta road 4 miles west of Nelway. Lead-zinc replacement bodies in limestone have been developed from the main haulage or 1900 level. The ore consists of bands, lenses, and disseminated grains of pyrite, honey-coloured sphalerite, and galena in dolomite. The mine has four orebodies which are being mined. They are the Reeves, B.L., O'Donnell, and No. 4 orebodies and are faulted segments of a single zone.

The Reeves orebody, 3,500 feet from the 1900 portal, is almost mined out above the 1900 level. Above this level it is serviced by an internal 55-degree shaft extending from the 1900 level to the 2650 level. The lower section of the Reeves orebody is serviced by a 52-degree inclined winze in the footwall of the orebody. The winze was steepened to 62 degrees at the 1300 level to keep under the ore, and was bottomed at the 1100 level. From this development, No. 3 shaft was raised from the 1100 level, and timbering was completed from the 1900 level to the 1100 level. A main hoist was installed in the 1900 level hoistroom. Ore pockets were cut and timbered in No. 3 shaft. The 1900 level was extended beneath No. 4 orebody.

The main ore production came from the O'Donnell zone, lesser amounts being obtained from the Reeves and B.L. areas above the 1900 level. Mining is by blast-holes drilled from an undercut which is slashed to the ore boundaries. Improved costs are being obtained by increasing the size of the blast-holes and increasing the burden on the holes.

The mill operated continuously at an average rate of 36,000 tons per month. Concentrates were shipped to smelters in the United States for the first part of the year, and later to the Trail smelter. Mine-rescue and first-aid classes were held at the mine, with a mine-rescue team competing in the West Kootenay Mine Rescue Competition. The number of men employed was 120.

[Reference: ***B.C. Dept. of Mines,*** Bull. No. 41, 1959, pp. 139–146.]

NORTH KOOTENAY LAKE*

RIONDEL (49° 116° N.W.)

Silver-Lead-Zinc

Bluebell (The Consolidated Mining and Smelting Company of Canada, Limited) Company office, Trail; mine office, Riondel. D. S. Campbell, property superintendent; J. B. Donald, mine superintendent; T. F. Walton, mill superintendent. This property is at Riondel on a small peninsula on the east shore of Kootenay Lake, 6 miles by road north from the tram-provincial highway at Kootenay Bay ferry landing. The ore deposits are sulphide replacements in a limestone band about 100 feet thick, striking north and dipping 35 to 38 degrees to the west, under the lake. There are three separate ore zones-the Kootenay Chief on the south end, Bluebell in the centre, and Comfort to the north. The early history of this mine was given in the Annual Report for 1949, in which year the company started an extensive development programme.

The mine is serviced by No. 1 shaft, which is inclined at 3.5 degrees. This shaft is 7 by 20 feet to a point above No. 5 level, where it was widened to 7 by 22 feet for use of the manway as a sinking compartment. It is completely timbered for its entire length of 1,625 feet. The levels are at intervals of 150 vertical feet. In sinking No. 1 shaft from No. 8 to No. 9 level in 1956 a heavy flow of thermal

* By J. D. McDonald.

water, with large quantities of CO_2 gas, was encountered just below No. 8 level. It was found necessary to seal off this flow with a 90.cubic-yard concrete plug just below No. 8 level.

The present development programme is the sinking of No. 2 winze from No. 8 level (elevation, 960 feet) to No. 9A level (elevation, 735 feet) through the foot-wall argillite. Two hundred and twenty-five feet of sinking has been completed, with 110 feet remaining. Pump stations will be established at No. 9A level, and drifting to a point below the downward extension of No. 1 shaft will follow. From this point a number of 4-inch diamond-drill holes will tap the thermal zone and the water will be led off by pipe, pumped to No. 5 level sump, and thence to surface. When the water-level of the thermal zone has dropped sufficiently, No. 1 shaft will be raised to No. 8 level. No. 2 winze was extended to No. 6 level by raising from No. 8 level. An arrangement of a dump door, raise, pocket, and chute allows the transfer of sinking muck directly to the muck skip in No. 1 shaft. The hoist for No. 2 winze is on No. 6 level.

Development work was confined to the Kootenay Chief and Comfort ore zones. The drift on No. 5 level north to the Comfort zone was completed, and raising in the ore from No. 5 level to No. 2 level is now under way. Primary development on No. 8 level has been hampered by thermal water. The 10- by IO-foot ventilation raise from No. 6 to No. 5 level was completed. Development work in 1959 was as follows: 2,546 feet of drifting, 3,659 feet of crosscutting, 3,797.5 feet of raising, and 1,327 feet of timbering. Diamond drilling consisted of 22,734 feet of exploratory drilling on No. 5 level Comfort zone, No. 8 level Kootenay Chief zone, and the remainder on *various* levels gathering additional information.

Production was mainly from the Kootenay Chief zone, although some production came from No. 2 level Comfort zone. A start was made on recovery of longitudinal pillars in the upper levels. Recovery was started on a sill pillar in No. 1 level below one of the old gravel-filled stopes.

A total of 60,531 cubic yards of backfill was placed in empty stopes. This amount was composed of 257 cubic yards of gravel, 8,467 cubic yards of mine waste, and 51,807 cubic yards of deslimed tailings. Deslimed tailings are now used for fill in all the cut-and-fill stopes, and are delivered to the stopes through a system of 4-inch-diameter drill-holes and 4-inch-diameter plastic pipe. The ore-passes in the stopes arc 4 feet in diameter, ¼-inch rolled mild steel plate, in half sections bolted together; these are raised along with the fill during filling operations. Filling of the mined-out shrinkage stopes in the Comfort zone is being carried out by pumping deslimed tailings a distance of 3,800 feet from the storage tank, through a 4-inch plastic pipe laid along the surface; there is a booster pump in series at about 1,500 feet from the tank. In December, 1959, the average amount of water pumped was 3,416 imperial gallons per minute. The capacity of No. 5 level pump station remained the same, but the capacity of No. 8 level pump station is being increased with the installation of two additional 300-horsepower 1,000-gallons-per-minute pumps. Water is discharged to surface through two 12-inch-diameter pipes which follow the No. 1 shaft manway.

The induced ventilation of the mine was maintained at 150,000 cubic feet of air per minute. Local changes are made as development and stoping progress. CO_2-contaminated areas are localized and kept well under control. Ventilation of development headings is by 19- and 24-inch aerofoil dual-duty fans.

An addition to the compressor-house was completed, and two 375-kva. diesel generating units were installed for stand-by power. These two units, together with the 150-kva. unit for the main fans, give installed capacity of 900 kva. for stand-by power.

Mine-rescue and first-aid classes were held. Two mine-rescue teams competed in the West Kootenay competition at Castlegar. The team, captained by B. Ramage, was successful in winning the West Kootenay competition and competed in the Provincial competition in Kamloops. The average number of persons employed was 289, of whom 168 were employed underground.

The concentrator treated 251,366 tons of ore, or 689 tons per calendar day.

AINSWORTH (49° 116° N.W.)

Silver-Lead-Zinc

Highlander, etc. (Yale Lead & Zinc Mines Limited)

Company office, 525 Seymour Street, Vancouver 2; mine office, Ainsworth. H. M. Turner, of Western Mines Limited, is managing the property; C. Anderson, mill superintendent. Capital: 5,000,000 shares, $1 par value. This company controls most of the mineral claims lying between Coffee and Cedar Creeks. The property was closed December 12th, 1958, and since then has been worked by lessees. The mill operated part time, milling ore from lessees of Yale Lead & Zinc Mines Limited, Western Mines Limited, and Caledonia Mines Limited. A three-man crew was employed on a part-time basis.

	Milled in 1959	Silver	Lead	Zinc
Western Mines Limited—	Tons	Oz.	Lb.	Lb.
Lakeshore	720	1,156	118,851	65,074
Florence	3,270	6,685	439,679	180,168
Yale Lead & Zinc Mines Limited	5,880	10,799	760,934	211,130
Totals	9,870	18,640	1,319,464	456,372

Banker.-P. Gilchrist and C. Hartland, leasing the Banker vein, hand-sorted ore and shipped it to Trail smelter. Production: Ore shipped, 142 tons. Gross content: Silver, 3,465 oz.; lead, 184,931 lb.; zinc, 11,499 lb.

Highlander.-T. G. Laughton and partners worked on the 2150 adit level, cleaning down old stopes and removing pillars. The main work was done at the north end of 2150 north drift. Production: Ore milled, 5,880 tons; lead ore shipped, 44 tons.

Kootenay Florence, Lakeshore (Western Mines Limited)

Company office, 850 West Hastings Street, Vancouver 1; mine office, Ainsworth. H. M. Wright, president; H. M. Turner, superintendent, Capital: 3,000,000 shares, $1 par value. This company owns a large group of mineral claims lying south of Lendrum Creek and astride Princess Creek. The mine plant and mill are on the Nelson-Kaslo Highway 2 miles north of Ainsworth. Lessees N. B. Sirak and partners mined in the Kootenay Florence during the early part of the year. In the Lakeshore they did 200 feet of raising and crosscutting in ore on No. 2 and No. 3 levels. Diamond drilling amounted to 285 feet, some new ore being found 60 feet south of 9370 crosscut on No. 2 level. The ore was trucked to the Yale Lead & Zinc mill and the concentrates were shipped to the Trail smelter.

Production: Ore milled, 3,990 tons.

WOODBURY CREEK*

Gold-Silver-Lead-Zinc

Scranton (Scranton Mines Limited) (49° 117° N.E.) Company office, 1519 Marine Building, 355 Burrard Street, Vancouver 1. A. A. Lceb, president: C. J. Bailer, general manager. Capital: 3,000,000 shares, $1 par value. This company owns the Scranton group of claims in Kokanee Glacier Park, astride Pontiac Creek, a tributary of Woodbury Creek. The mine camp is on Pontiac Creek, at an elevation of 5,600 feet, and is reached by 11% miles of road from a point on the Nelson–Kaslo Highway 8 miles south of Kaslo. One man was employed reopening the mine road and stripping on the Pontiac claims. Plans are to reopen the mine in the spring of 1960.

PADDY PEAK*

Silver-Lead-Zinc

Utica (Lajo Mines Limited) (49" 117" N.E.) Company office, 717 West Pender Street, Vancouver 1; mine office, Kaslo. J. A. Cooper, manager. This company holds a long-term lease on the Utica mine (which had been operated under lease from 1953 to 1956 by J. A. Cooper) from Utica Mines (1937) Limited, The mine is at the head of Twelve Mile Creek, about 15 miles by road from Kaslo. The main haulage level is No. 7 adit (elevation, 5,950 feet), with a diesel locomotive hauling to the coarse-ore bin on surface.

Development work during the year consisted of 350 feet of drifting and 360 feet of raising. No. 5 level drift was extended 300 feet to the south to check the downward extension of the veins on No. 1 and No. 2 levels. Another 200 feet is to be driven. Raising consisted of a 250-foot ore-pass from No. 7 level to No. 5 level and the remainder was stope development above No. 5 level. Milling is to begin in January, 1960, in the 50-ton mill on the property. Nine men were employed at the end of the year.

A new section of road was completed in December. This goes above the rock bluffs and is a considerable improvement.

RETALLACK-THREE FORKS*

Silver-Lead-Zinc

Caledonia (Caledonia Mines Limited) (50" 117" S.E.) Company office, 609 Baker Street, Nelson; mine office, Kaslo. Charles Lind, Kaslo, president and manager. Capital: 100,000 shares, 50 cents par value. This company had under option the Caledonia mine near Blaylock from G. E. McCready, of Kaslo. No. 3 adit was driven north 38 degrees east from the old Kaslc-New Denver Highway a distance of 624 feet, where the ore zone was intersected. Drifting was done for about 100 feet along the vein, which was irregular. This section of vein is 200 feet below the vein in No. 2 adit; it has the same strike, south 80 degrees east, and an apparent dip of 80 degrees to the south. Three hundred tons of ore from No. 2 adit was shipped to the Yale Lead &Zinc concentrator. The option an the property was dropped in October.

Texas, Cowboy, Fourth of July, etc. (Lucky Edd Mines Limited).-(50" 117" S.E.) Company office, Edmonton, Alta.; mine office, Retallack. P. E. Colthorp, manager; H. E. Singel, superintendent. This company has optioned a group of Crown-granted mineral claims at the headwaters of Robb Creek, a tributary of Kaslo River.

* By J. D. McDonald

Snap, Lucky Jim

(SO" 117" SE.) The Snap claim and the Lucky Jim mine at Zincton are leased to a group known as the Lucky Four Leasers under the direction of Richard E. Martin, of New Denver. The Snap is owned by J. L. Drumheller, of Spokane, Wash., and the Lucky Jim by Sheep Creek Mines Limited, of Nelson. A shipment of 504 tons of ore was trucked to the Carnegie mill at Sandon.

SANDON*

Silver-Lead-Zinc

Silver Mountain Mines, Ltd.

(49" 117° N.E.) Company address, 405 Canadian Bank of Commerce Building, Calgary; mine office, Sandon. A. C. Weich, president; Ted Kleim, manager. Capital: 20,000 shares, no par value. This company controls the old Reco property of twenty-six Crown-granted claims and fractions, and holds two recorded claims on the south slope of Reco Mountain. The property adjoins the east boundary of the Cody-Reco property. Access is by 2 miles of road from Cody to a new adit at 5,300 feet elevation, which has been designated No. 16 adit in relation to the near-by Cody-Reco workings. The company did 90 feet of raising and 40 feet of drifting. This property was leased to E. Bordula and three partners during the summer. Production was 552 tons, which was concentrated at the Carnegie mill.

Silversmith, etc. (Carnegie Mining Corporation Limited)

(49" 117" N.E.) Company office, 416, 25 Adelaide Street West, Toronto; mine office, New Denver. George A. MacMillan, president; J. C. Black. manager. Capital: 5,000,000 shares, no par value. In January, 1958, by terms of an agreement with Violamac Mines Limited, Carnegie Mines of British Columbia, Ltd., was reorganized to form Carnegie Mining Corporation Limited. This company owns forty-$x Crown-granted and six recorded claims and fractions, property that includes the Silversmith. Slocan Star, Richmond-Eureka, Ruth-Hope. and Slocan King mines on Sandon Creek, south of Sandon.

The Richmond-Eureka was leased to E. Perepolkin, L. Fried, and A. Maxinuk. The main work was done on the northeast limits of the orebody between No. 6 and No. 4 levels. Production was514 tons of mill-feed, which produced 46 tons of lead concentrates and 101 tons of zinc concentrates. In addition, 14 tons of lead ore was shipped to the Trail smelter.

The Ruth mine was leased to E. and J. Perepolkin and L. Fried. Production was from two sublevels which were driven off the main raise connecting No. 3 and No. 4 levels. Mill-feed of 540 tons produced 26 tons of lead concentrates and 155 tons of zinc concentrates. In addition, 18 tons of lead ore was shipped to Trail.

The Hope mine was leased to E. H. Petersen and A. Maxinuk. Extensive stripping was done with a bulldozer in the vicinity of No. 4 and No. 1 portals. A hangingwall vein, discovered near No. 4 portal, was followed by a drift for 20 feet and produced 2 tons of lead ore.

The concentrator, employing a crew of three men, milled 7.747 tons of ore, of which 5,990 tons was the production from the Victor mine and 2,130 tons was from the various lessees in the district.

Victor (Violamac Mines Limited)

(49" 117° N.E.) Company office, 416, 25 Adelaide Street West, Toronto: mine office, New Denver. Mrs. Viola MacMillan, president: J. C. Black, manager, western operations. Capital: 5,000,000 shares, $1 par value. This company

* By I. D. McDonald.

owns the Victor mine, 2½ by road northwest of Sandon, or 2% miles by road southeast of Three Forks. Development and stoping continued in the west end of No. 5 level. A raise was driven from the 4150 sublevel under the western productive section of No. 5 level, and from this two sublevels were driven 150 and 50 feet. The first was 25 feet and the second was 50 feet below No. 5 level. In the same area a second raise was driven, and a sublevel was established 30 feet above No. 5 level. On No. 7 level 130 feet of crosscutting was done to complete the work that was started the previous year to by-pass a section of heavy ground.

Production was 6,028 tons of mill-feed, which produced 703 tons of lead concentrates and 896 tons of zinc concentrates. In addition, 39 tons of crude lead-silver ore was shipped to Trail. The main production was from the No. 5 west section, the remainder coming from the Victor orebody adjacent to No. 7 level. The average number of men employed was nineteen. There were no lost-time accidents during the year.

Wonderful (Silver Ridge Mining Company Limited)

(49° 117° N.E.) Company office, 373 Baker Street, Nelson. H. F. Magnuson, Wallace, Idaho, president. Capital: 5,000,000 shares, 50 cents par value. This company owns a large group of claims southwest of Sandon. The claims lie between the holdings of Violamac Mines Limited and those of the Carnegie Mining Corporation Limited. Early in 1959 Violamac Mines Limited obtained a lease on this property, and the short adit 100 feet above No. 2 level, started in 1958 by R. McLanders, was extended 56 feet. Production from this work was 11 tons of lead ore, shipped to the Trail smelter.

Lone Bachelor (Lone Bachelor Mines Limited)

(49° 117° N.E.) This company is controlled by Violamac Mines Limited, which owns the adjoining Victor property. The mine was leased to E. Perepolkin, L. Fried, E. DeRosa, and V. C. Hanson in the latter part of 1959. A 7-foot winze was sunk on No. 2 vein from No. 4 level, the bottom level in the mine. Production was 18 tons of lead ore. Mill-feed was stockpiled.

SLOCAN LAKE*

Silver-Lead-Zinc

Mammoth, Standard, Monarch, Enterprise (Western Exloration Company Limited)

(49° 117° N.E.) Company office, 38 South Dearborn Street, Chicago, Ill.; mine office, Silverton. M. P. McCullough, Chicago, president; A. M. Ham, Silverton, managing director; J. M. McDearmid, manager; R. A. Avison, mine superintendent; C. E. Towgood, mill superintendent. Capital: 2,000,000 shares, 50 cents par value. A management contract is held by H. L. Hill and Associates, consulting mining engineers, Vancouver. The company owns the Mammoth, Monarch, and Standard mines near Silverton, and the Enterprise mine on Enterprise Creek, 12½ miles by road south of Silverton. The operations of Western Exploration Company Limited were suspended on June 20th, 1959.

Prior to the suspension of operations considerable development work was done. The road to No. 12 adit portal was widened and a surface ore-bin was built. On No. 12 level the downward extension of the Mammoth ore zone was reached by the 2,600.foot-long crosscut which was driven parallel to the Buffalo vein. The Mammoth lode was found to contain the same sort of mineralization as had been mined above No. 9 level. A limited amount of drifting was done and a 51-degree raise to

* By J.D. McDonald.

No. 9 level was started in the footwall of the lode. A station was cut at 170 feet, and the raise was 180 feet long when work ceased. Oxygen deficiency prevents access to the raise unless ventilation is provided.

While operating, twenty-one men were employed underground and seven were employed widening the road. There was no production. The 250-ton concentrator remained idle.

Bosun (New Santiago Miner Limited).—(49° 117° N.E.) Company office, 511, 850 West Hastings Street, Vancouver 1. R. Crowe-Swords, president. Capital: 3,000,000 shares, 50 cents par value. The Bosun mine is on the east shore of Slocan Lake, 1½ miles south of New Denver on the Nelson–Nakusp Highway. The main haulage, No. 6 adit, is driven beneath the highway from a site 40 feet above the lake. W. H. McLeod, of Silverton, with the aid of two partners, is sinking a winze on the main vein to a proposed depth of 100 feet.

Galena Farm.—(49° 117° N.E.) Frank Mills, of Silverton, holds a lease on this mine, 2 miles by road south of Silverton. Mining was done on a short vein east of the "Camels Hump" stope on the main vein. The ore is by-passed down to the main level and trammed to the ore-bin at the old mill-site. The ore was trucked to the Western Exploration concentrator, where it was stockpiled.

Westmont (Silver King Miner Limited).—(49° 117° N.E.) This property is owned by J. A. Cullinane, of the Ellis Syndicate of Nelson. It consists of nine Crown-granted mineral claims and fractions on the north side of Enterprise Creek, opposite the Enterprise *mine.* Silver King Mines Limited had an option on this property but dropped it in the summer of 1959. Approximately 210 tons of ore was shipped.

NORTH LARDEAU*

FERGUSON (50° 117° N.E.)

Silver-Lead-Zinc

Black Warrior, **Elsmere.**—This property, owned by J. Main, of Ferguson, is at the headwaters of Ferguson Creek, 10 miles by trail from Ferguson. Minor repairs were made on the trail.

HALL CREEK (50° 117° N.E.)

Silver-Lead-Zinc

Bannockburn.—J. Gallo, of Howser, owns the Bannockbum group of Crown-granted mineral claims. The Shelagh group of five adjoining mineral claims is owned by Sheep Creek Mines Limited. This property is on the south side of the headwaters of Hall Creek, a tributary of Duncan River, about 19 miles north of the head of Duncan Lake, on the northeast side of Mount Abbott. The property is reached by 17 miles of road from a point on the Lardeau–Gerrard Highway, about 3 miles south of Gerrard, up Healy Creek to the summit into Hall Creek basin. During the summer a new road, about 3 miles long, was built from the summit down to Bannockburn Creek.

Wagner.—J. Gallo, of Howser, owns the Wagner group of Crown-granted mineral claims on the north side of the headwaters of Hall Creek, a tributary of Duncan River. The property

* By J. D. McDonald.

is reached by the same road that provides access to the Bannockburn group. A cat-road was built in 1959 from the summit north to the claims. No work was done on the claims due to the heavy snow-pack remaining.

SOUTH LARDEAU*

Silver-Lead-Zinc

J.G. (The Consolidated Mining and Smelting Company of Canada, Limited) (50° 116° S.W.) Company office, Trail. Property superintendent, J. J. McKay. This company has an option from Joe Gallo and associates, of Howser, on a group of about fifty mineral claims extending north from Glacier Creek to the north end of the peninsula on the east side of Duncan Lake. The claims are mostly held by record; one on the south end of the peninsula is Crown granted (Lot 14371) and eight claims straddling the ridge north of Glacier Creek are held by the company as a retention lease. The property, once known as the Amato-Ruby and Glacier groups, in recent years has been called the J.G. and is referred to by the company as the Duncan property. The claims cover a band of limestone mineralized with galena and sphalerite. The showings over a strike length of about 5 miles have been explored from time to time by trenching, diamond drilling, and underground work (see Annual Report, 1952, p. A 192). The most extensive underground working is an adit driven in 1952 on the slope north of Glacier Creek. The present exploration by The Consolidated Mining and Smelting Company of Canada, Limited, was started in 1957. Geological mapping in 1957 and mapping and diamond drilling in 1958 disclosed an extensive zone of lead-zinc mineralization. Drilling was continued in 1959, and an adit was driven on the peninsula to crosscut the mineralized zone.

Mineralization is in a band of limestone a few hundred feet thick that strikes about north 15 degrees west and dips steeply to the east. It is on the eastern limb of an overturned anticline plunging gently to the north. Quartzites, micaceous quartzites, and phyllites which occupy the core of the anticline underlie the limestone, and dark-grey phyllite and argillite which are found on the liibs of the anticline overlie the limestone. The limestone is correlated with the Badshot formation, the underlying quartzites with the upper part of the Hamill series, and the overlying phyllites and argillites with the lower part of the Lardeau series (see *Geol. Surv., Canada, Mem.* 161 and Map 12-1957). Close geological work by the company has established details of the stratigraphic succession that have facilitated the interpretation of diamond-drill data and the defining of mineralized zones. A series of phyllite, quartzite, and calcareous rocks containing recognizable markers is immediately below the limestone. The limestone. itself contains beds and lenses of dolomite and dark-grey to black siliceous dolomite, which to some extent have affected mineralization.

Mineralization on the ridge north of Glacier Creek is in the lower part of the limestone formation and appears to form lenses with long axes plunging gently northward parallel to the plunge of dragfolds and nearly parallel to the northwest slope of the ridge. Considerable exploration of the showings has been carried on in the past, and in 1959 four holes were drilled near the crest of the ridge and on the northwest slope almost 1,500 feet in elevation above Duncan Lake. Continuity of the sulpbide lenses in depth in a direction at right angles to the plunge was not established.

* By J. D. McDonald and J. T. Fyles.

Diamond drilling on the peninsula discovered a zone containing sphalerite, galena, pyrite, and very minor pyrrhotite extending across the peninsula parallel to the formational trend.

In the northern part of the peninsula, where most exploration has been done, the sulphides appear to be localized in a breccia dipping steeply to the east. The limits of the mineralized zone are not known, but drilling results have been encouraging enough for the company to begin underground exploration.

In the summer of 1959 an adit was collared on the west side of the peninsula at an elevation of about 1,800 feet, 35 feet above the level of Duncan Lake. The adit was driven east for a distance of 990 feet to the mineralized zone. Drifts were then extended to the north and to the south along the strike. The main part of the drifting has been to the south. Crosscuts to the west for diamond drilling are being completed at regular intervals. Drilling commenced in November.

Drifting and crosscutting in 1959, 2,469 feet; underground diamond drilling in 1959, 1,744 feet.

Ventilation is by a 19-inch dual-duty reversible aerofoil fan, rated 5,000 c.f.m. at Y .6-inch water-gauge, with 24-inch-diameter 20-gauge fan pipe. An additional 19-inch fan will be installed in series when required. Transportation is by a 38-horsepower diesel locomotive using 3-ton V-cars. Drilling is done with a 3-boom jumbo using carbide bits. Three-man mining crews average 8 feet of advance per shift.

The mine and camp-site is 4 miles by boat north of Howser. Until November, 1959, the only means of access to the property was by water. All building material, equipment, fuel, and other supplies were transported from Howser on log rafts equipped with two outboard motors.

Seven miles of new road extending north from the road on the east side of Duncan Lake to the mine was completed in November. One mile of the old road along the lake was widened. From Howser the road to the mine runs 2 miles south to the bridge at the south end of the lake, 1 mile east from the bridge, and 9 miles north along the lake and across the peninsula.

The buldings at the mine camp are prefabricated. The shop, compressor, and diesel generator buildings are of galvanized-steel construction; the warehouse and office, cook-house, change-house, bunk-house, and two residences are of prefabricated plywood-panel construction.

At the end of 1959 there were twenty-three men employed plus five diamond-drillers working underground. There were no lost-time accidents.

Additional work was done on the surface at the south end of the property. During the summer 2,728 feet of surface drilling was done, an average of eleven men being employed.

[References: Walker, J. F.. Bancroft, M. F., and Gunning, H. C., Lardeau map-area, British Columbia, *Geol. Surv.*, Canada, Mem. 161 (1929); Reesor, J. E., Lardeau (East Half), *Geol. Surv., Canada,* Mzp 12-1957; *Minister of* Mines, B.C., Ann. Rept., 1952, p. A 192.1

Lead-Zinc

Mag (The Consolidated Mining and Smelting Company of Canada, Limited)

(SO" 116" S.W.) Company office, Trail. Prospecting during the summer of 1959 by this company has discovered, south of Glacier Creek, lead-zinc mineralization similar to that on the J.G. property. It occurs in the same band of limestone and in a repetition of this limestone on the western limb of the anticline referred to in the report on the J. G. As a result of this prospecting, the Consolidated company located nineteen claims astride the ridge between Glacier and Hamill Creeks, 4½ miles by road southeast of Howser and 2% miles east by access road. A portion of the property covers claims previously known as the Bonaventure on the south side of Glacier Creek, and the Al and High Hope on the north side of Hamill Creek. Approximately 4,000 feet of a proposed 2½-mile access road was constructed late in the fall.

CRESTON*

Gold-Copper-Tungsten

Option (49' 116" S.E.) Mr. and Mrs. R. T. Drury, of Kitchencr, hold twenty-five claims 2 miles east of Kitchener and one-half mile north of the main highway to Cranbrook. Pits have been dug exposing four separate veins. On the north end of the claims there are two quartz veins, 4 to 6 feet wide, striking north 30 degrees west and dipping steeply to the northeast. These veins appear to be parallel. On the south end there are two veins which appear to be shear zones, 4 to 8 feet wide, striking north 10 degrees west and dipping steeply to the north. The country rock consists of granodiorite and quartzite.

The veins contain copper, gold, and tungsten (scheelite). No systematic sampling has been done.

KIMBERLEY†

Silver-Lead-Zinc

Sullivan (The Consolidated Mining and Smelting Company of Canada, Limited) (49" 115° N.W.) Company office, 215 St. James Street West, Montreal; western headquarters, Trail. W. S. Kirkpatrick, Montreal, president; R. D. Perry, Trail, vice-president and general manager. Sullivan mine office, Kimberley. J. R. Geigerich, general superintendent; R. M. Porter, mine superintendent: H. J. Chalmers, Chapman Camp, superintendent, Sullivan concentator. The Sullivan mine is on Mark Creek 2 miles north of Kimberley and the concentrator is at Chapman Camp, 2 miles south of Kimberley. The holdings include 678 Crown-granted claims and fractions. The following report, prepared by the management, is a synopsis of the operations.

" During 1959, the Sullivan Mine produced and the Concentrator treated about 2,440,000 tons of ore. Sixty-nine per cent was produced from the section above 3900 level and thirty-one per cent from below 3900 level.

" One of the significant points of the year's operation was the blasting of one of the mine's largest pillars in a single blest. In this blast 57.0 tons of powder was used to break 1,060,000 tons of ore. The ore is being drawn through 105 drawholes to eight slusher drifts.

" Development footage was 73,912 feet. This is the highest footage for any year and 41% above the 1958 total. Extending No. 1 pilot shaft a distance of 533.5 feet to a point 270 feet below the 2,500-foot level and raising the main shaft a similar distance was completed during the year. Placing of steel shaft sets was started.

" The revision to No. 27 shaft was completed in 19.59. The total amount of development involved in this program was 736.5 feet, of which 437.5 feet was actual shaft footage. In addition to this, excavations were completed for a new hoist-room, a motor-generator and transformer station, and shop area.

* By J. D. McDonald.
† By D. R. Morgan.

"A total of 523,600 cubic yards of fill were placed, made up as follows: 167,195 cubic yards of float fill; 354,135 cubic yards of planned cave; 2,270 cubic yards of development waste fill. No gravel fill was placed during the year.

" Primary ventilation of the mine was done by eleven fans, using 1,375 H.P. Volume of air handled was in the order of 1,000,000 c.f.m. or four tons of air for every ton of ore produced.

" The safety program at the Mine and the Concentrator was effective in reducing the frequency of accidents to an all-time low. The Concentrator had 3 lost-time accidents and 150 days time loss, to give a frequency of 3.7 and a severity of 185 per million man-hours worked. The Mine had 26 lost-time accidents and 1,334 days time loss, to give a frequency of 14.4 and a severity of 740 per million man-hours worked. One fatal accident occurred underground in July, 1959.

"Eight Sullivan employees obtained their Industrial First Aid certificates. A two-week Mining School for eight new miners was held. Total trained since 1947 has been 339. Six men were trained in Mine Rescue work and obtained their Department of Mines certificates. Total trained since 1930 has been 255. A ten-hour Job Safety Training Course was given to 28 supervisors. The sixth 8-hour session in Rescue Squad Training was attended by 20 active Mine Rescue men. A five-man Mine First Aid team won the East Kootenay First Aid competition, and was second in the Provincial Workmen's Compensation Board competitions, held at Kamloops.

" The Concentrator operated 253 days during 1959 at an average of 9,650 tons per day. Employees totalled 1,380 at the year-end, with 984 at the Mine and 396 at the Concentrator."

SKOOKUMCHUCK*

Tungsten

Molly (The Consolidated Mining and Smelting Company of Canada, Limited)

(49" 116" N.E.) This property, comprising four mineral claims owned by The Consolidated Mining and Smelting Company of Canada, Limited, is on the north fork of Skookumchuck Creek. It is at an elevation of 7,500 feet, and is reached by 32 miles of logging-road and 7 miles of trail from a point on the highway near Torrent. The claims cover a showing of scheelite and skarn in recrystallized limestones near a granite batholith. During 1959 the company employed a small party of men conducting a mapping and trenching programme for a period of six weeks. Some twenty-six shallow cots and trenches were made exploring for extensions to the showing.

WINDERMERE†

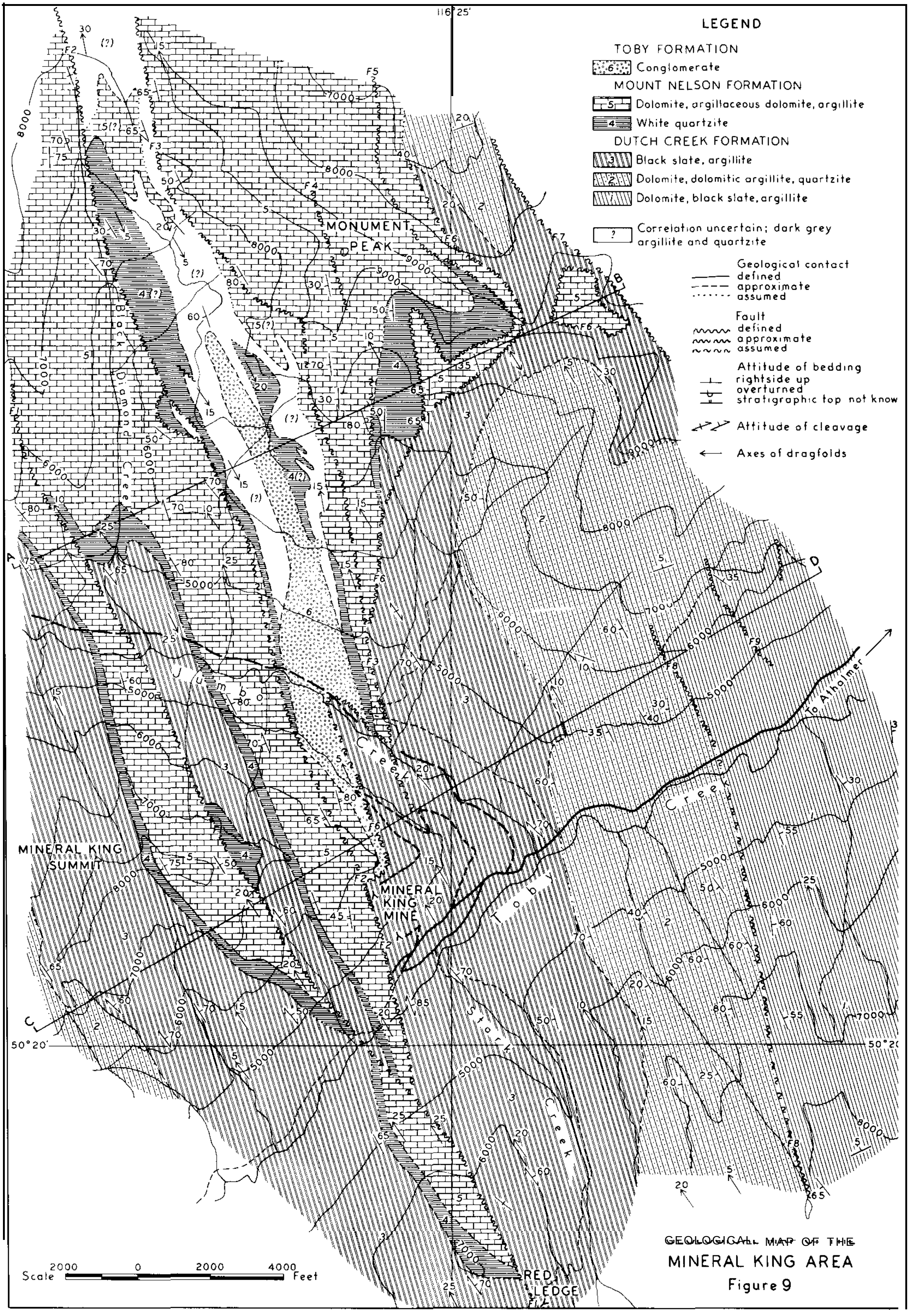
TOBY CREEK (50" 116" S.E.)

Silver-Lead-Zinc

Mineral King (Sheep Creek Mines Limited)

Company office, 6. 490 Baker Street, Nelson; mine office, Toby Creek. H. E. Doelle, managing director; J. B. Magee, resident manager. This mine is at Toby Creek, 28 miles by road southwest of Athalmer, on the Toby Creek side of the ridge between Jumbo and Toby Creeks. Showings of lead-zinc mineralization were discovered about 1898 on the Mineral King property, at an elevation of about 5,500 feet on the Toby Creek slope. They were explored by two short adits and several surface trenches, mainly between about 1915 and 1922.

* By D. R. Morgan.
† By J. T. Fyles.



~~GEOLOGICAL MAP OF THE~~
MINERAL KING AREA
Figure 9

The Sheep Creek company, which acquired the property in 1950, diamond drilled the showings in 1950, 1951, and 1952 and began underground exploration. A mill, plant, and camp were built in the valley of Toby Creek below the showings in 1953, and production of lead and zinc concentrates began early in 1954. Production has continued at an average rate of 12,000 to 16,000 tons per month, and to the end of 1959 totalled 935,765 tons. Gross content of concentrates: Silver, 679,503 oz.; copper, 748,027 lb.; lead, 30,908,707 lb.; zinc, 74,418,611 lb.; cadmium, 262,147 lb. The production of barite began in 1959, and during the year 8.081 tons of barite was shipped.

The orebodies at the Mineral King mine are replacements of dolomite by barite, sphalerite, galena, and pyrite. The geological relationships between the various rock units in and near the mine and the distribution of the orebodies is complex. A geological study of the mine area was started in the field season of 1957 by the late C. G. Hewlett and was continued in 1959 by the writer. About ten weeks were spent on the field work in 1957 and about eight weeks in 1959. The work in 1957 was confined mainly to 40-scale underground mapping and 200-scale surface mapping of the ridge between Toby and Jumbo Creeks. In 1959 this work was reviewed, and an irregular area of about 25 square miles centred on the mine was mapped on a scale of 1,500 feet to the inch (see Fig. 9).

Stratigraphy.—The area studied, which will be referred to as the Mineral King area, is within the Windermere area mapped by J. F. Walker (1926) between 1922 and 1924 and is also covered by the Lardeau (East Half) sheet mapped by J. E. Reesor between 1953 and 1956. These regional studies established that rocks in the Mineral King area are part of a thick sequence of late Precambrian sedimentary rocks in the upper part of the Purcell and lower part of the Windermere systems. The Dutch Creek and Mount Nelson formations of the Purcell system form a conformable sequence overlain unconformably by the Toby formation, at the base of the Windermere.

The most easily identified marker bed in the Mineral King area is a white quartzite comprising the basal member of the Mount Nelson formation. In general the quartzite is blocky, with poorly defined joints more or less parallel to the bedding and a few inches to a few feet apart. Quartz grains are difficult to see in the field, but thin sections reveal clear rounded grains less than a millimetre in diameter surrounded by quartz grains less than a tenth of a millimetre across and minor sericite. West of the Mineral King mine, on the steeply dipping limb of a large fold, the quartzite is 100 to 200 feet thick. On a gently dipping part of the fold the quartzite is as much as 500 feet thick. The white quartzite grades upward through a few tens of feet of platy grey micaceous quartzite into a sequence of dolomites and argillites.

The dolomites and argillites overlying the basal quartzite are referred to here as the Mount Nelson dolomites. They form a thick, apparently conformable succession consisting of very fine-grained buff- to brown-weathering grey dolomite with argillaceous interbeds. Dolomite beds range from less than a foot to several feet thick, and some beds have a very fine internal banding brought out by weathering. Interbeds of argillite a few feet to a few tens of feet thick are found in the dolomite, and much of the dolomite is argillaceous. The argillite is mainly dark grey but locally is greenish or brownish. In general the Mount Nelson dolomites are resistant to erosion and form bluffs and high peaks. Although they are well exposed and contain a somewhat varied sequence, detailed subdivisions of the succession have not been made. West of the mine, on the north slope of Toby Creek, the lower part of the succession consists of several alternations of grey dolomite and greenish or greyish phyllitic argillite as much as 100 feet thick, above which is several hundred feet of blocky grey dolomite. This blocky dolomite appears to be the uppermost member exposed near the mine, but to the west, a short distance east of Mineral King Summit, an infold of brownish siliceous argillite overlies the dolomite.

On the southeast face of Monument Peak the first 300 feet of beds above the basal quartzite consists of blocky buff dolomite overlain by dark-grey argillaceous dolomite overlain in turn by platy buff dolomite. The dolomites are separated from the quartzite by a fault of unknown but probably small displacement. The next 200-foot section is a prominent blocky light-grey bed of dolomite which is overlain by a distinctive sequence of seven or eight brown-weathering beds 3 to 10 feet thick. These beds form the crest of the south ridge and the summit of Monument Peak. They are overlain by grey dolomite and dark-grey slaty argillite on the western slope. of the south ridge, and are truncated on the west by a fault that crosses the southwestern slopes of the mountain (see Fig. 9).

The basal quartzite of the Mount Nelson formation is underlain by 1,000 to 3,000 feet of dark-grey to black slate in the upper part of the Dutch Creek formation. The contact of the quartzite with the underlying slate is sharp and apparently conformable. Near the mine, thin beds of greyish-green slate follow the contact a few feet below the quartzite. In much of the Mineral King area the slate is

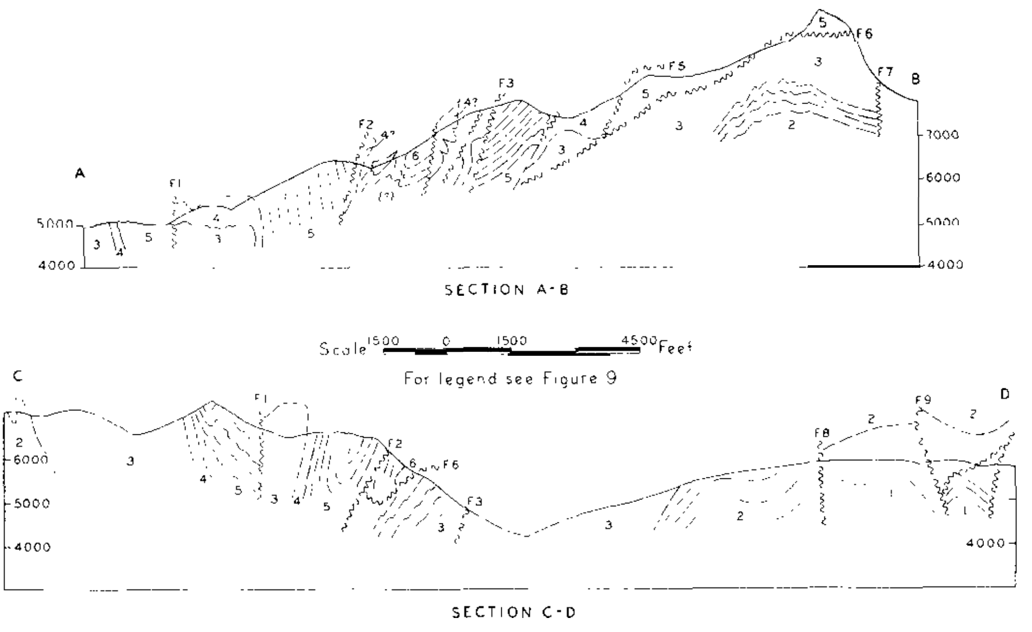


Figure 10. Geological cross-sections, Mineral King area.

strongly cleaved, but in the northeast and southwest corners of the area, and locally at other places, the cleavage is poorly developed and the rocks are more correctly referred to as argillites than slates. The cleavage may obscure the bedding, but bedding is conspicuous in many exposures. Where both bedding and cleavage are seen, they are rarely parallel. Lenticular beds of greyish-brown quartzite are present at various places in the section. They are interbedded with black slates; individual beds of quartzite are a few inches to a few feet thick, and in the aggregate are several tens of feet thick. One prominent series of quartzitic beds is found 1,000 to 1,500 feet east of the mine. Green and light-grey slates are present locally in the black slate. They are well exposed on the ridge between Toby and Stark Creeks and in the canyon of Jumbo Creek, but have not been mapped.

The slates arc underlain by about 100 feet of buff-weathering dolomite which grad-s downward into several hundred feet of interbedded buff-weathering dolomite and green or grey siliceous argillite. Beds are a few inches to a foot thick and are well defined. Cleavage is inconspicuous. These dolomitic rocks grade downward into greyish and greenish thin-bedded argillaceous quartzites. Some of the quartzites have a poor cleavage, but mainly they are blocky, with well-defined beds a few inches to about a foot thick. They are several hundred feet thick and form prominent ridges on both sides of Toby Creek east of Jumbo Creek. The total thickness of rocks between the base of the quartzites and the base of the uppermost black slate on the north side of Toby Creek is estimated to be about 1,500 feet.

The stratigraphic sequence below the quartzites is not well known because the rocks are exposed in only one small part of the Mineral King area. In this part, along the valley of Toby Creek east of the mine, the structure is complex. Black argillite ranging in thickness from a few tens of feet to several hundred feet underlies the quartzites. The argillite is underlain by a few hundred feet of buff-weathering dolomite which in turn is underlain by more black argillite. Another member of dolomite underlies the argillite and constitutes the oldest rock exposed within the Mineral King area.

The Toby formation unconformably overlies the Mount Nelson and Dutch Creek formations. The Toby is mainly conglomerate, but as mapped by Walker (1926, p. 13) it included a variety of rock types. The only rocks in the Mineral King area that can be correlated with certainty with the Toby formation are conglomerates extending northwestward from the mine to the western slope of Monument Peak. Immediately north of the mine the conglomerate weathers light brown and is composed of fragments of white quartzite and grey dolomite with minor phyllite and argillite in a siliceous and somewhat micaceous matrix. The fragments are mainly angular, average 1 to 6 inches across, and form a high proportion of the rock. North of Jumbo Creek the conglomerate has a greenish-grey cast. The fragments are mainly grey and white quartzite in a greyish-green argillaceous matrix. The conglomerate is found only in a zone of complicated structure, and relationships between the conglomerate and adjacent rocks in the area require considerable interpretation. The base of the conglomerate is well defined, but at only two places is it known to be well exposed. At one place, immediately north of the mine (see Fig. 9) on the western side of bluffs of conglomerate, the formation is in contact with grey dolomite presumed to belong to the Mount Nelson formation. The contact is sharp, and rocks near the contact are blocky, without bedding or cleavage. The contact is steeply dipping, broadly folded, and in part is overturned. The other place where the base of the conglomerate is exposed is at an elevation of about 7,200 feet on the south side of the cirque west of Monument Peak. The contact is gradational, from grey siliceous argillite upward through greyish-green quartzite into siliceous conglomerate containing scattered pebbles. The argillite and quartzite, which are thinly bedded, have the form of an open syncline containing the conglomerate. Correlation of the argillite with other formations in the Mineral King area is uncertain. Rocks overlying the conglomerate have not been recognized, although regional maps show overlying formations immediately north and south of the area.

Structure.—The rocks in the Mineral King area are complexly folded and are transected by many faults. The regional structure consists of relatively open folds plunging gently to the northwest, which together form a broad geanticline extending across most of the Purcell Mountains (see Reesor, 1957; Walker, 1926). Southwesterly dipping thrust faults and north to northwesterly trending normal faults are common.

The Mineral King area includes a belt of steeply dipping beds striking to the northwest between two broad anticlines which are largely outside. the area. Many north and northwesterly trending faults are present. For descriptive convenience the faults have been numbered (see Fig. 9), without regard to type. Mainly they are steeply dipping normal faults downthrown on the west. Two important faults, F5 and F6, and several smaller faults between F5 and F2 are westerly dipping thrusts. The pattern of folding and of thrust faulting has resulted from a relative. movement of west over east. The place of the normal faults in the history of deformation is uncertain, but it is known that the rocks have been subjected to multiple deformation. They have been folded, faulted, crushed, and brecciated with subordinate shearing and flowage.

Faults.—F1 is essentially vertical and strikes north 25 degrees west through most of the Mineral King area. To the north it swings to almost due north in strike and dips moderately to the west. Judging from the relative positions of the basal quartzite of the Mount Nelson formation on either side of the fault on the ridge between Jumbo and Toby Creeks, the vertical displacement on Fl is of the order of 4,000 feet down on the west. The fault zone, which is well exposed at a number of places, contains only a few feet of sheared and crushed rock.

F2 is more complex and less well defined than F1. It is readily traced from the upper part of Black Diamond Creek to the slope north of Jumbo Creek. In thii area it dips steeply to the southwest and marks the contact between a synclinal mass of Mount Nelson dolomite on the west and complexly folded quartzite, argillite, dolomite, and dolomite breccia to the east. The fault probably continues south of Jumbo Creek and passes a short distance west of the Mineral King mine, where it forms the contact between the upper slate member of the Dutch Creek formation and Mount Nelson dolomite on the west. The displacement on F2 is uncertain, but existing evidence indicates that the west side is downthrown more than 2,000 feet. This estimate is based on the probable offset of F6 near the mine and of white quartzite tentatively correlated with the basal member of the Mount Nelson formation exposed east of the fault north of Jumbo Creek.

F3 is another complex fault zone clearly defined on the western slopes and south ridge of Monument Peak. The fault separates a large mass of broadly folded Mount Nelson dolomite forming the summit of Monument Peak from complexly folded and faulted rocks to the west. The Mount Nelson dolomite dips gently westward on Monument Peak, and steepens in dip and becomes strongly sheared near the fault. Dolomite breccia is found along the fault west of the sheared Mount Nelson dolomite. On the west ridge of Monument Peak the breccia is siliceous, with rounded and angular fragments of dolomite up to a few inches across in a siliceous dolomite matrix. Commonly the fragments also are siliceous, and it is concluded that the breccia has been silicified. On the south ridge of Monument Peak, in addition to dolomite breccia dolomite-quartzite breccia is found. Quartzite fragments a few inches across are scattered through a dolomite matrix, or locally the breccia is composed mainly of quartzite fragments in a dolomite matrix. Most of these fragments are angular and some are as much as 2 feet across. Zones of breccia are discontinuous and appear to be in the western or hangingwall side of the fault. Although F3 has not been found south of Jumbo Creek, it is believed to cross the creek and to offset a gently dipping fault, F6. Judging from the relative positions of F6 on either side of F3, the vertical displacement on F3 has been several hundred feet down on the west.

F4 is a relatively unimportant fault well displayed in the upper cliffs of Monument Peak. It is essentially vertical, and the relative positions of a series of marker

Mineral King property, Toby Creek.

Mineral King glory-hole. Synclinal remnant of argillite in mineralized dolomite.

beds in the Mount Nelson dolomite on either side of the fault indicate the west side has been downthrown a few hundred feet.

F6 is a thrust fault dipping at low angles to the west and northwest. F5 branches upward from F6 southeast of Monument Peak. The two faults are broadly folded. On the north slope of Jumbo Creek, F6 probably dips at moderate angles to the west and is dropped down by F3 into the bottom of the valley of Jumbo Creek. Between the north bank of Jumbo Creek and the Mineral King mine, the trace of F6 indicates that the fault dips at low angles to the northwest. Near the mine it is probably truncated by F2 and is dropped beneath the valley of Toby Creek on the western side of F2. Southeast of Monument Peak, where the faults are well exposed, F6 and F5 are sharply defined and more or less parallel to beds in the rocks above and below. Large discontinuous masses of breccia are found in the dolomite close to the faults, particularly where dolomite lies between the two faults half a mile southeast of Monument Peak. Breccias consist of rounded and angular fragments of dolomite a fraction of an inch to several inches across in a dolomite matrix. The fragments are distinguished from the matrix only by slight colour differences. Near quartzite, scattered fragments of quartzite are present in the breccia, and adjacent to the faults quartzite is crushed and brecciated. Breccia zones in quartzite are only a few feet thick, and the fragments are difficult to distinguish from the matrix. Southeast of Monument Peak, rocks of the Mount Nelson formation are thrust over slates in the upper part of the Dutch Creek formation. The slates are strongly cleaved within a few hundred feet of F6.

F5 and F6 are the largest and most conspicuous thrust faults, but many apparently smaller thrust faults lie between F6 and F2 and are well exposed on the southeast face and western slopes of Monument Peak.

F7 is a well-defined steeply dipping fault which brings black argillite of the Dutch Creek formation into contact with dolomite of uncertain correlation to the east.

F8 and F9 are steeply dipping faults marked by sheared zones in the Dutch Creek formation. Displacement of members in the Dutch Creek formation indicates they are both downthrown on the west.

Folds.—For purposes of description the Mineral King area may be divided into three parts-a western, a central, and an eastern part separated by faults. The western part of the map-area is west of F2. In it the formations dip steeply to the northeast and are on the northeast limb of an asymmetrical anticline. The crest of the anticline lies west of the map-area, and, although it is broad and poorly defined, the crestal zone of gently northward dipping beds is well displayed on the southern slopes of Mount Earl Grey, 3 to 4 miles southwest of the Mineral King mine. The eastern limb of this anticline that is within the western part of the map-area is outlined by the basal quartzite of the Mount Nelson formation. In general the quartzite dips 60 to 80 degrees to the northeast, but at one point the dip flattens and steepens again to form a narrow structural terrace that has the shape of a huge dragfold on the northeastern limb of the anticline. Between the ridge between Jumbo and Toby Creeks and the north side of the valley of Jumbo Creek this dragfold has an average plunge of 15 degrees to the northwest and the axis strikes about north 25 degrees west. The dragfold is transected by the fault F1.

The eastern part of the map-area is bounded on the west by F6 and by parts of F3, F2, and F1 which offset F6. A broad anticline is outlined in the eastern part of the area by the dolomite at the base of the uppermost slate member of the Dutch Creek formation. The anticline plunges about 10 degrees to the northwest. and the axial plane is essentially vertical. In the most deeply exposed part of the core of the anticline. on the north side of Toby Creek east of Jumbo Creek. the rocks are crushed and complexly faulted. The faults, which include FX and F9, strike to the northwest, dip steeply, and have a relatively small displacement. Argillite members have been squeezed and thickened in the core of the anticline, and faults tend to follow contacts between the argillite members and adjacent more competent rocks. Judging by the map and sections of the Windermere map-area (see Walker, 1926), this anticline in the eastern part of the Mineral King area is one of a series of open folds which result in a low cumulative easterly dip extending several miles to the east.

Between the eastern and western parts of the area the structure is dominated by a series of folds and related thrust faults in which the western side has tended to move upward and to the east over the eastern side. The folds have the form of dragfolds on the western limb of an open anticline, and because in section looking northwest they resemble a letter " N," they will be referred to as N-shaped dragfolds. East of F3 the dragfolds are relatively simple, but between F2 and F3 they are complex and many are broken by faults. The Mount Nelson dolomite on Monument Peak dips to the west at angles ranging from about 20 to 70 degrees, and in general the sequence is stratigraphically right side up. East and south of the peak small overturned anticlines are present, with axial planes dipping to the west and with thrust faults along the overturned limbs.

To the west, between F2 and F3, the structure is more complex (see Fig. 9). Near Jumbo Creek the plunge is a few degrees to the northwest. West and southwest of Monument Peak the plunge reverses abruptly to southeast, and farther to the northwest it again reverses to northwest. This local change in plunge is not seen east of F3 or west of F2. Although folds and faults are well exposed in most of the area between F2 and F3, structural complexities make stratigraphic correlations uncertain, and a complete understanding of the structure is not possible on the basis of present knowledge. The Toby conglomerate displays no internal structure, but externally it has the general form of a syncline. White quartzite, which is tentatively correlated with the basal member of the Mount Nelson formation, occurs in two discontinuous bands on either side of the conglomerate. These bands may lie on the limbs of the syncline containing the conglomerate, but the syncline is not apparent from structural observations in the field. Folds that affect the quartzite have the form of N-shaped dragfolds. The folds are commonly broken by thrust faults along overturned limbs. This same pattern of folding and thrusting is seen also in the dolomite and argillite between F2 and F3. Stratigraphy is of little value in determining the over-all structure because correlation of the dolomite with the Mount Nelson is tentative and because probably only part of the argillite can be correlated with the Dutch Creek formation (see Fig. 9).

The structure and stratigraphy of the belt between F2 and F3 is important in exploration because the Mineral King orebodies are at the southern end of the belt and because scattered sulphide mineralization has been found within and immediately east of the belt, north of Jumbo Creek. The pattern of folding and faulting is important because mineralization at the mine has been partly controlled by N-shaped dragfolds.

A number of N-shaped dragfolds in the western part of the area, particularly between Jumbo and Toby Creeks, occur on the eastern limb of the major anticline described previously, and because of their shape appear to be unrelated to the formation of the anticline. It is suggested that they are superimposed on the anticline and, together with other N-shaped dragfolds, may be related to a late thrusting of west over east.

Dykes.—Several dark-preen fine-grained dykes up to about 15 feet thick transect the rocks of the Mineral King area. In thin section they appear to be altered diorites, containing mainly plagioclase (andesine) and chlorite which has entirely replaced crystals of amphibole. Minor quartz, magnetite, biotite, and more or less rusty iron carbonate are present. In the western and eastern parts of the area the dykes are blocky with somewhat sheared margins. They commonly strike north or northwestward, dip steeply, and are fairly continuous. They are widely scattered; two of the most continuous follow faults F1 and F8.

In the central part of the area the diorite dykes are sheared and altered, and commonly contain fragments of quartzite, dolomite, or green phyllite. They form lenses a few tens of feet thick, ranging from about a hundred to a few hundred feet long. In general they dip steeply and strike to the north or northwest, and appear to be more numerous near faults than away from them. Several are found along F3 between Jumbo Creek and the western slopes of Monument Peak. At least one is found along F2 north of Jumbo Creek, and another occurs along F6 near its juncture with F5. These fragmental dykes resemble conglomerate with angular and rounded pieces of quartzite and dolomite a few inches across in a greenish phyllitic matrix. Thin sections reveal the presence of altered plagioclase crystals and scattered rhombs of iron carbonate which are typical of the diorite dykes and are not found in the Toby conglomerate. One diorite breccia contains apparently indigenous fragments of amygdaloidal rock.

Conglomerate and *Breccia*.—An understanding of the origin of the coarsely fragmental rocks in the Mineral King area is of importance in exploration. Three types-the Toby conglomerate, diorite breccia, and dolomite breccia-have been described, and the last two superficially resemble conglomerate. Judging from the distribution of the Toby formation on Monument Peak shown on the Windermere sheet (Map 2070), all these fragmental rocks have been correlated previously with the Toby. Thin sections clearly distinguish the diorite breccias from conglomerate. Whether the diorite breccias formed by intrusion or whether they are wholly or partly tectonic is uncertain. The contrast between the lenticular diorite breccias in the structurally complex central part of the area and the clean, continuous diorite dykes in the eastern and western parts of the area suggest that deformation was important in the development of the diorite breccias. Field relationships may be interpreted to mean that intrusion and deformation were coincident.

Localization of the breccias along faults leads to the conclusion that most, if not all, of the dolomite breccias are of tectonic origin. The relation of the breccias to faults is clearly shown southeast of Monument Peak between F5 and F6. Zones of dolomite breccia are also found along F2 and F3. Lithologically the breccias contain mainly rounded fragments of dolomite in a dolomite matrix, and the occurrence in them of scattered fragments of quartzite raises the possibility that some of the breccias may be of sedimentary origin. Near FS quartzite fragments increase in size and number toward quartzite above the fault and appear to have been derived from the quartzite in faulting. Quartzite fragments in breccias near F2 and F3 may have a similar origin. Masses of dolomite breccia found underground near the Mineral King orebodies are in a zone of strong faulting.

Mineral King.-The Mineral King mine has three principal adit levels with portals on the hillside north of Toby Creek. No. 7, the main haulage level, is at an elevation of 4,775 feet, No. 3 level is at 5,460 feet, and No. 2 level is at 5,595 feet (see Fig. 11). No. 1 level, an original exploratory adit at an elevation of 5,690 feet, has been partly destroyed by surface mining. An inclined underground shaft connects No. 7 and No. 3 levels, and intermediate levels-No. 4 at 5,285 feet, No. 5 at 5,120 feet, and No. 6 at 4,945 feet elevation-extend from the shaft. The top of the shaft at No. 3 level (elevation, 5,460 feet) is almost vertically below the crest of the ridge between Toby and Jumbo Creeks (elevation, about 6,400 feet).

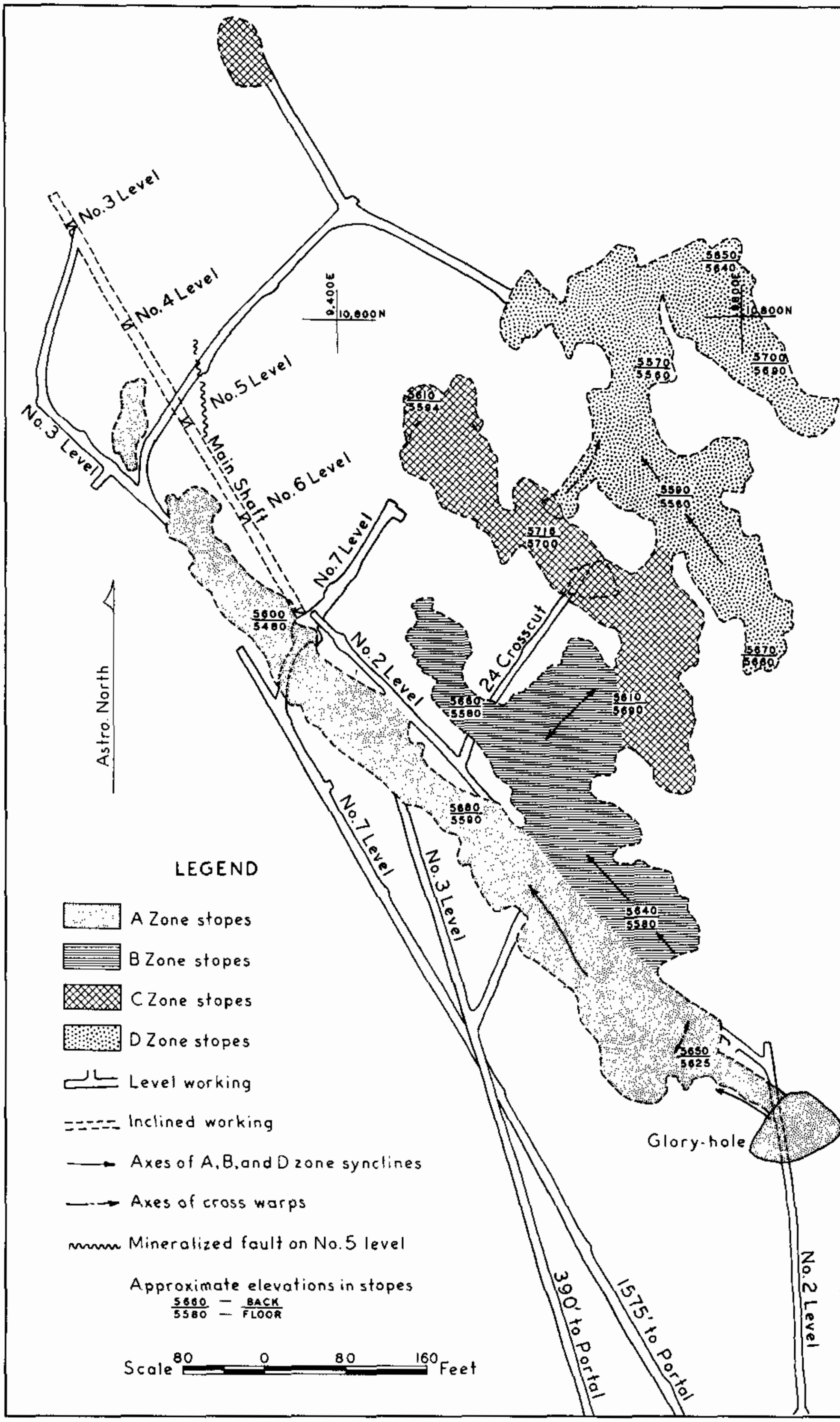


Figure 11. Plan of part of Mineral King mine. Pillars in stopes not shown.

The largest stopes are above No. 3 level, where relatively flat orebodies plunging to the northwest at angles of less than 30 degrees have been mined by open stoping. Orebodies developed more recently are steeply dipping and lie to the north of the relatively flat orebodies and are being mined “ear No. 3, No. 4, and No. 5 levels. Ore is trammed to ore-passes leading to the main haulage level. A surface incline from No. 3 portal to the mill, which originally handled all the ore, in 1959 carried only barite.

The geology of the surface close to the mine gives only the most general information about the geology underground. Only the rocks close to the glory-hole and the level portals can be projected underground. Rocks and structures above the glory-hole and on the ridge between Toby and Jumbo Creeks cannot be recognized with assurance in the underground workings. Black slate of the uppermost member of the Dutch Creek formation, which outcrops at the adit portals and over wide areas to the east and northeast, is in fault contact with dolomite, argillite, and conglomerate to the northwest. Probably more than one fault marks the north and west contact of the Dutch Creek slate. A steeply dipping fault, F2, which strikes about north 20 degrees west, lies immediately west of the mine and offsets a complex, gently dipping fault, probably F6, which lies beneath the orebodies. This gently dipping fault is exposed on No. 2, No. 3, and No. 6 levels and in the shaft and has been encountered in several drill-holes. In the workings the fault contact is sharp, the slate is moderately well cleaved, and the dolomite is massive. The cleavage is more or less parallel to the contact, and from observations in the mine alone it is not possible to conclude with certainty that the contact is a fault. Poorly defined zones of breccia are found in the dolomite close to the fault on No. 2 level, and a siliceous argillite breccia was encountered in drill-holes which penetrated the fault on No. 6 level. The fault plane has the form of a” open syncline plunging to the northwest at a” average of between 30 and 35 degrees. Although details of the plunge and cross-sectional shape of the fault plane are not well known, they appear to vary from place to place. The general form is indicated on surface and from scattered data for about 700 feet to the northwest down the plunge.

Rocks above the footwall are mainly grey fine-grained dolomite, here called the mine dolomite, with minor lenses of olive green and black argillite. Most of the mine dolomite is mottled, light grey and white. Some has dark-grey to black streaks, and some is light grey and massive.* More or less continuous masses of dolomite breccia are found locally. They are composed of distinct rounded and angular fragments of grey dolomite in a grey dolomite matrix. The fragments, which are mainly rounded and up to a few inches across, are distinguished from the matrix by shades of colour. I” some breccia, fragments of white quartzite are present.

Green argillite, which forms lenses in the dolomite, is a very fine-grained blocky or poorly phyllitic rock. Study of thin sections shows the principal constituents to be sericite and quartz. Under the microscope very fine-grained angular and rounded detrital quartz grains are see” scattered through a felted mass of sericite. Lenses of grey to black argillite, which are also found in the dolomite, contain quartz, sericite, and carbonaceous material.

Little is known of the structure and internal stratigraphy of the mine dolomite. On surface the dolomite, which is exposed in one large outcrop and in the glory-hole, has a maximum horizontal dimension measured in a northeasterly direction of about 250 feet and a vertical dimension of about 100 feet. The dolomite cannot

* Chemical analyses of specimens of the [illegible] dolomite show that [illegible] essentially pure $CaMg(CO_3)_2$.

be traced beyond the outcrop and glory-hole and cannot be correlated satisfactorily with steeply dipping layers of dolomite to the west and northwest, though the mine dolomite is on strike and down dip from them. The mine dolomite appears to have a lenticular cross-section which in general is synclinal. Underground to the northwest the dolomite widens and thickens, and several hundred feet from the surface the vertical and horizontal dimensions are several times those on surface. Lenses of argillite, small in relation to the dolomite, and banding in some of the orebodies, outline a few folds within the mine dolomite. The known folds are anticlines and synclines plunging to the northwest at variable angles. Two of the largest synclines have sharply pointed troughs, and the intervening anticlines are relatively broad and rounded. A series of irregular cross-warps trending to the northeast causes relatively abrupt changes in the plunge of the folds. The folds and cross-warps are seen in the upper part of the mine; in the lower part the fold structure is not known. Several faults which strike north and dip steeply are recognized on the lower levels.

Orebodies.—Orebodies in the upper part of the mine are replacements of dolomite by barite and sulphides. They plunge gently to the northwest. have a relatively low dip, and mainly appear to conform to fold structures within the dolomite. Toward the northwest the plunge steepens, and the orebodies are more or less continuous with other orebodies in the lower part of the mine which follow steeply dipping faults. The faults strike to the north, and sulphides and quartz occur along them as replacements and fillings.

The principal sulphides are sphalerite, galena, pyrite, and minor bournonite ($PbCuSbS_3$), and the gangue is dolomite, barite, and quartz. Sphalerite ranges from finely disseminated yellowish-brown grains to coarse resinous brown crystals. Galena is commonly fine to medium grained, though it may be coarse or extremely fine grained. In the upper part of the mine, sphalerite and galena commonly occur as irregular masses and lenses or in more or less regular bands in dolomite. In barite their distribution is much more irregular. Pyrite is found closely associated with galena and sphalerite as well as in separate bands and lenses within or on the margins of the orebodies. Bournonite is most conspicuous in barite, where it occurs as intersecting veinlets and less commonly as massive clusters several inches across.

The grade of the ore and the lead-zinc ratio are extremely variable. Grades as high as 15 per cent combined lead and zinc are common, and ore fed to the mill ranges from 5 to 10 per cent combined lead and zinc, zinc being always higher than lead. Copper contained in bournonite is recovered from the lead concentrates.

The form of the orebodies is extremely complex, and the detailed form cannot be adequately described. Four ore zones distinguished in mining are named the A, B, C, and D zones (see Fig. 11) They grade into one another and are most clearly defined in the upper, southeastern part of the mine, where the form of the orebodies is least complicated. Considered together in this part of the mine, they are roughly in the same plane, and form an irregular tabular to lenticular mass with great variations in thickness and attitude (see Fig. 12). In general the dip is low to moderate, and elongate, abnormally thick sections plunge gently to the northwest. Toward the northwest the plunge of the elongate sections increases and the orebodies become more lenticular in section and are not in the same plane. On the lower levels they are distinct, steeply dipping orebodies which strike to the north. Figure 11 shows parts of the levels and outlines of the stopes above No. 3 level of the mine, and indicates the approximate positions of the ore zones.

Although the detailed form of the orebodies cannot be described, several characteristics of form will be considered. The southeastern upper parts of the A and B zones occur in wedge-shaped synclines. The A zone syncline is well displayed in the glory-hole, where it is outlined by a bed of dark-grey slaty argillite a few feet thick (see photo of glory-hole). The axial plane dips steeply to the northeast and the trough is very sharp. Ore occurs in dolomite beneath the argillite in a zone several feet thick. On the southwest side of the syncline, irregular masses of barite and well-defined quartz veins contain most of the sulphides. On the northeast the ore is mainly in dolomite.

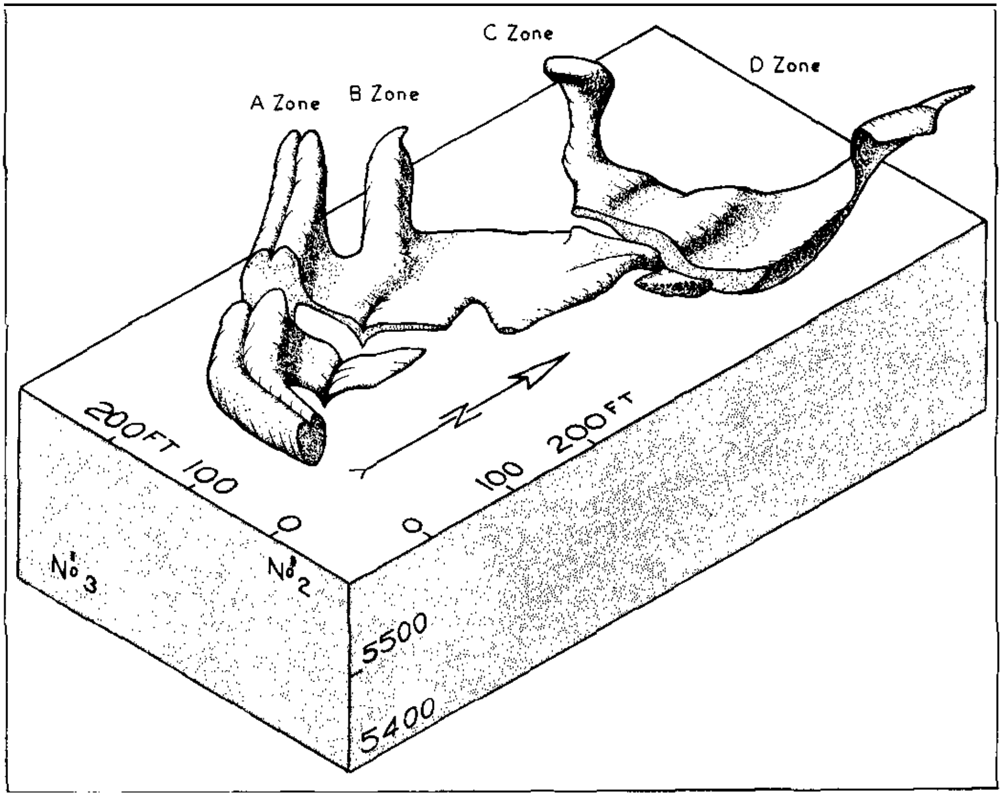


Figure 12. Isometric diagram of upper part of Mineral King orebodies. Tbe plunge of the orebodies is to the northwest, away from the observer.

Underground for about 150 feet from the face of the glory-hole the axis of the syncline plunges at a low angle to the west. It then swings abruptly to the northwest and maintains a northwesterly strike and a variable low plunge for another 600 feet or more. The form of the syncline is obscure underground, though in places a wedge-shaped mass of slaty argillite can be seen in the back of the stopes. Mineralization lenses out rapidly up the limbs of the syncline, and as mined the A zone has an oval cross-section 100 feet or more high and several tens of feet wide.

To the east the A zone grades through a narrow low-grade section into the B zone, which also follows a sharply troughed syncline. The anticline between the A and B zones is upright with a rounded crest. More or less well-defined banding in tbe dolomite and sulphides outlines a syncline in the centre of the B zone that is very similar to the A zone syncline displayed in the glory-hole. The argillite above the A zone does not appear in the B zone. The syncline plunges gently to the northwest and is recognized only in the southeastern part of the B zone.

The D zone, which is a few hundred feet northeast of the B zone, also has a synclinal form, but the syncline is more open and is outlined by separate parts of the zone. The syncline plunges to the northwest at angles of 10 to 25 degrees. The C zone lies between the B and the D, forming a zone which is gently dipping, broadly anticlinal, and plunges at a low angle to the northwest. The C and D zones range from a few feet to several tens of feet thick, the thickest sections being in the trough of the D zone.

The B, C, and D zones do not continue southeastward to surface as the A zone does. The B and C zones terminate against a mass of dolomite breccia that dips gently to the east and lies above the B and C zones. The dolomite breccia does not outcrop but is lithologically similar to breccias seen on surface north of Jumbo Creek that are associated with faults. Underground the breccia in general is not mineralized. In the southeast it contains fragments of quartzite, farther north it is entirely dolomite, and still farther north both dolomite breccia and green argillite breccia are found. The form of the breccia zone is imperfectly known. The lower contact is mainly with mineralized dolomite, but above the D zone it is in contact with black argillite. The lower surface of the breccia clearly transgresses bedding and has a general synclinal form dipping gently east above the C zone and steeply west above the western side of the D zone. To the northwest the breccia has an irregular form closely associated with the C and D ore zones.

The D zone is limted on the southeast by masses of argillite that intertongue with the mineralized dolomite. The uppermost parts of the D zone, both to the southeast up the plunge and to the east up the eastern limb, lens out into green and dark-grey argillaceous rocks.

Although the orebodies are incompletely known to the northwest, they appear to become steeply plunging pipe-like bodies or steeply dipping lenticular zones. The A zone, which is more completely developed than the others, northwest of the synclinal part passes into a pipe-like body extending from No. 3 to No. 4 levels. On No. 4 level and more particularly on No. 5 level, it appears to lie along a fault trending north and dipping steeply east. The fault is well defined on No. 5 level, is less conspicuous on No. 4 level, and is difficult to distinguish on No. 3 level. The orebodies are on the western side of the fault. The hangingwall is defined by the fault plane and the footwall is gradational. The fault is not continuously mineralized, and in places the orebody splits away from the fault on the footwall side. The sulphides are commonly massive, and the mineralized zones are of higher grade than those in the upper levels. Other mineralized zones have been found along northerly trending faults on the lower levels of the mine, but as yet they are not well known. Most movement on the faults is thought to have occurred before mineralization because the sulphides are not sheared.

Several more or less well-marked zones of cross-warps are recognized in the upper part of the mine. One is at the southeast end of the B zone, where the crest of the anticline between the A and B zones is broadly curved on an axis trending northeast. Another is found in the B and C zones immediately south of the 24 crosscut, where green argillite forming the footwall of the ore is warped upward on a northeasterly trending axis, causing the mineralization to pinch out against barren dolomite in the hangingwall. Pronounced cross-warps appear to have controlled mineralization on the western side of the D zone north of the 24 crosscut. They have the form of dragfolds with axes striking northeast and north. The shape of the dragfolds indicates a relative movement of the upper side to the northwest and west. Mineralization has followed the crests of folds and small thrust faults along the lower limbs of the folds.

Although a general concept of the mineralizing process may be postulated, direct evidence of the process is difficult to obtain. Mineralizing solutions may have passed upward along the northerly trending steep faults in the lower part of the mine and spread out to produce the pipe-like replacement bodies at higher levels. Cross-warps may have influenced the formation of the pipe-like bodies. Troughs of pinched synclines in the A and B zones were favourable for replacement. Faulting has almost certainly been an important control of mineralization in the gently plunging orebodies. Although the fault beneath the mine dolomite is the only gently dipping folded fault known with certainty, other similar faults undoubtedly transect the mine dolomite. The general tapering of the mine dolomite toward the southeast up the plunge may have served to limit the circulation of mineralizing solutions and to promote deposition.

Barite is scattered irregularly through most of the ore, and much of the barite contains suphides. Zones of fairly pure barite found between the C and D zones have been mined recently for the barite alone. The barite is white, fine to medium grained, and has a sugary texture. Coarse-grained barite is found locally. Masses of barite being mined, though very irregular, in general have a gentle plunge to the northwest. They are a few tens of feet thick in section and a few hundred feet long parallel to the plunge. Sulphides are more abundant around the margins than in the central parts of the barite zones. Analyses of three samples of barite are given below. Sample A was taken in the 35D stope across 10 feet of clean barite. Samples B and C were grab samples from the shipping-bin. Sulphides were obvious in them, and dolomite and quartz may have been present also.

	A	B	C
	Per Cent	Per Cent	Per Cent
BaO	65.31	61.89	60.56
CaO	0.04	0.08	0.46
SrO	0.18	0.45	0.51
Fe (total)	0.015	0.06	0.08
SO_3	34.57	33.56	33.44
CO_2	*Nil*	0.03	0.08
Specific gravity	4.48	4.43	4.16

During 1959 the mine produced 181,495 tons of lead-zinc ore, most of which came from the workings above No. 4 level. Approximately 41 per cent was mined from the A zone, 10 per cent from the C zone, 39 per cent from the D zone, and the remainder from new development. The ore was developed and mined from all levels, and the A zone was developed northward and downward to No. 6 level. Total development included 3,300 feet of drifts and crosscuts, 1,360 feet of raises, and 13,200 feet of diamond drilling.

Barite, the production of which began in 1959, was mined from the upper levels. Barite production was separated from lead-zinc production by using the No. 3 level and surface skip for transportation and a 100-ton bin at the bottom of the skip for loading into trucks. The crude barite was trucked to Invermere for shipment by rail.

There were no major installations underground during 1959, and, apart from the barite production, there was very little change in the operation. The mine was ventilated by both mechanical and natural means and approximately 29,000 cubic feet of air per minute was exhausted from the workings. Of this quantity, 18,000 cubic feet per minute was supplied by a 1 S-horsepower electrically driven fan located on the No. 2 intake airway. The remainder was natural ventilation. Some difficulty was experienced in part of the workings at one time due to leakages of air on No. 3

level, but this was overcome by duplicating the ventilation door on the level. One fatal accident is reported more fully in another part of the Report.

The concentrator operated at 85 per cent capacity throughout the year and produced 13,071 tons of zinc and 6,779 tons of lead concentrates. All the concentrates were trucked to Invermere for shipment by rail. Improvements were made to the blacksmith's shop, several residences, tailings-disposal pond, and concentrate railway siding.

The average number of men employed during 1959 was ninety-six, of whom fifty were employed underground.

[References: Reesor, J. E. (1957), Lardeau (East Half), *Geol. Surv., Canada,* Map 12-1957; Walker, J. F. (1926), Geology and Mineral Deposits of Windermere Map-area, B.C., *Geol. Surv., Canada,* Mem. *148; Minister* of *Mines, B.C.,* Ann. Rept., 1953, p. 151.]

Red Ledge

This group of eight claims, held by record by Noel Routson and associates, of Trentwood, Wash., is on the west side of Stark Creek about 2 miles southeast of the Mineral King mine. It is reached from the mine by a trail which, for about a mile southeast of Toby Creek, is on the east side of Stark Creek, and then crosses Stark Creek and climbs the slope to the southwest to a cache and tent camp at an elevation of about 6,200 feet. The claims were originally located in 1952 to cover a mass of rusty gossan about 500 feet south of the tent camp. Prospecting since 1952 has disclosed showings of lead and zinc northwest of the camp.

Rocks on the claims are mainly black slate and argillite of the uppermost member of the Dutch Creek formation. Toward the northwest the Dutch Creek slates are overlain by white quartzite and dolomite in the lower part of the Mount Nelson formation. On the crest of the ridge west of Stark Creek these rocks form a northeasterly dipping succession which is truncated on the east by a fault. The fault dips steeply, strikes about north 30 degrees west, and is downthrown on the west.

The zone of gossan. which is mainly limonite and rubble of black argillite, forms a clearing on the hillside about 200 feet in diameter. An adit, the portal of which is on the upper western side of the clearing at an elevation of about 6,300 feet, has been driven approximately 110 feet at south 60 degrees west. It passes through the limonite into black slate. From exposures at the portal the gossan appears to be about 30 feet thick and to lie parallel to the slope of the hill. A sample across 10 feet of the gossan assayed nil in gold and silver and traces in lead and zinc.

Showings of galena, sphalerite, and grey copper are found at an elevation of about 6,600 feet about 1,500 feet northwest of the adit. They are essentially confined to one outcrop about 80 feet long from north to south and 25 feet wide in an area containing few outcrops. The sulphides are scattered through dolomite in irregular lenses and veinlets, the largest of which are an inch thick and a few feet long. Irregular quartz veinlets present in the dolomite may or may not carry sulphides. Small pits and trenches have been made to expose the outcrop more fully. A chip sample in one of the trenches showing material of higher than average grade assayed: Gold, nil; silver, 0.8 oz. per ton; lead, 5.67 per cent; zinc, 0.9 per cent. A sorted sample of broken material rich in grey copper assayed: Gold, nil; silver, 4.4 oz. per ton; lead, 2.56 per cent; zinc, 0.6 per cent.

HORSETHIEF CREEK (50° 116° N.E.)*

Silver-Copper

Ptarmigan (The Selkirk Ptarmigan Miner Limited)

Heinz K. F. Seel, president, Edgewater. This mine is at the headwaters of Red Line Creek, a tributary of McDonald Creek, which in turn is a tributary of the Horsethief Creek. It is at an elevation of 8,600 feet, and is reached by a 29-mile roadway leading from Wilmer. The mine is an old operation that was abandoned for many years, and the present company was formed in 1958 to continue operations after the owner, Mr. Seel, had removed a large quantity of ice from the old workings. There are over 3,000 feet of development workings in the mine.

The mine operated for a period of three months during 1959. A crew of four men was employed, and 60 tons of ore was mined and trucked to the Trail smelter. Most of the ore was obtained from a small cut-and-fill stope above No. 3 level. The remainder was mined from a new stope which was started on No. 1 level. Assays of ore shipments from No. 3 level ranged from 225 to 250 ounces of silver per ton. Those from the No. 1 level were of a lower grade, ranging from 55 to 65 ounces per ton. The workings on both levels are on a narrow quartz vein mineralized with tetrahedrite. The mine is ventilated by natural means.

BIG BEND OF COLUMBIA RIVER†

GEOLOGICAL RECONNAISSANCE OF THE COLUMBIA RIVER BETWEEN BLUEWATER CREEK AND MICA CREEK

Introduction

This report summarizes the results of a geological reconnaissance along the Columbia River from near Donald on the main line of the Canadian Pacific Railway to near Boat Encampment at the northern end of the Big Bend. The reconnaissance was made between early June and late August, 1958, for the Water Rights Branch of the Department of Lands and Forests in connection with possible hydro-electric power installations on the Columbia River.

Very little previous geological work has been done along the part of the Columbia considered in this report. In 1889 A. P. Coleman made a trip of geological and geographical exploration down the Columbia from Beavermouth to Kinbasket Lake and published brief notes of historical interest in Royal Society of Canada Transactions for 1889 (Vol. 7, Sec. A, pp. 97-108). Since then no general geological work has been done. An area a few square miles in extent on the southwest side of Kinbasket Lake was mapped geologically by The Consolidated Mining and Smelting Company of Canada, Limited, during 1951 in connection with exploration for lead and zinc. The map was of considerable assistance in the present work. Details of the geology near the Mica Creek dam-site, some 6 miles southwest of Boat Encampment, are given by Jones (1951).

Several geological studies have been made along the Canadian Pacific Railway, both in the Selkirk and the Rocky Mountains (see Okulich, 1949, p. 21; North and Henderson, 1954, p. 71), and part of the map made by C. S. Evans (1932) in the Brisco and Dogtooth Ranges is immediately southeast of the area considered in this report. The map of Gunning (1929, p. 136) along the western side of the Big Bend lies several miles to the west. Papers by F. K. North and G. G. L. Henderson in the Alberta Society of Petroleum Geologists Field Conference Guide Book for 1954,

*By D. R. Morgan.
† By J. T. Fyles.

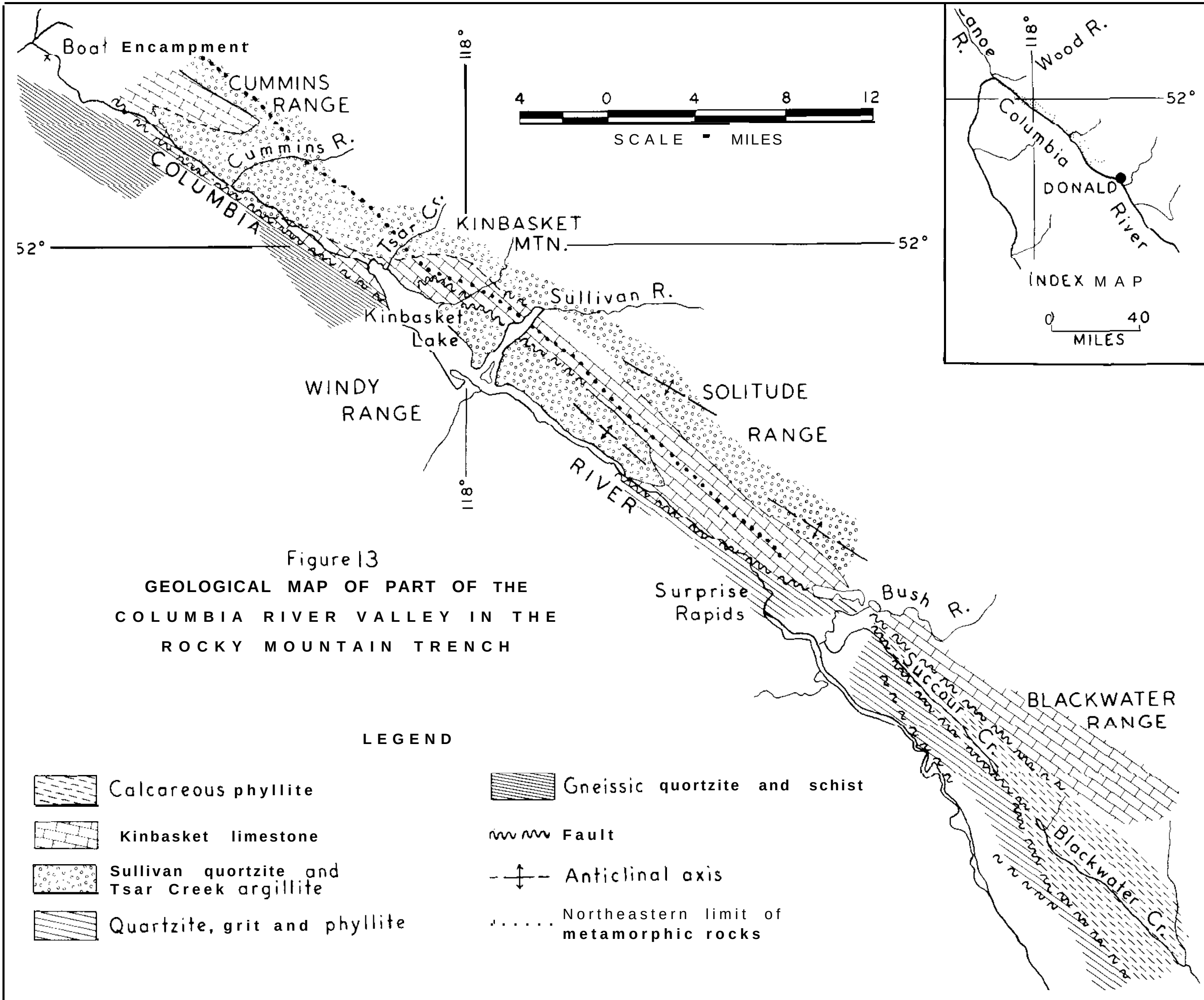


Figure 13

GEOLOGICAL MAP OF PART OF THE COLUMBIA RIVER VALLEY IN THE ROCKY MOUNTAIN TRENCH

which discuss the stratigraphy and structure of the southern Rocky Mountains and the significance of the Rocky Mountain Trench, have direct general application in the present study.

The purpose of the present work was to obtain a broad knowledge of the regional geology to aid future geological studies at specific dam-sites. The work consisted of geological traversing, mapping, and sketching, and interpretation of air photos along the Columbia River valley and summits adjacent to it. Plotting of data was done on a scale of half a mile to the inch, using air photos and interim maps prepared by the Aii Survey Division of the Department of Lands and Forests. A relatively continuous strip of map a few miles wide was made of an area north-east of the river between Bluewater Creek, 4 miles northwest of Donald, and Boat Encampment (see Fig. 13). Reconnaissance traverses were made between Kin-basket Lake and Nagle Mountain, 8 miles west of Boat Encampment, and near Surprise Rapids. Detailed studies of proposed dam-sites were not made, although several sites were visited briefly. Mineral occurrences of possible economic value were noted only in passing.

The area studied is mainly along the Rocky Mountain Trench and includes a part of the trench in which it changes from a relatively broad valley to the south to a relatively narrow valley to the north. This change occurs close to the Bush River. A system of major faults lies within the trench and, for purposes of this report, is considered in two sections. Northwest of Surprise Rapids a fault zone closely follows the Columbia River and is referred to as the Trench fault zone. Southeast of Surprise Rapids a fault zone along the valley of Succour and Black-water Creeks is the northern part of a regional fault known as the White River Break (see North and Henderson, 1954, Map No. 1). Rocks occurring northeast of the fault system are in a part of the Rocky Mountains that corresponds to the western part of the Main Ranges subprovince as defined to the south (see North and Hen-derson, 1954, p. 17). Rocks occurring southwest of the two fault zones are in-cluded in at least two geological terrains-one south of the Succour-Blackwater Creek valley and the other in the northern part of the Selkirk Mountains. The Trench fault zone is relatively narrow and inconspicuous, but the White River Break is marked by a wide zone of sheared rocks extending for many miles to the southeast.

Rocky Mountains

Within the area studied the Rocky Mountains are divided into four ranges by the valleys of the Bush, Sullivan, and Cummins Rivers. The Blackwater Range lies south of the Bush River. An unnamed range containine Solitude Mountain and here referred to as the Solitude Range lies bet&en the Bush and the Sullivan Rivers. Kinbasket Mountain, north of Kinbasket Lake, dominates the range between the Sullivan and the Cummins Rivers, and the Cummins Range lies north of the Cum-mins and is terminated by the Wood River. These ranges are composed of sedi-mentary and metamorphic rocks which form a thick conformable stratigraphic succession.

Stratigraphy

Three lithologic units have been mapped in the Rocky Mountains. The oldest is a thick sequence, of quartzites, named for convenience in description the Sullivan quartzite from exposures along the lower Sullivan River. This sequence is overlain by a relatively thin unit of grey argillite, called the Tsar Creek argillite, which in turn is overlain by a thick sequence of limestone, argillaceous limestone, and argillite known as the Kinbasket limestone. Northwest of Surprise Rapids, along the lower slopes of the Solitude Range, Kinbasket Mountain, and in most of the Cummins

Range, the rocks of this succession are metamorphosed to garnetiferous quartzites, garnet mica schists, and micaceous crystalline limestones. Through much of the area they are strongly folded.

The formations have not been satisfactorily correlated with others in the Rocky Mountains, but on the basis of general lithology it seems probable that at least part of the Sullivan quartzite can be correlated with the Lower Cambrian St. Piran formation. The St. Piran is a relatively thick quartzitic formation occurring widely in the Rocky Mountains to the south. Diagnostic fossils have not been found in the present work, but structures of organic origin resembling worm tubes and trails were found in places in the Sullivan quartzite, particularly north of Tsar Creek about a mile and a half from its mouth. Similar markings are described from the St. Piran formation in the Field map-area (see Allan, 1914, p. 65).

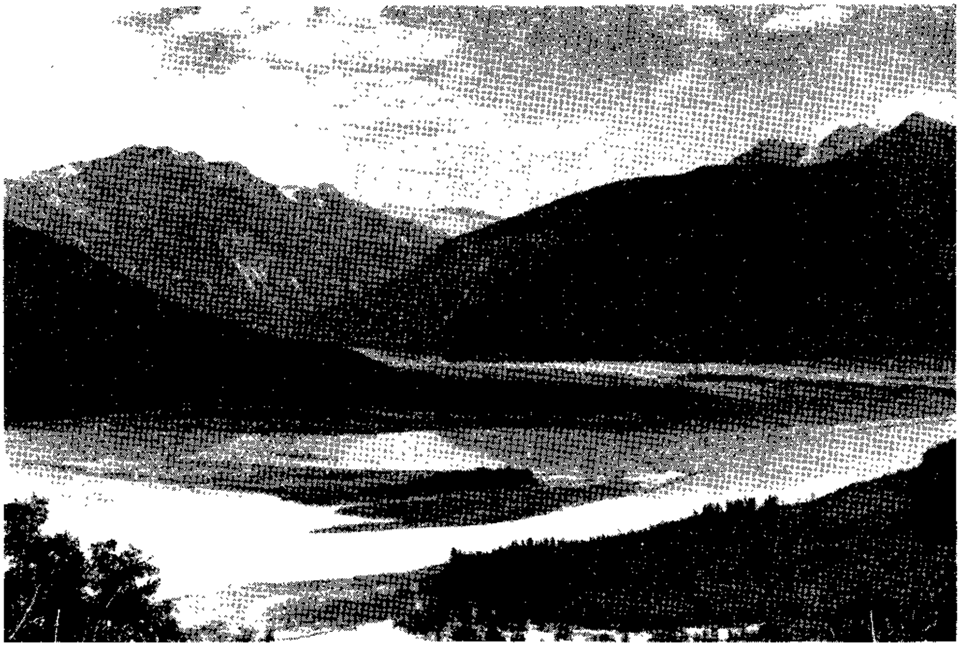
The Sullivan quartzite is exposed best at some distance from the Columbia River valley, east of the area mapped, where it forms high peaks and is gently folded. In the area mapped, only the uppermost part of the quartzitic sequence has been studied. In the lower part of Tsar Creek and on the ridge north of it, the lowest rocks exposed are massive light-grey grits. They are overlain by blocky fine-grained white quartzite as much as 200 feet thick which in turn is overlain by several hundred feet of grey to brown argillaceous quartzite containing two calcareous members and forming the uppermost part of the quartzitic sequence. The argillaceous quartzite is rusty weathering; beds range from a few inches to a few feet thick. Pinkish, whitish, and locally greenish beds occur near the top. The lowest calcareous member consists of 100 to 200 feet of buff-weathering limestone, argillaceous limestone, and dolomite. It is separated by about 100 feet of quartzite and green phyllite from an upper grey limestone 50 to 100 feet thick. Limy quartzite above the upper limestone is cross-bedded. The quartzitic sequence containing the calcareous members is abruptly overlain by the dark-grey to black Tsar Creek argillite.

The Sullivan quartzite exposed in the lowest canyon of Sullivan River and on the slopes northwest of the canyon consists of light-grey to green grit and white quartzite overlain by argillaceous quartzite containing one or two thin bands of limestone. The structure is complex and rocks in the canyon are sheared. The stratigraphic sequence is not known with certainty, but many of the rocks are probably stratigraphically lower than those seen in Tsar Creek.

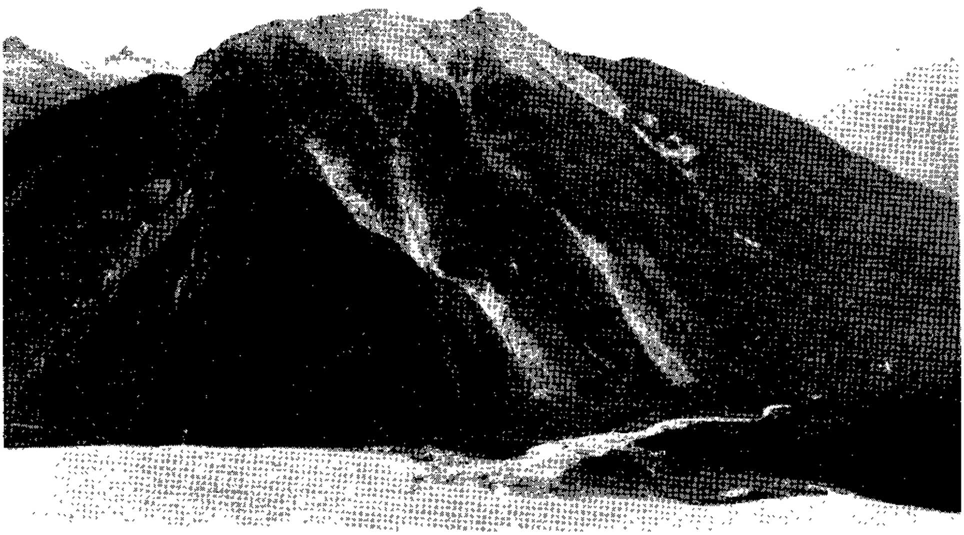
The uppermost parts of the Sullivan quartzite in the southern part of the Solitude Range is much the same as in the lower stretch of Tsar Creek, but in the Solitude Range a higher proportion of the rocks are greenish, and only one calcareous bed was noted. Only the uppermost 1,500 to 2,000 feet of beds was studied, and distant exposures in the Solitude Range suggest that a relatively great thickness of blocky quartzitic strata underlies the beds studied.

The Tsar Creek argillite, which overlies the Sullivan quartzite, is well exposed in Tsar Creek and on Kinbasket Mountain. It is seen at a number of places to the southeast and has been mapped for a few miles near the south end of the Solitude Range.

On the south side of the lower part of Tsar Creek, and north of the creek in a synclinal trough, the argillite is dark grey to black, relatively blocky, and poorly bedded. On Kinbasket Mountain it is grey and dark grey, highly sheared, and is a slate or phyllite. To the southeast, between Sullivan and Kinbasket Rivers and southeast of Sullivan River, the argillite is also strongly sheared and on steep slopes commonly breaks down into prominent light-coloured talus slides.



Mouth of Sullivan River at the head of Kinbasket Lake.



Mouth of Kinbasket Kiver, Kinbasket Lake.

In the Solitude Range the Tsar Creek argillite is dark grey to black near the top and contains visible clear quartz grains. It grades downward into grey and greenish-grey phyllitic argillite.

The thickness of the Tsar Creek argillite is difficult to estimate, but at a few places where measurement has been possible it is between 500 and 1,000 feet.

The Kmbasket limestone, a thick sequence of limestone, argillaceous limestone, and argillite, overlies the Tsar Creek argillite. It forms the southwestern slopes of Kinbasket Mountain, the first summits northeast of the Columbia River in the Solitude Range, and all of the southwestern part of the Blackwater Range. On Kmbasket Mountain and in the Solitude Range the base is marked by grey fine-grained platy limestone about 100 feet thick that weathers to form local promontories and ridges. This limestone is overlain by a thick sequence of grey and dark-grey argillaceous limestone and limy and non-limy argillite. The sequence is at least a few thousand feet thick and the top is not exposed. No distinctive lithologic units have been recognized within it, and detailed study will be necessary for its subdivision.

The Kinbasket limestone is well exposed in the Blackwater Range. Much of the limestone is fine grained, with wispy argillaceous partings a few inches to a few feet apart. Bedding is indistinct, and on the lower southwestern slopes of the range where the rocks are strongly sheared, bedding can be distinguished only with difficulty. Irregular lenses of buff- to red-weathering dolomite a few feet to a few hundred feet long occur within the limestone near the head of Clearwater Creek and are found locally at other places in the Blackwater Range. Breccias, which commonly weather to form hoodoos and are composed of angular fragments of limestone a few inches across, occur at a number of places in the southwestern part of the Blackwater and Solitude Ranges. The breccia zones are discontinuous and appear to represent local zones of crushing rather than continuous faults.

Metamorphism

The foregoing descriptions are of a stratigraphic sequence of unmetamorphosed rocks. In the southwest part of the Solitude Range and north of Kinbasket Lake, these rocks grade into metamorphic rocks, and in the Cummins Range the entire sequence is metamorphic. During the reconnaissance it became clear that, northeast of the Trench fault zone, the metamorphic rocks are stratigraphically equivalent to the sequence just described. The nature of the work did not permit mapping of metamorphic facies or a direct study of the metamorphism, but the general correlation of the metamorphic rocks with the unmetamorphosed sequence is fairly certain.

Along the Columbia River for several miles northwest of Surprise Rapids, and for more than a mile to the northeast, the Kinbasket limestones are buff weathering, finely crystalline, and contain fine flakes of muscovite and biotite. These relatively pure limestones are interbedded with grey limy and non-limy phyllites with porphyroblasts of biotite, chloritoid, epidote, and amphibole. At places near the river, interbeds of mica schist with small garnet porphyroblasts are found. These metamorphic rocks grade into unmetamorphosed limestones and argillites to the northeast. They probably also grade southeastward into unmetamorphosed rocks, but immediately north of the Bush River limestone bluffs in which the change may take place were not studied.

Near Caribou Creek the metamorphosed Kinbasket limestone is underlain by a few hundred feet of a distinctive grey to dark-grey garnet mica schist in which red-brown garnets are as much as one-quarter of an inch across. These rocks are correlated with the Tsar Creek argillite and are underlain by a thick sequence of quartzitic rocks which outcrop along the northeast side of the Columbia River from near Caribou Creek to Kinbasket Lake. Many of the quartzites contain small garnets and are interbedded with garnet mica schist and grey micaceous phyllite. Beds of white quartzite and light-grey grit are fairly common, and locally lenses of crystalline limestone are found. Bedding is distinct in the purer quartzites, and schistosity is the predominant structure of the micaceous rocks. Near the Sullivan River quartz mica schists contain small crystals of kyanite with or without garnet, and lenses of pegmatite are common. The rocks are in fault contact to the northeast on both sides of the Sullivan River with limestone containing small porphyroblasts of biotite.

On the lower slopes of Kinbasket Mountain the Kinbasket limestone contains rounded clusters of biotite and muscovite about one-quarter of an inch in diameter. Higher on the slope the clusters become smaller, and near the top no mica is visible and the limestones, though sheared, appear unmetamorphosed.

Along Tsar Creek the Sullivan quartzites appear unmetamorphosed, but some beds in the lower part of the creek contain small porphyroblasts of chloritoid. The unmetamorphosed rocks grade northwestward into metamorphic rocks. No more than 3 miles northwest of Tsar Creek, essentially along the formational strike, the quartzites contain porphyroblasts of garnet and are interbedded with garnet mica schists and locally with garnet staurolite schists. Bands of micaceous limestone in the quartzite are widely exposed, but their stratigraphic position south of the Cummins River has not been determined. North of the Cummins River the entire stratigraphic sequence in the area studied is metamorphic. The quartzitic sequence contains light-grey grit and quartzite, gametiferous quartzite,' and quartz mica schist and near the top two bands of limestone as much as 200 feet thick. This sequence, which is correlated with the Sullivan quartzite, is overlain by a few hundred feet of a remarkable garnet mica schist. The schist is grey and studded with abundant well-formed garnets as much as an inch across in a fine-grained matrix. This garnet mica schist is regarded as the metamorphic correlative of the Tsar Creek argillite and is overlain by rocks correlated with the Kinbasket limestone. These rocks are buff-weathering micaceous limestones with minor interbeds of grey garnet mica schist. They form the summits and southwest slopes of the Cummins Range. The metamorphic rocks probably grade into unmetamorphosed rocks a short distance northeast of the Cummins Range, beyond the area mapped.

Structure

The structure of parts of the ranges in the Rocky Mountains immediately northeast of the Trench fault zone and the White River Break is fairly well known. Details of folds have not been mapped and faults have not been traced, but several generalized structural sections have been determined (see Fig. 14). Three patterns of folding are recognized. One consists of broad open folds with low plunge and steeply dipping axial planes. These folds are mainly northeast of the area studied and are readily seen, particularly in the Solitude Range well away from the Columbia River. Fold axes appear to strike more to the west than the Trench fault zone, and consequently the folds are gradually transected by the trench and disappear toward the northwest.

The second type of folding is closely associated with the first and consists of large folds overturned toward the southwest. The overturned folds are asymmetric and have a low plunge to the southeast. They are displayed best in quartzites in the Solitude Range and limestones in the Blackwater Range, and within the area studied are found only in these two ranges. Like the open folds farther to the northeast, the overturned and asymmetric folds trend more to the west than the Trench fault zone and are truncated at a small angle by the Rocky Mountain Trench.

The southwestward overturning is accentuated by northeastward-dipping faults. The faults dip 40 to 50 degrees to the northeast and appear to be thrusts. They are common on the southwest slopes of the Blackwater Range and in the southern

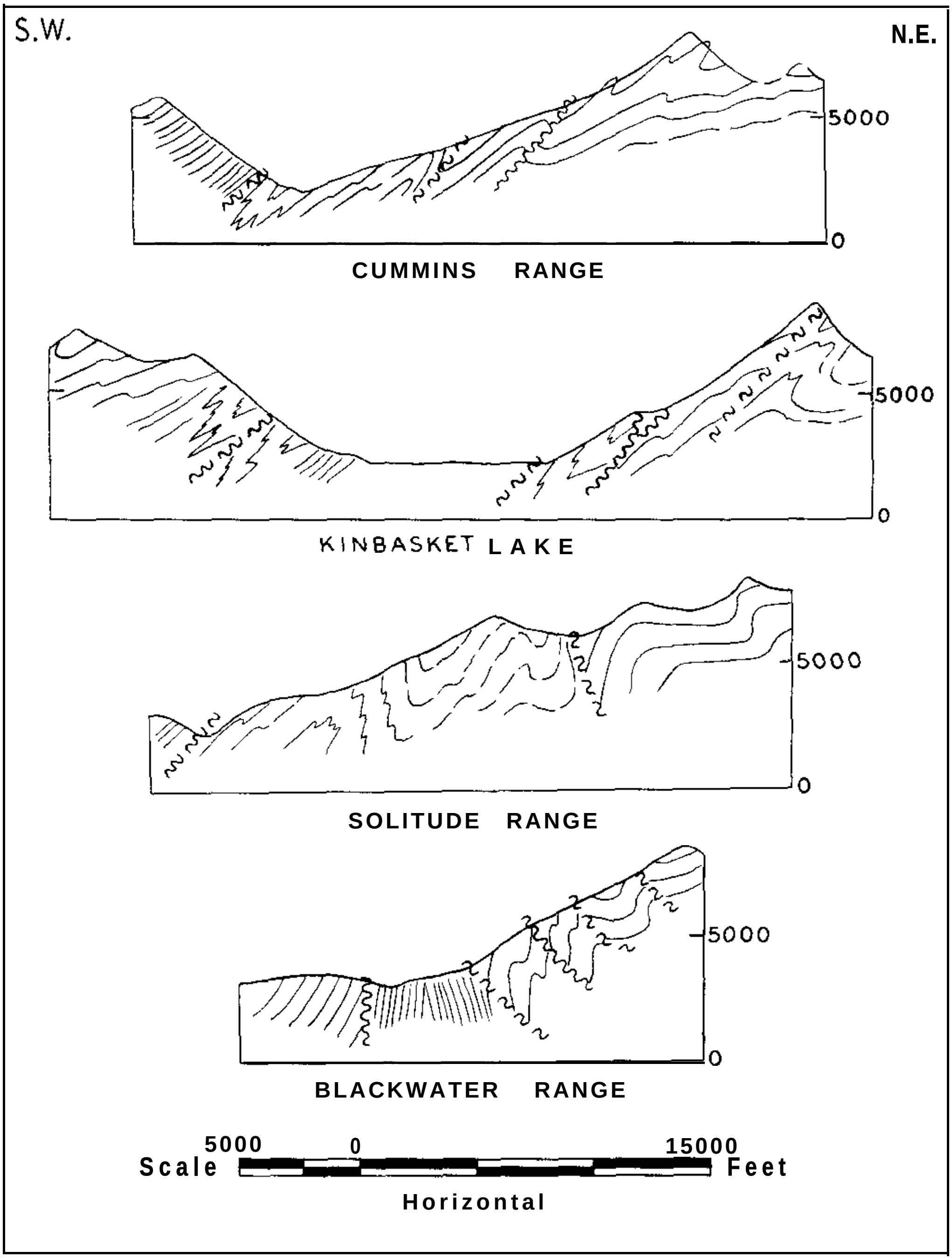


Figure 14. Geological cross-sections, Columbia River valley.

part of the Solitude Range in the Kinbasket limestone. In places they are well-defined crushed zones, in others they are wide, poorly defined zones of breccia, and in still others they are zones of strongly sheared phyllite.

The third type of folding is found only northwest of the Bush River. Unlike the other two types which are truncated by the Rocky Mountain Trench, the third type follows the trench. Folds are overturned toward the northeast and appear to be superimposed on the first two types. The axes plunge at low angles both to the northwest and to the southeast, and axial planes dip as low as 45 degrees to the southwest.

One major fold of this type has been mapped on the slopes northeast of the Columbia 5 to 10 miles northwest of Surprise Rapids. The fold is anticlinal, with axis plunging about 15 degrees to the southeast and axial plane dipping about 60 degrees to the southwest. Although the axis is essentially parallel to the trench, formations on the southwest limb of the anticline are transected by a fault of the Trench fault zone. Northeast of the axis of this anticline the limestones form a series of large relatively tight folds with steep axial planes, which, toward the northeast, change in dip from southwest to northeast (see Fig. 14). The anticline is obscured by metamorphism and faulting at the Sullivan River. The northeast limb on the Sullivan River is broken by a fault striking northwest and dipping steeply to the southwest. North of the river the fault swings and passes westward, probably with a low southerly dip. This fault appears to be closely related to the anticline on the southwestern slopes of the Solitude Range to the southeast. Northeast of the fault the Kinbasket limestone, as well as being folded on gently plunging axes, is warped about axes plunging to the southwest at 50 to 70 degrees. The warps are of a type suggesting relative movement of the northeast side northwestward.

Another fault apparently related to the northeastward overturned folds is exposed on the southwest slopes of Kinbasket Mountain. It transects the Kinbasket limestone, which dips between 40 and 60 degrees to the south and southwest, and is marked by a zone of breccia which weathers yellowish-buff and shows up prominently from the Big Bend Highway. The zone of breccia is well defined and is composed of fragments of limestone in all sizes up to about 15 feet across. Blocks larger than about a foot across are somewhat rounded; smaller fragments are angular. The breccia is nearly 1,000 feet wide at the widest part and narrows to a few tens of feet to the west and probably also to the southeast. At the widest section the southwest side of the breccia zone is nearly vertical and strikes northwest. The northeast side dips about 45 degrees to the southwest, nearly parallel to bedding in the limestone beneath it. To the northwest, on the Kinbasket Lake slope, the breccia zone dips about 35 degrees to the southwest.

On the summits and southwest slopes of the Cummins Range, folds of the third type are overturned, with axial planes dipping 40 to 60 degrees southwest. Fold axes plunge at a low angle to the northwest and are essentially parallel to the Rocky Mountain Trench. The folds are relatively tight and are locally broken by southwestward dipping thrust faults. They pass rapidly into broad open folds immediately northeast of the Cummins Range.

Hills Southwest of Succour and Blackwater Creeks

Southeast of the mouth of the Bush River and between the Columbia River and the valley of Succour and Blackwater Creeks, the hills and ridges rise to elevations of 5,000 feet. The hills are southwest of the White River Break and are separate from the Blackwater Range to the northeast. The southern slopes of the hills were mapped by Evans (1933, pp. 106A–179A), who correlated the rocks with Cambrian formations in the Dogtooth and Rocky Mountains. In the present study the stratigraphy and correlation of rocks on the hills southwest of the Succour Creek-Blackwater Creek valley have not been determined.

Rocks in the hills southwest of the Succour Creek-Blackwater Creek valley are largely quartzites and grits. They are separated from limy phyllites to the northeast by a series of faults that strike more to the west than the quartzites and grits and truncate them at an acute angle. Light-coloured quartzites and grits form the southern part of the hills. They are succeeded by green and grey grits and phyllites which outcrop southwest of Succour Creek. Locally a few feet of clean grey limestone and a somewhat thicker member of grey argillite are found with both the light-coloured quartzites and the green and grey grits.

Rocks in the southern part of the hills include white quartzite with grey interbeds a few inches to a few feet thick, light-grey and pinkish-brown grits or coarse-grained quartzites with rounded green, pink, or bluish quartz grains locally as much as one-quarter of an inch in diameter, and brown argillaceous quartzites. The coarse-grained quartzites have beds a foot to a few feet thick and commonly are cross-bedded. Green and grey grits and phyllites which outcrop southwest of the lower part of Succour Creek are locally blocky, but mainly they are strongly cleaved and bedding is rarely seen. The grits are poorly sorted and contain angular and rounded feldspar and green, pink, or bluish quartz grains commonly an eighth of an inch across.

Little is known of the structure of the rocks southwest of the Succour Creek-Blackwater Creek valley. Bedding in the quartzites and cleavage in the grits and phyllites dip steeply to the southwest, and the sequence appears to be homoclinal. The rocks are bounded on the northeast by a series of faults which in general strike northwest and which intersect each other at acute angles. Lineaments on air photos suggest that faults other than those mapped occur to the southwest and cut the quartzitic sequence into a number of blocks. Direct evidence for faulting has not been found, but reconnaissance has shown that some of the lineaments are zones of strong cleavage and that adjacent blocks have a divergent strike.

Rocks similar to those just described occur along the Big Bend Highway near the Bush River and along the Columbia River near Surprise Rapids. On the highway the rocks are strongly cleaved grey and green grit and phyllite. Similar rocks with some blocky beds of greenish-grey grit are in the upper part of Surprise Rapids where the river flows northward. Downstream from the point where the river turns abruptly to the northwest the grey and green grits and phyllites grade into grey and brown quartzites, and farther downstream into interbedded grey and white quartzite, light-grey grit, and locally conglomerate.

All the rocks near Surprise Rapids are strongly cleaved and break into flaggy slabs. Fine-grained micas lie along the cleavage planes, small porphyroblasts of biotite occur in some beds of grey and brown quartzite, and small garnets are found in bluffs southwest of the upper part of the rapids. The rocks dip 45 to 60 degrees to the southwest and form what appears to be a homoclinal sequence, but the stratigraphic top of the sequence was not determined. Over short distances the strike of both bedding and cleavage changes from northwest to almost west, and gradually returns again to northwest. The broad southwestward plunging warps thus formed suggest a relative movement of the northeast side northwestward.

Outcrops of light-grey grit and quartzite locally including beds of conglomerate occur on the southwest bank of the Columbia River for several miles northwest of Surprise Rapids. Although only the outcrops in the river bank were visited, it is suggested that the same sequence of grits and quartzites continues along the southwest side of the river.

Northern Selkirk Mountains

Two principal areas were studied in the northern Selkirk Mountains-one near Kinbasket Lake and the other between the mouth *of the* Cummins River and the Columbia River southwest of Boat Encampment. The area near Kinbasket Lake is in the northeastern part of the Windy Range and is transected by the deep valley of Trident Creek, which enters the lake near the middle of the southwest side. A complexly folded sequence of varied rock types is found on the slopes above Kinbasket Lake and in lower Trident Creek. The sequence consists of crystalline limestone overlain by quartzite and underlain by metamorphosed black argillite. The quartzite, exposed in the trough of a syncline, is thin bedded, micaceous, and locally garnetiferous. It contains beds of white quartzite high in the sequence and a few tens of feet of garnet mica schist near the base, above the limestone. North of Trident Creek a more complete section contains several hundred feet of white quartzite. The limestone is 100 to 200 feet thick and is medium grained, white to light grey, with dark-grey wisps and bands. It is underlain by dark-grey argillite and garnet mica schist, with thin interbeds of dark-grey limestone. Near Kinbasket Lake these argillaceous rocks range from a few tens of feet to a few hundred feet thick, but greater thicknesses are found on the northwest slope of Trident Creek.

Higher on the slope south of Trident Creek is a thick sequence of gneissic quartzite and mica schist. The relationship between this sequence and the argillite-limestone-quartzite sequence lower on the slope is uncertain. The mica schist contains garnet, kyanite, and locally staurolite. The gneissic quartzites contain biotite and feldspar, and some layers contain garnet. On the crest of a northwesterly trending ridge 2 to 2½ miles from the lake and at an elevation of 7,500 to 8,000 feet a 50-foot band of buff to white crystalline limestone overlies the sequence of gneissic quartzite and schist and is overlain by grey platy micaceous quartzite containing small garnets. The limestone contains thin phyllitic lenses and in places is altered to diopside-epidote skarn.

The structure southwest of Kinbasket Lake is characterized by tight and isoclinal folds complicated by strike faults. Near the lake the fold axes plunge west at 25 to 35 degrees, and away from the lake change to a more northwesterly strike and a lower plunge. Close mapping of a band of crystalline limestone by the Consolidated company revealed the presence of an isoclinal syncline less than a mile from the lake. The axial plane dips about 45 degrees to the southwest, and the northeast limb is broken by a fault dipping gently to the southwest. Quartzite of the stratigraphic sequence just described occupies the trough of the syncline, and the limestone and black argillite are repeated on the limbs.

Another syncline is well exposed on the crest of the ridge between 2 and 2% miles from the lake. The syncline, as outlined by the narrow band of limestone just described, is overturned, with axial plane dipping about 35 degrees to the southwest and axis plunging 15 degrees northwest. Little is known of the structure between the two synclines and along the lake northeast of the lower syncline. Close studies would probably discover other tight folds and bedding or strike faults. Many of the rocks show we&defined patterns of dragfolds, and the rock types are distinct enough to permit detailed mapping and correlation.

Reconnaissance. to the west of the Cummins Range indicates that the northern Selkirk Mountains are composed of a monotonous succession of mica schists and gneissic quartzites. Gneissic quartzites occur in layers a few feet to several tens of feet thick. In hand specimens they resemble fine- to medium-grained granite gneiss. They are interlayered with fine- to medium-grained mica schist containing quartz.

feldspar, muscovite, and biotite commonly with garnet, kyanite, and rarely staurolite. The schists weather to a yeilowish-brown. Calcareous rocks are inconspicuous. Lenses of pegmatite ranging from a few inches to several hundred feet in both length and width are common throughout the northern Selkirks. Mainly they are composed of quartz and feldspar in grains 1 to 4 inches across. Muscovite, biotite, and black tourmaline are fairly common. Mica crystals are usually 1 to 4 inches across and twinned. Small kyanite crystals cluster along the margins of some pegmatites. Gneisses, schists, and pegmatites at the Mica Creek dam-site are described by Jones (1951; 1959, p. 131).

In general, foliation in the gneissic quartzites and schists, in the part of the northern Selkirks studied, dips between 25 to 50 degrees to the southwest. No large faults were recognized, but several small ones striking between north and northeast were seen above the timberline where rock is well exposed. In places, gneissic layers contain tight dragfolds from a few inches to several feet across that show strong overlapping and squeezing-out of quartzitic layers. The dragfolds appear to be abundant only locally, and where they are abundant show a uniform plunge and pattern of shape, though individual folds may vary widely in detail. Lineation found in some of the gneisses is parallel to axes of dragfolds.

The gneisses and schists are folded into large and very large, generally open folds, which represent changes in the attitude of the foliation. The regional dip is to the southwest, but the angle of dip steepens and flattens and locally is to the northeast. These folds range from a few tens of feet to many miles across. Smaller folds may be fairly tight, but the largest ones are open. One large fold was seen in the distance several miles northwest of Trident Creek. The southwesterly dip on the northeast side of the range flattens toward the southwest and reverses to northeast. North of the Selkirks, on the south slopes of Nagle Mountain, a southwesterly dip of less than 45 degrees on the lower slopes gradually steepens upward through vertical to a steep northeasterly dip west of the summit of Nagle Mountain.

The meaning of the dragfolds within the gneissic layers and of the broad folds involving the foliation is uncertain. Tight and isoclinal folds near Kinbasket Lake are on strike from the gneisses and schists in the northern Selkirks. Casual observations near Kinbasket Lake reveal an apparently homoclinal succession, and the actual complexity of the structure is discovered only by detailed study, and then only because distinctive rock units are present. It is suggested that the apparently homoclinal succession of schists and gneisses in the northern Selkirks is in fact isoclinally folded, and that evidence of this folding is obliterated by subsequent shearing, metamorphism, and refolding.

White River Break

The White River Break was named by Henderson (1954, p. 43) for "the major longitudinal fault zone that limits the Western Ranges subprovince [of the Rocky Mountains] on the northeast." He considered the fault zone to be continuous from Whiteswan Lake in the southern Rocky Mountains northwest almost to Donald, a distance of about 120 miles. Throughout its length the fault zone is entirely within Cambro-Ordovician strata of the McKay group and is marked by a wide belt of highly sheared calcareous phyllite.

The same belt of calcareous phyllite which forms the northern part of the White River Break narrows northwest of Donald and ends near the mouth of the Bush River. In the lower canyon of Bluewater Creek and in the Succour Creek-Blackwater Creek valley soft limy phyllites coloured whitish-grey, greenish-grey, and locally dark grey are exposed. They form scattered outcrops and light-coloured road cuts and talus banks. The phyllite is characterized by a strong but irregular cleavage. The irregularity is produced by slight variations in the attitude and continuity of the cleavage planes. The cleavage dips steeply, on the northeast side of the belt to the northeast, and on the southwest side of the belt to the southwest. A few masses of blocky grey limestone occur within the phyllite. One of the best known is lenticular, several hundred feet long, and a few hundred feet wide. It resembles a large unsheared fragment in a shear zone.

This belt of phyllite, comprising the northern part of the White River Break, is bounded on both sides by faults not directly related to the break. The southwestern side of the phyllite is marked by a series of faults which transect each other at small angles and probably dip steeply. The northeastern side of the belt is covered by talus northeast of Succour Creek and is poorly defined toward the southeast. Overturned folds on the lower slopes of the Blackwater Range with axial planes dipping northeast and broken by northeasterly dipping thrusts suggest that a northeasterly dipping thrust fault marks the northeast side of the belt of phyllite.

South of Blackwater Creek the strongly sheared phyllites grade into phyllitic limestones and argillaceous limestones mapped by Evans (1933, p. 126A and Map 295A) as part of the Cambro-Ordovician McKay group. The phyllites closely resemble rocks of the McKay group in the White River Break described by Henderson (1954, p. 22). Although direct evidence is lacking, there is little doubt that most, if not all, of the limy phyllites in the Succour Creek-Blackwater Creek valley belong to the McKay group.

Trench Fault Zone

The Trench fault zone closely follows the Columbia River northwest of Surprise Rapids. It is a complex zone of faulting, including the northern continuation of the White River Break and probably also a number of other regional faults. The fault zone is inconspicuous in contrast to the White River Break southeast of Surprise Rapids. Many faults occur throughout the zone, although few have actually been seen. A main fault or series of faults separating rocks of the Selkirk Mountains from those of the Rockies can be fairly closely located at a number of places. Other faults have been located in the Rockies and are inferred in the Selkirks.

The presence of the main fault is shown by the fact that on a regional scale formations in the Rocky Mountains are truncated at a small angle by the line of contact with rocks in the Selkirk Mountains to the southwest. The actual fault itself is not exposed but can be closely located at *a* number of places. Just north of Surprise Rapids, the fault separates strongly sheared quartzites, grits, and conglomerates on the southwest from limestones and metamorphosed limy argillites belonging to the Kinbasket limestone to the northeast. It is covered by alluvium at this locality and to the northwest is close to the Columbia River and is not exposed.

Northwest of Kinbasket Lake the main fault appears to be immediately southwest of the Columbia River. A wide zone of shearing along the southwest side of the river contains a grey calcareous mica schist locally including masses of grey limestone. These rocks are probably sheared and metamorphosed parts of the Kinbasket limestone. The fault contact between the calcareous rocks and gneissic quartzites and schists to the southwest can be located fairly accurately, but close studies are necessary to define individual faults.

Faults northeast of Kinbasket Lake are probably subsidiary to the main fault beneath the lake. Two faults have been recognized and are described on page 97. One is steeply dipping where it ***crosses*** the Sullivan River; it appears to swing westward in strike and to flatten in dip to the northwest. The other, on the southwest slope of Kinbasket Mountain, dips to the southwest and is marked by a spectacular zone of breccia.

Regional Structure

Something of the structural history of the White River Break and the Trench fault zone can be deduced from regional structural relationships. The White River Break is regarded by Henderson (1954, p. 44) as a thrust fault dipping to the southwest. Near the mouth of the Bush River it passes out of McKay strata into more competent and probably older rocks and to the northwest is included in a zone referred to as the Trench fault zone.

Regional speculation suggests that one or more faults may enter the Rocky Mountain Trench from the south, between the Bush River and Kinbasket Lake. Two faults are indicated by the following observations. Structural trends southwest of the Succour Creek-Blackwater Creek valley and near Surprise Rapids differ somewhat in strike from structural trends southwest of Kinbasket Lake and farther to the northwest. Structural trends near Golden in the Western Ranges of the Rocky Mountains (see North and Henderson, 1954, p. 16) suggest that the hills southwest of the Succour Creek-Blackwater Creek valley are structurally part of the Western Ranges of the Rocky Mountains. Those near Kinbasket Lake are in the Selkirk Mountains. North and Henderson, from a study of Evan's map of the Dogtooth Mountains (295A), suggest that a major southwesterly dipping thrust fault crosses the southeast slope of those mountains and reaches the Columbia River near Beavermouth. They regard it as a fault of regional extent along the eastern side of the Purcell Mountains and have named it the Purcell thrust, although the fault as a major structural feature has not been studied in the field. A second fault is suggested by topographic lineaments. Topographic maps, especially the 10 miles to the inch landforms map No. 1E (South Eastern British Columbia), show a pronounced lineament along the upper Beaver and Duncan Rivers. Near the Columbia River the lineament is poorly defined, but projected northward it would reach the Rocky Mountain Trench near Kinbasket Lake. Possibly this lineament follows a regional fault.

The relationship of these faults to the White River Break is uncertain, but it is clear that the relative movement along the Trench fault zone has been a thrusting of the southwest side toward the northeast. The thrusting is shown by the folds and faults that follow the northeast side of the Rocky Mountain Trench northwest of Surprise Rapids. Folds overturned toward the northeast and broken by thrust faults dipping to the southwest are well displayed in the Solitude and Cummins Ranges. Steeply plunging warps on both sides of the trench indicate that late movements on the fault zone included some strike slip, with northeast side moving northwest.

Of great significance to the development of the Trench fault zone and the regional structural history is the age of the regional metamorphism. Very little evidence is available, but the known data suggest that some faulting preceded metamorphism. The following observations are significant:—

(1) Near Surprise Rapids brief reconnaissance has shown that rocks on either side of the fault zone are of about the same metamorphic grade. Metamorphic zones appear to be relatively narrow in this area and close mapping might show whether or not metamorphic facies cross the fault zone without offset.

(2) Thii sections of fault breccia in limestone north of Kinbasket Lake (see p. 97) reveal the presence of small metacrysts of muscovite and biotite both in the matrix and in breccia fragments. The metacrysts are essen-

tially undeformed and appear to have grown in the breccia since it was formed.

(3) Northwest of Kinbasket Lake a zone of limy biotite-muscovite schist and limestone as much as half a mile wide marks the Trench fault zone. It lies mainly on the southwest side of the river and forms a relatively narrow zone, probably dipping to the southwest, which lies above a much wider zone of folds overturned to the northeast (see p. 101 and Fig. 14). The schist and limestone appear to be highly sheared Kiibasket limestone, and are similar to, though of higher metamorphic grade than, limy phyllite of the McKay group in the White River Break to the southeast. Possibly the faulting which produced the sheared rocks was followed by metamorphism in the area northwest of Kinkasket Lake.

The White River Break in the Succour Creek-Blackwater Creek valley and for several miles to the southeast is complicated by faults not directly related to it. Little is known of the faults on the southwest side of the valley. They appear to be steeply dipping local faults which have broken the strata into a series of wedge-shaped blocks. The faults have a pattern that implies that they are later than the White River Break. Along the northeast side of the Succour Creek-Blackwater Creek valley is a zone of thrust faults dipping to the northeast. The faults are closely related to folds overturned toward the southwest. Northwest of the Bush River these folds are transected by folds related to the Trench fault zone, and it is concluded that the northeastward dipping thrusts are older than the southwestward dipping thrusts, and that probably they also are older than the White River Break.

Nepheline Syenite

Two small masses of nepheline syenite occur within the area studied. One is exposed along the Big Bend Highway about 1½ miles southeast of the Sullivan River and the other is in the Solitude Range 8 to 9 miles southeast of the Sullivan River and about 2½ miles northeast of the highway. A third mass is reported to form the summit of Trident Peak and to extend southeast toward Windy Creek, but it was not visited.

The syenite exposed in rock cuts along the Big Bend Highway southeast of the Sullivan River is mainly medium-grained light-grey granitoid rock with a vague gneissic banding. Feldspar and small amounts of amphibole and locally biotite can be recognized in the field. Thin sections show a high proportion of plagioclase, less microcline-microperthite, and scattered grains of an isotropic feldspathoid. Where exposed in road cuts, the contact of the syenite with wallrocks *is* concordant and gradational. Wallrocks are mainly mica schists, which locally have calcareous interbeds. The northwestern part of the syenite and its western contact are beneath the river flats, so that the true size and shape of the mass is not known.

The syenite in the Solitude Range forms an irregular dyke-like body a little more than a mile long and less than 1,000 feet wide, with its long axis trending about north 70 degrees west. The dyke-like body crosses the valley of Caribou Creek, a tributary of the Columbia, about 2½ miles from the river. It cuts irregularly across part of the Kinbasket limestone. The texture of the syenite varies from place to place. Near the western end, on the northwest side of Caribou Creek, it is coarse grained with closely packed moderately well-formed crystals of potash feldspar and minor interstitial biotite. Toward the east it becomes fine to medium grained and near the east end is quite variable in texture and composition. Many dyke-like tongues extend into the limestone and liiy argillite around the eastern end of the mass, and inclusions of limestone within the syenite are common. Most of the syenite is composed of microcline-microperthite, nepheline, biotite, and locally carbonate. Amphibole, epidote, and garnet are present in coarse-grained lenses near the eastern end of the syenite mass. Contacts of the syenite with the enclosing limestone are generally well defined but in detail are highly irregular and are gradational over a few feet. On the southwest side of Caribou Creek, limestone forming inclusions in or lying along the margins of the syenite is altered to a fine-grained greenish rock composed mainly of calcite with interstitial feldspar, clinozoisite, and chlorite.

Mineral Deposits

In this geological reconnaissance, time did not permit a study of the mineral deposits. Only three occurrences of sulphide mineralization are known to the writer within the map-area. Showings of lead and zinc on the southwest side of Kinbasket Lake were discovered many years ago. A sulphide-bearing shear zone is reported in the canyon of the Cummins River about 1 mile from the Big Bend Highway. White quartz containing grey copper was noted in the Blackwater Range during the present work.

Kinbasket

The Kinbasket property is on the south side of the lake between Trident and Windy Creeks, and was covered by two Crown-granted claims which recently have reverted to the Crown. Galena in quartz was discovered on the claims in the 1890's, but little work was done until about 1948. In 1951 the property was under option to The Consolidated Mining and Smelting Company of Canada, Limited, who did detailed geological mapping and exploration of sphalerite and galena replacements of limestone. The showings were drilled and the option was dropped in the latter part of the year. No further work has been done.

The limestones, quartzites, and schists southwest of Kinbasket Lake have already been described (p. 99). The rocks are. isoclinally folded and dip about 50 degrees to the southwest into the hill. The showings are 300 to 400 feet above lake-level and are described in the Annual Report for 1951 as follows:-

" The original discovery is in quartzite and quartz-mica schist in the apex of a sharp fold surrounded by crystalline limestone estimated to be 100 feet or more thick. Quartz masses roughly follow the bedding but also break across it in the fractured apex of the fold in quartzite. An adit is driven 25 feet to the southwest across the main concentrations of quartz, and a branch 16 feet to the northwest reaches a shaft about 25 feet below the collar. A length of about 40 feet of quartz lenses in quartzite is exposed on the northwesterly limb of the fold, in masses up to 6 feet wide and making up about half the material encountered by the adit. Coarsely cubic galena occurs in masses as much as 2 feet across. Stripping for 100 feet to the northwest shows the same quartz zone about 3 feet wide and containing some galena.

" Limestone in the northwesterly limb of the same fold is acutely dragfolded and appears to terminate in a series of sharp fingers about 1,000 feet northwest of the main fold. Continuity farther to the northwest had not been established, but it is probable that the limestone is greatly thinned by squeezing, and the continuation of it is not readily seen. Replacement by sphalerite and galena occurs over much of this distance, in thin bands up to 3 or 4 inches wide, and in local aggregates of such bands across widths of several feet. Mineralization is apparently concentrated in the dragfold 'fingers.' "

Quartz float containing grey copper in the Blackwater Range was found at an elevation of about 6,000 feet near the head of a creek known locally as Clearwater

Creek, which flows into Blackwater Creek near the outlet of Blackwater Lake. The material was not found in place, but an old camp-site and tools suggested that showings were near by.

In recent years, interest has been taken in masses of nepheline syenite in the Rocky Mountains and in ranges immediately west of them because uraniferous pyrochlore in places is associated with the syenite. Radioactive minerals are reported to be present in the delta of Trident Creek and are presumed to have come from masses of syenite near the head of the creek. Geiger-counter field tests of the two syenite bodies within the map-area (see p. 103) gave counts only as high as twice the normal background. The highest counts were obtained from altered limestones near the syenite on the southwest side of Caribou Creek.

References

Allan, J. A. (1914) : Geology of Field Map-area, B.C. and Alberta, *Geol. Surv., Canada,* Mem. 55.

Coleman, A. P. (1889) : Notes on the Geography and Geology of the Big Bend of the Columbia River, *Roy. Soc.,* Canada, Trans., Vol. 7, Sec. 4, pp. 97–108.

Evans, C. S. (1933) : Brisco-Dogtooth Map-area, British Columbia, *Geol. Surv., Canada,* Sum. Rept., 1932, Pt. A II, pp. 106–187.

Gunning, H. C. (1929) : Geology and Mineral Deposits of Big Bend Map-area, B.C., *Geol. Surv., Canada,* Sum. Rept., 1928, Pt. A, pp. 136–194.

Henderson, G. G. L. (1954) : Geology of the Stanford Range, *B.C. Dept. of Mines,* Bull. No. 35.

Jones, A. G. (1951) : Geology of the Mica Creek Damsite on Columbia River, British Columbia, *Geol. Surv., Canada,* Special Report.

——— (1959) : Vernon Map-area, British Columbia, *Geol. Surv., Canada,* Mem. 296.

North, F. K., and Henderson, G. G. L. (1954): Summary of the Geology of the Southern Rocky Mountains of Canada, *Alta. Soc. Pet. Geol.,* Guide Book, pp. 15–81.

——— (1954) : The Rocky Mountain Trench, *idem,* pp. 82–100.

Okulitch, V. J. (1949) : Geology of Part of the Selkirk Mountains in the Vicinity of the Main Line of the Canadian Pacific Railway, British Columbia, *Geol. Surv., Canada,* Bull. No. 14.

McCULLOCH CREEK*

Gold

Stanmack Mining Co. Ltd. (51° 118° S.E.) Registered office, 625 Fort Street, Victoria. C. W. Stanberry, president. Capital: Authorized, 1,000,000 shares, 50 cents par value, issued 500,000 shares. This company holds the original Ole Bull and Orphan Boy claims which were worked in 1895. Six additional claims have been located, tying in the Orphan Boy and the Ole Bull claims. The property is in the Groundhog Basin at the headwaters of McCulloch Creek, and is accessible by road from Mile 57 on the Big Bend Highway. The road follows the north side of the Goldstream River for a distance of 8 miles, then turns and follows McCulloch Creek for 5½ miles.

The rocks in the area are mainly mica and chloritic schists which appear to strike northwest and dip to the northeast fairly flatly. The schists are cut by numerous quartz veins which appear to be parallel, striking north 10 degrees east and dipping very steeply to the west. The quartz veins, which range from 6 inches

* By I. D. McDonald.

to 8 feet thick, contain stringers of pyrite. The wider veins are found on the Orphan Boy claim. It has been reported that free gold is found in the quartz or associated with the pyrite. Coarse placer gold is found in McCulloch Creek and its small tributaries.

In 1959 a road to the property was completed and the quartz veins on surface were opened up so that channel samples could be taken below the oxidized covering.

REVELSTOKE*

Silver-Lead-Zinc

Mastodon (Mastodon Zinc Mines Limited)

(51° 118° S.E.) Head office, 405, 25 Adelaide Street West, Toronto; mine office, Revelstoke. D. F. Kidd, mine manager. This company holds about fifty Crown-granted claims crossing the ridge between La Forme and Carnes Creeks about 17 miles north of Revelstoke. The main camp and mill are on the north side of La Forme Creek at an elevation of about 3,400 feet, 4½ miles by road from a point on the Big Bend Highway 17 miles north of Revelstoke. The mine is on the divide between La Forme Creek and Carnes Creek at an elevation of about 5,000 feet. It is serviced from the main camp by an incline and a narrow-gauge railway. The mine has been idle since October, 1953, and the machinery and buildings have been maintained by watchmen.

The mine camp and near-by workings are on the east side of a broad northerly trending upland valley which forms a saddle between the deep valleys of La Forme Creek to the south and Carnes Creek to the north, Outcrops are scarce near the workings and on the lower slopes of the upland valley, but are abundant on the steep slopes of the deep valleys and on high ridges to the east. The writer spent the month of August in a geological study of the mine and in a short reconnaissance of the surrounding region. Before the mine was closed, the walls of essentially all the underground workings had been washed with pressure hoses. In this study the workings were mapped on 20 feet to the inch, showings about half a mile north of the mine were mapped by compass and tape, and reconnaissance traverses were made between Carnes and La Forme Creeks east of the mine.

The early history of the property is summarized in the Annual Report of the Minister of Mines for 1950. Road construction from the Big Bend Highway was started in 1950, and in 1951 and part of 1952 a 150-ton mill, a hydro-electric plant on La Forme Creek, and camp buildings were constructed. By July, 1952, the mine, connected to the mill by an incline and a narrow-gauge railway, was ready for production. Between August and December about 16,400 tons of ore was milled, from which a zinc concentrate was produced. Although there was no further production, work at the mine continued until the end of October, 1953, during which time a low adit level, the 5000 level, was driven.

The Mastodon orebodies are replacements of calcareous rocks, principally by sphalerite. Regionally the orebodies are on the western side of a lenticular mass of limestone and dolomite which extends northwest from the upper slopes of the east fork of La Forme Creek to Carnes Creek, a distance of about 3 miles, and has a maximum width from east to west of about three-quarters of a mile. These carbonate rocks are in contact on both the east and west with dark-grey and, less commonly, green phyllites. All the rocks are isoclinally folded and strongly sheared. In general the limestones and the phyllites have a pronounced foliation which is either banding or cleavage. Bedding is rarely seen and is difficult to identify. The foliation strikes to the northwest and dips to the northeast at angles ranging from 20

* By J. T. Fyles.

to 70 degrees and averaging about 45 degrees, Because of structural complexities neither the regional structure nor the stratigraphy is known, Folds that are recognized are too highly sheared to permit the determination of local stratigraphy, and regional mapping was not extensive enough to establish a general stratigraphic sequence. Dragfolds, which are locally common and well displayed, plunge at 20 to 45 degrees to the north and in the area studied have the form of a letter "Z" in section looking down the plunge. Because essentially all the dragfolds have the same Z shape, it is thought that they are related to regional shearing and probably cannot be used in the determination of the positions of axes of major folds.

The Mastodon mine has four principal levels: the 5500 level, formerly called No. 1 level; the 5300 level, formerly No. 2 level; the 5100 level, formerly No. 3 level; and the 5000 level, formerly No. 4 level. These levels are at elevations of 5,540, 5,320, 5,130, and 5,040 feet respectively. The levels are connected by inclined raises; the three lower levels are adits and the 5500 level is connected to surface 60 feet above by an inclined shaft. The 5300 level is caved near the portal. A sublevel drift, the 5200 level, is at an elevation of 5,240 feet. Near the orebodies the workings are extensive enough and close enough together to permit the tracing of contacts and projection of rock units, but the 5100 and 5300 level crosscuts and much of the 5000 level are too widely separated to enable the projection of geological units from one working to the next.

In detailed geological studies a relatively great number of rock types can be recognized in the mine. They comprise a series of limestones, dolomites, and phyllites, with few distinctive rock types and no easily recognized markers. Several types have been formed by the bleaching and shearing of others. Because of this and because of complexities of the structure, a stratigraphic sequence is not recognized. The rock units shown in Figure 15 are generalized. Only significant contacts are shown, and details of the lithology are given in the following paragraphs.

Most limestone is finely crystalline, blocky, light to dark grey, and more or less well banded. Colour bands a fraction of an inch to about 2 inches apart resemble gneissic foliation, and probably at most places are not bedding. Where seen on crests of folds, the bands are parallel to the axial planes of the folds and not to limestone-phyllite contacts which represent the bedding. Variations in width and colour of the bands produce marked variations in the appearance of the limestone. Along strongly sheared contacts and on certain joint planes, the limestone is white with little or no banding and apparently has been bleached.

Dolomite in general is blocky, very fine grained, and without banding. Dark-grey to black, and buff to white dolomite are the most common types. The dolomite in general differs from the limestone in being finer grained, less well banded, and more strongly jointed. Locally the dolomite closely resembles the limestone, and the two are difficult to distinguish without the use of dilute acid. Bleached zones several inches wide following joints or narrow quartz veinlets are found in the dark-grey dolomite, and it seems probable that the buff to white dolomite has formed by widespread bleaching.

Phyllites of various colours are the third type of rock found in the mine. They are grey, greenish or brownish grey, very light grey, and green. Differences between the phyllites are slight, and correlations of rock types between workings are difficult. Thin sections reveal that quartz, sericite, and minor tourmaline with or without chlorite, biotite, and carbonates are the principal constituents. Scattered pyrite and carbonaceous material is common.

The various colours of phyllite appear to have little or no stratigraphic significance. Biotite is a minor constituent, but it greatly affects the colour. Rocks con-

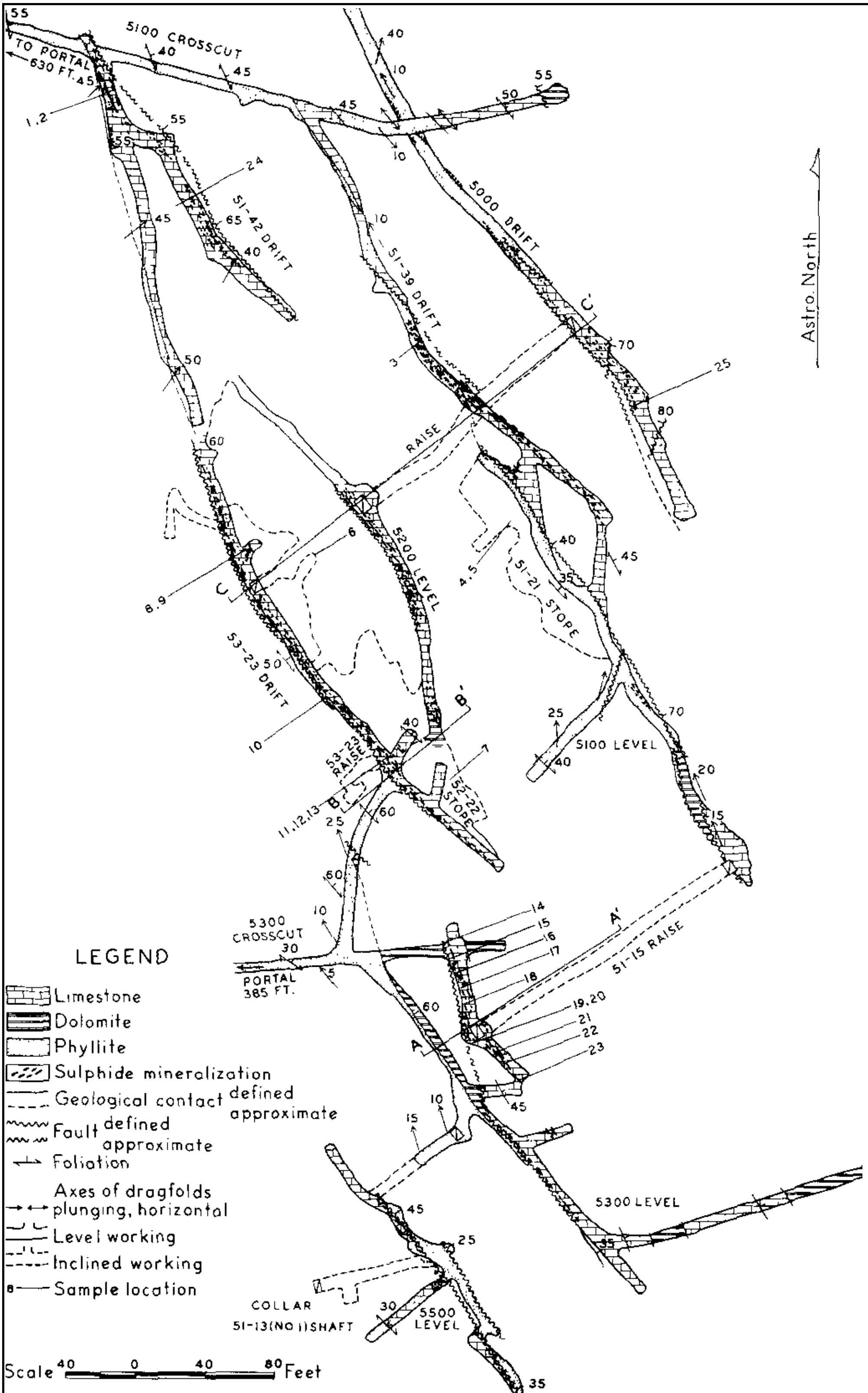


Figure 15. Geology of part of Mastodon mine, La Forme Creek.

taining biotite are grey and brownish grey, those containing chlorite are greenish and become greener in proportion to the amount of chlorite. Biotite has developed from chlorite, and hence the colour of the phyllite is to some extent an indication of the grade of metamorphism. Certain phyllites, particularly those in the footwall of some orebodies, have been bleached, probably by silicilication and sericitization. Because colour appears to have little or no stratigraphic significance and because of structural complexities, lithological subdivisions of the phyllites have not been made.

The phyllites have a more or less well-developed cleavage. Some are more highly sheared than others, but no continuous shear zones have been recognized from the distribution of sheared rocks. Banding is poorly developed in the phyllites, and bedding cannot be recognized with assurance. One distinctive variety of phyllite, encountered at several places, is composed of alternating bands a few inches thick of green phyllite and white limestone. This variety of phyllite is seen at several places but is not associated with the same rock types and probably is not a stratigraphic unit. The bands display tight dragfolds and may themselves be sheared infolds of limestone and phyllite.

The rock types decribed in the preceding paragraphs are found on all the levels. In addition, somewhat different types of dolomite and phyllite are found on the 5000 level. Some light-grey dolomite on the 5000 level is medium grained and contains grey and dark-grey bands half an inch to a few inches thick. The bands are discontinuous, fade out gradually into light-grey dolomite, and in places change attitude abruptly in distances of a few feet as though they were in adjacent blocks of a coarse breccia. A striking dolomite breccia is found on the 5000 level. It is composed of black carbonaceous dolomite containing rounded and angular blocks of white or light-grey fine-grained dolomite as much as 1 foot across. This breccia, which probably forms large irregular lenses, is exposed at two places in the 5000 drift but is not seen elsewhere in the mine. Some of the phyllites encountered on the 5000 level are more coarsely crystalline than those on the other levels. They are light grey and contain visible scattered flakes of brown biotite.

Structure.—The rocks in the mine are isoclinally folded and strongly sheared. Foliation dips to the northeast at angles ranging from about 20 to 70 degrees. The average strike of the foliation is north 30 degrees west, and the average dip is about 45 degrees to the northeast. Relatively small isoclinal dragfolds can be seen at many places in most of the workings, and several larger dragfolds can be seen or inferred. No major folds are recognized, and all the folds seen or inferred are termed dragfolds. Axial planes of the dragfolds strike about north 30 degrees west and dip 30 to 50 degrees to the northeast. The plunge of the axes varies widely from gently northwest and north to northeast down the dip of the foliation planes. Most of the dragfolds have the shape of the letter " Z " looking down the plunge. A few gently plunging dragfolds in the 5300 crosscut have the shape of the letter " S." Most dragfolds are tight and show marked overlap; many have sheared limbs.

The plunge, shape, and origin of the dragfolds are of concern in exploration because the zinc mineralization is partly controlled by the dragfolds. Probably more than one generation of dragfolds is present in the mine, but it is diicult and in most cases impossible to distinguish one generation from another. In well-exposed gently plunging folds, banding in the limestone is parallel to axial plane cleavage and is not folded, whereas some steeply plunging dragfolds are outlined by folded banding. Possibly steeply plunging dragfolds are superimposed on older more gently plunging folds. Z-shaped dragfolds plunging more or less down the dip of the foliation form part of a regional pattern which is probably related to regional shear. Judging from the shape of the dragfolds, the direction of shear has been of the west side northward.

The plunge of the dragfolding has been studied statistically. Plunges of axes exposed well enough to be measured in the course of underground mapping were plotted in stereographic projection, and a contoured diagram of the plot is shown in Figure 17. The diagram shows the wide variation in the plunge and the high proportion of axes plunging down the dip of the foliation. Some general variations in plunge from place to place in the mine. were noted, but available data were insufficient to make statistical plots for each level. In Figure 17 the maxima at A and at C are made up of plunges from all levels, whereas the maximum at B is largely produced by plunges measured at the eastern end of the 5000 crosscut. The diagram

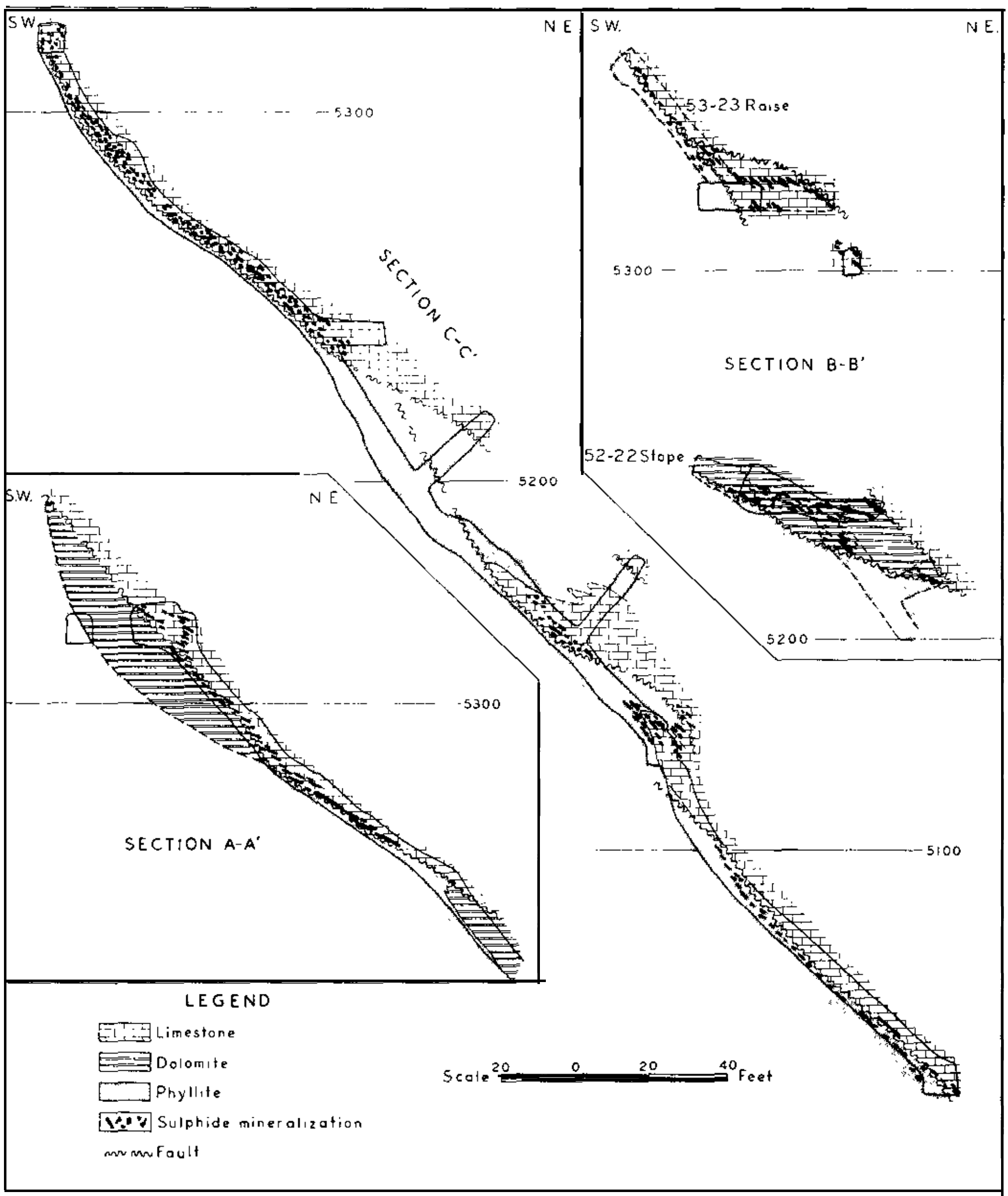


Figure 16. Geological cross-sections, Mastodon mine.

can be interpreted to mean that two generations of folds are present, one plunging gently to the northwest, and the other plunging to the northeast down the dip of the foliation. This interpretation is in accordance with observations referred to in the preceding paragraph.

Several shear zones referred to as strike faults are recognized, and probably many more are present which have not been recognized. They strike northwest and dip at moderate angles to the northeast parallel to the foliation. The known strike faults, which are marked by a relatively inconspicuous zone of sheared and crushed rock, are along contacts between contrasting types of rock. They are difficult to recognize, and continuous shear zones have not been found wholly within the phyllites where there is no marked contrast in rock type. On the levels the faults follow one contact for relatively great distances, but in the raises they pass rapidly from one contact to another and from one fold to the next (see Fig. 16). The strike faults appear to constitute a primary control of the zinc mineralization.

Orebodies.—The orebodies are replacements of limestone, dolomite, and phyllite mainly by sphalerite. The sphalerite ranges in colour from light yellowish-brown to dark brown. Brown and light-brown sphalerites, which occur in limestone and dolomite, are more abundant than dark-brown sphalerite, which is found mainly in phyllite and dark-coloured limestone and dolomite. Fine-grained galena is present in minor amounts, and grey copper is found locally. Unreplaced remnants of the host rocks constitute the gangue.

The mineralized zones that have been explored and mined are in or close to the strike faults just described. Some are in the fault zones; others are in folds or in banding related to cleavage, both of which are cut by the faults. The orebodies dip to the northeast and rake to the north. They are tabular or lenticular and commonly split or branch. Assays of samples are given in the following table, and the locations of the samples are shown in Figure 15.

CHANNEL SAMPLES

Sample No.	Location	Width		Gold	Silver	Lead	Zinc
		Ft.	In.	Oz. per Ton	Oz. per Ton	Per Cent	Per Cent
1	West side	4	....	Trace	0.5	1.03	37.0
2	East side	2	10	*Nil*	*Nil*	0.03	2.8
3		5	6	0.01	Trace	0.03	13.2
4	West side	5	....	*Nil*	*Nil*	0.04	15.8
5	East side	6	....	Trace	0.2	....	20.9
6		6	....	*Nil*	0.6	0.46	21.8
7		7	6	*Nil*	0.2	0.08	28.4
8	West side	6	....	*Nil*	0.1	1.0	25.7
9	East side	6	....	*Nil*	0.1	Trace	34.9
10		3	9	Trace	6.3	12.4	17.9
11	West side	6	....	Trace	0.6	1.4	34.6
12	Centre	6	....	*Nil*	0.2	0.5	34.6
13	East side	6	....	*Nil*	0.7	0.7	23.6
14		2	....	*Nil*	*Nil*	Trace	9.2
15		5	3	Trace	0.9	0.5	28.2
16		5	9	*Nil*	0.2	0.3	29.8
17		4	....	*Nil*	*Nil*	Trace	31.0
18		5	....	*Nil*	*Nil*	Trace	24.3
19	West side	5	4	Trace	0.1	Trace	22.5
20	East side	4	10	Trace	*Nil*	Trace	9.6
21		4	...	*Nil*	*Nil*	Trace	8.0
22		3	4	*Nil*	Trace	*Nil*	13.2
23		2	6	*Nil*	*Nil*	*Nil*	15.1
24		9	6	*Nil*	*Nil*	0.05	1.7
25		5	....	*Nil*	*Nil*	....	4.3
26		8	6	*Nil*	0.5	1.49	3.8
27		3	....	Trace	0.1	2.74	4.1
28		5	6	Trace	0.5	2.44	17.7
29		4	....	*Nil*	0.8	2.40	5.8

The largest orebody, which is followed by the 53-23 drift (see Fig. 15) and is here referred to as the 53-23 orebody, has been mined between the 5200 and 5300 levels. It is a slightly curved tabular to lenticular orebody with a strike length of 200 to 300 feet, and a width parallel to the dip of 150 to 200 feet. The orebody strikes about north 30 degrees west and dips 50 to 55 degrees to the northeast. Near the 5300 level it is slightly concave to the northeast, whereas on the 5200 level it is concave to the southwest. The mineralization is along a shear zone on the contact between a light-grey phyllite on the southwest or footwall and grey limestone on the northeast. Most of the sphalerite is in limestone, but some is in the footwall phyllite within a foot or two of the contact. Dark-brown sphalerite occurs in cleavage planes in the phyllite as closely spaced lenses less than an inch thick and a foot or so long. In the limestone immediately above the phyllite, sphalerite is massive or occurs as the matrix of a breccia enclosing irregular unreplaced limestone fragments up to a few inches across. Above this massive and breccia ore, sphalerite occupies fractures or fine crackles in the limestone. The footwall is well defined, and the hangingwall is gradational. The orebody has a fairly uniform thickness of 5 to 10 feet and pinches out rapidly toward the extremities. On most of the 5300 level and part of the 5200 level it appears to follow a single strike fault, referred to here as the 53-23 shear. Toward the southeast the fault splits. Mineralized zones follow the branch faults, and the form of the orebodies becomes complicated.

One of these mineralized zones on branch faults has been mined at the south end of the 5200 level in the 52-22 stope. Sphalerite occurs in dark-grey to black dolomite along what appears to be a gently north-plunging anticlinal crest cut by a number of strike faults (see Fig. 16, section B-B). One fault which dips about 30 degrees to the northeast marks the footwall of the dolomite and separates it from light-grey phyllite beneath. Two faults branch upward through the dolomite from the footwall fault. Slivers of phyllite a foot or so thick are found locally in the dolomite along the branch faults. Tbe sphalerite occurs in irregular lenses or bands, some of which are breccia. Most dip gently to the northeast, and a few have a jagged fold pattern suggestive of a riding of the hangingwall over the footwall. The mineralization becomes narrower and of lower grade toward the south but probably is continuous with that in the upper part of the 51-15 raise (see Fig. 16, section A-A).

The 53-23 orebody has been mined down to the 5200 level and is explored below by the 51-30 raise. The 53-23 shear appears to split down the dip, and the hangingwall split, which follows an apparently favourable limestone-phyllite contact, is not mineralized 50 feet below the 5200 level. The footwall split passes downward through phyllites until it transects an anticlinal mass of limestone and is again mineralized. This lower mineralized zone has been mined in the 51-21 stope south of the 51-30 raise.

The orebody in the 51-21 stope, here called the 51-21 orebody, is lenticular and plunges gently to the north. Like the 53-23 orebody, it is mainly in limestone above a strike fault, dipping about 40 degrees to the northeast with a footwall of light-grey phyllite. The orebody has been mined for 135 feet along the level and to as much as 50 feet above the level. The mineralization lenses out rapidly both up and down the dip. To the south it gradually thins and to the north continues for about 100 feet along the level. Immediately north of the 51-21 stope the footwall fault is joined by subparallel faults which truncate a series of gently plunging isoclinal infolds of limestone and phyllite. The faults and the mineralization pass from the limestone into the phyllite toward the northwest, and within the phyllite the

Mastodon skipway leading from mill on La Forme Creek to narrow-gauge railway.

Dragfolds in limestone (light) and phyllite (dark), Mastodon No. 2 level.

mineralization and probably also the faults die out. The faults have not been recognized in the 51-72 crosscut 200 feet to the northwest.

Dark-brown sphalerite occurs in the phyllite as many small lenses parallel to the cleavage. The long axes of the lenses plunge gently to the northwest more or less parallel to the axes of near-by dragfolds and to the rake of the 51-21 orebody. Scattered mineralization is found in the 51-30 raise below the 5100 level. It is along a strike fault dipping to the northeast with limestone above and light-grey phyllite below. On the 5000 level scattered mineralization is found adjacent to the fault for almost 200 feet along the strike, but it lenses out gradually to the northwest and abruptly toward the southeast.

Mineralized zones in the 51-44 and 51-42 drifts differ somewhat from the others. They are in limestone on the footwall side of a strike fault dipping to the northeast, with grey phyllite in the hangingwall. The limestone wedges out to the northwest along the fault and is crowded with highly attenuated steeply plunging dragfolds. Sphalerite occurs in the limestone as irregular lenses not obviously related to the folds but with long axes which in general plunge steeply. Two small stopes have been made-one above the 51-44 drift and the other above the 51-42 drift. Sample No. 24 was taken in the latter stope.

Mineralization in the 51-15 raise is along a northeasterly dipping strike fault with limestone in the hangingwall and either dark-grey dolomite or light-grey phyllite in the footwall. Sphalerite occurs along the shear zone in limestone or dolomite and locally in phyllite. In limestone it follows banding which dips less steeply to the northeast than the shear zone. At the top of the raise in the 5300 level the mineralized zone splits. One branch follows the fault, the other diverges to the southeast along banding in the limestone.

The 55-13, or old No. 1, shaft, inclined at 37 degrees to the east, was sunk from surface on a mineralized zone following or close to several closely spaced strike faults. The zone is 6 feet wide at the surface and tapers irregularly downward, terminating about 50 feet from the collar of the shaft. In addition to sphalerite, galena and grey copper are present. The zone follows a fault with light-grey phyllite in the footwall, limestone in the hangingwall, and lenses of dark-grey dolomite between the limestone and phyllite. The fault dips less steeply than the inclination of the shaft and is exposed only in the upper part of the shaft and on the northeasternmost wall of the 5500 level. Near the bottom of the shaft and along most of the 5500 level a mineralized zone in another subparallel fault has been explored. It consists of light-brown sphalerite in limestone beneath light-grey phyllite. Near the shaft the mineralized zone has a maximum thickness of about 7 feet and tapers gradually to the northwest and to the southeast.

About fifteen trenches made several years ago explore mineralization for about 500 feet north and 800 feet south of the collar of the 55-13 shaft. Most of the rock encountered in the trenches is now poorly exposed, but recent stripping immediately south of the collar of the shaft has established continuity of mineralization between two of the trenches. In this stripping, sphalerite is in light-grey dolomite, occurring as irregular masses and one or two more or less continuous bands. The mineralized zone is as much as 90 feet long and 30 feet wide and lies to the west in the footwall of the mineralization exposed in the shaft. Old trenches to the north and to the south are described in the Annual Report for 1950 (p. A 161).

From the foregoing descriptions it is apparent that the zinc mineralization is controlled by faults which are more or less parallel to the foliation. The genetic significance of the fault zones is a matter for speculation, but it seems probable that they acted as channelways for mineralizing solutions. In places sphalerite was deposited along the shear zones themselves; elsewhere it spread out from them along cleavage planes or shattered zones in crests of folds. The plunge of dragfolds is important in determining the rake of some of the orebodies and also the distribution of the rocks. The statistical analysis of the plunge (Fig. 17) was made to determine the average. plunge, which might be of use in exploration. As the work progressed, it became clear that it is not the average plunge that is of significance in determining

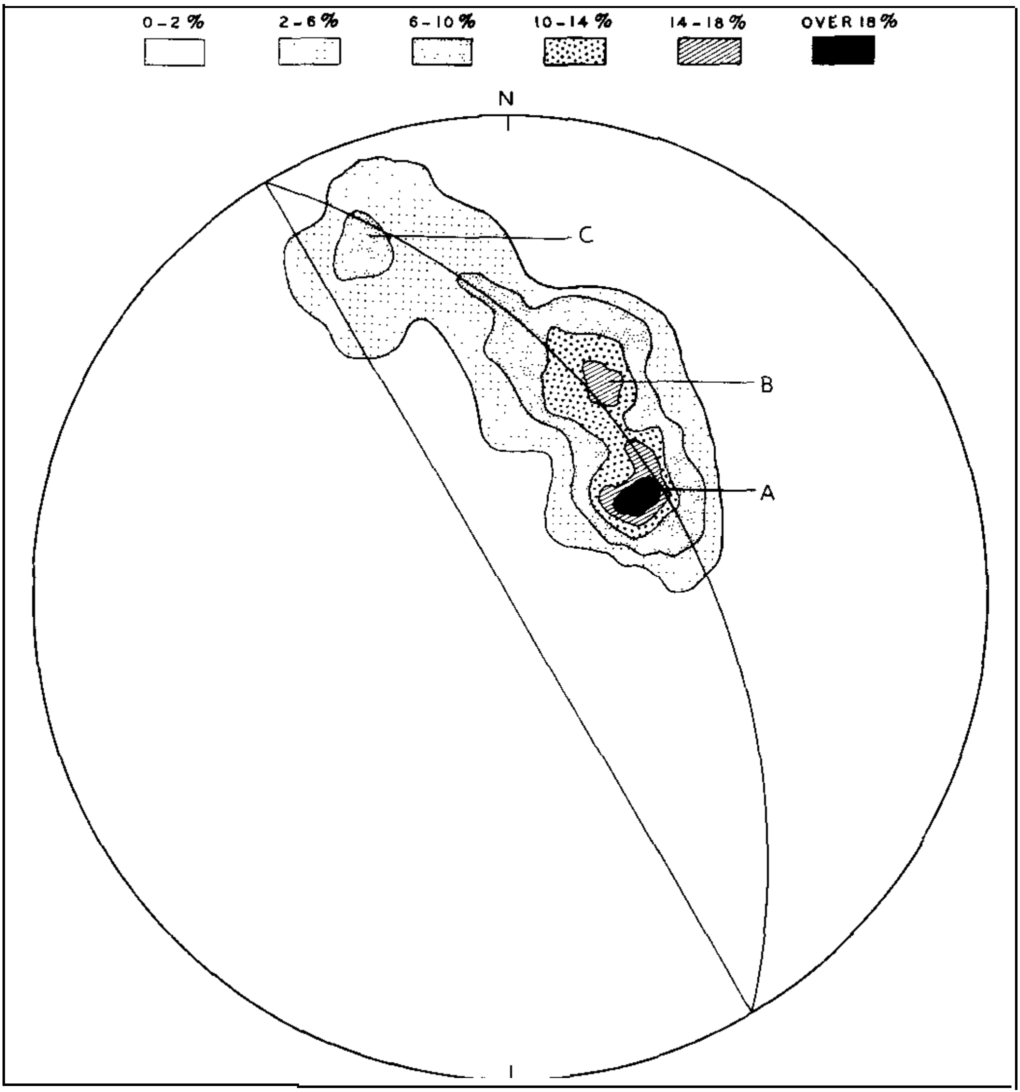


Figure 17. Contour diagram of the plunges of dragfolds in the Mastodon mine. Lower hemisphere stereographic projection, 100 determinations. The average attitude of the foliation is shown by the great circle.

the geometry of the ore-bodies but the individual plunges, which vary widely. The wide variations in plunge and the long angle at which the strike faults intersect the isoclinal folds have produced an exceedingly complex distribution of rock types and mineralized zones. An understanding of this distribution is the key to the exploration and mining of the orebodies.

The significance of lithology on sulphide distribution is uncertain. Limestone and dolomite appear to have been the most favourable rocks for replacement, but phyllite has also been replaced. Many of the mineralized zones have a footwall of light-grey phyllite, and limestone-phyllite contacts of this type may have been particularly favourable. Several different types of rock are mineralized, and in some zones limestone forms the footwall and in others the hangingwall. The structural condition of the rocks in and adjacent to the shear zones was of more importance to sulphide deposition than was the chemical composition.

The 5000 level was driven to intersect the mineralized zones farther to the north and down the structural plunge. It was driven almost due east 1,020 feet from the portal, which is at an elevation of 5,040 feet and is 1,650 feet north and 1,150 feet west of the collar of the 55-13 shaft. It is 800 to 1,000 feet north of the nearest crosscut, on the 5100 level. From a point about 200 feet west of the face of the 5000 crosscut a curving drift was driven to the south and southeast a total distance of 1,450 feet. The inner 380 feet of this drift is shown in Figure 15, and the mineralized zone along it has already been described (*see* p. 114). In the outer 400 feet of the crosscut, rocks similar to those encountered in the other levels are found, but farther east there is a much higher proportion of limestone and dolomite. Vaguely banded dolomite is common in the crosscut and is found together with dolomite breccia in the drift to the south. Near the crosscut the drift followed a sheared limestone-phyllite contact but encountered little or no mineralization along it. Two narrow zones of sulphides were found in the crosscut. One, 345 feet from the portal, is along a shear zone in limestone and contains 1 to 2 feet of sphalerite and pyrite. The other, 375 feet from the portal, *is* a zone up to 2 feet wide containing dark-brown sphalerite along cleavage planes in phyllite.

Zinc mineralization is found on surface 1,000 to 2,000 feet north of the 5000 crosscut. These showings, known as the "north showings," are on the ridge above, and on the upper part of the steep slope of the valley of Carnes Creek. The geology in the vicinity of the showings is shown in Figure IX, and their location in relation to the main workings is shown in the Annual Report for 1950, Figure 5 (facing p. A 166). The rocks exposed near the north showings are essentially the same as those already described. They include dark-grey phyllite, grey banded limestone, and buff-weathering light-grey to white porcelaneous dolomite, The showings are in a contorted zone containing lenses of dolomite and limestone in grey phyllite between two extensive masses of limestone. The contorted zone is bounded on the cast and probably also on the west by faults. The fault on the east strikes between north and north 20 degrees west and dips 40 to 65 degrees to the east. It transects grey phyllite on the west with a strong cleavage dipping SO to 60 degrees to the northeast and containing complex lenses of limestone and dolomite. The lenses derive their shape from intense folding and shearing. Dragfolds, which are common in the limestones, mostly plunge about north 10 degrees east at 30 to 40 degrees, although some plunge more steeply to the northeast and others more gently to the north. The variation in plunge, like that in the mine, probably results from multiple deformation. No major folds are recognized with assurance, though the larger folds are represented by the lenses of limestone and dolomite which probably plunge parallel to the fold axes. Visualization of the folds is complicated by the slope of the hill, which is parallel to or less steep than the steep plunges and steeper than, the gentle plunges. Possibly the lenses in the contorted zone represent the sheared remnants of a syncline on the west and an anticline on the east, plunging to the northeast steeper than the slope of the hill.

Mineralization consists of sphalerite and galena in limestone and dolomite near contacts with phyllite. Copper stain indicative of grey copper is noticeable in some

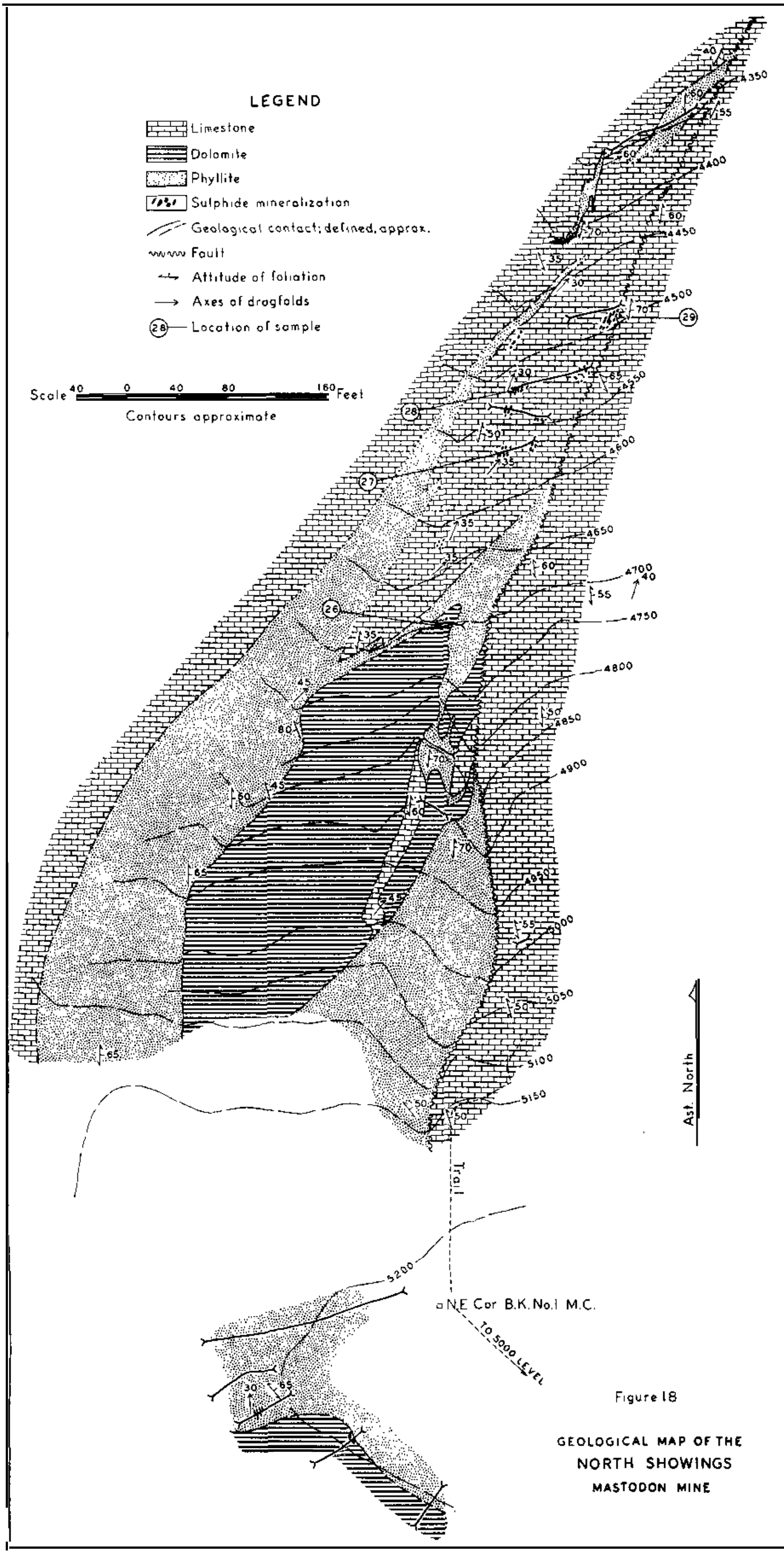


Figure 18

GEOLOGICAL MAP OF THE NORTH SHOWINGS MASTODON MINE showings. Two groups of showings have been explored by trenches-one at an elevation of about 5,200 feet on a knoll at the top of the steep slope, and the other to the north between elevations of about 4,350 and 5,000 feet on the slope itself. On the first group three closely spaced trenches expose scattered brown sphalerite and galena along a dolomite-phyllite contact trending irregularly to the northwest and dipping to the northeast. Small lenses of limestone, which contain most of the sulphides, are found along the contact. Mineralization in the group of showings to the north varies considerably in occurrence. One showing at an elevation of about 4,500 feet consists of narrow bands of sphalerite in limestone across a width of about 6 feet extending up a small cliff for 10 to 15 feet parallel to the bands. At several places massive brown sphalerite forms lenses in limestone that appear to be on crests of folds plunging to the north. The largest seen is about 5 feet wide and 3 or 4 feet thick. Locally sphalerite is found in lenses along cleavage planes in light-grey phyllite. Two trenches expose closely spaced quartz veinlets carrying galena. Although many of the trenches are closely spaced, it is difficult to project the mineralization and details of the rock types from one trench to the next. The location of samples of the highest-grade mineralization seen are shown in Figure 18, and the assays are given in the table.

[Reference: Minister *of* Mines, B.C., Ann. Rept., 1950, pp. A 159-A 166.]

Lead King

(51” 118” S.E.) The Mastodon group of Crown-granted claims covers lead and zinc showings known as the Lead King. The showings are near the southeast end of the claims on the upper part of the slope north of the east fork of La Forme Creek. They are at an elevation of about 6,000 feet, 1½ miles east of the Mastodon mill, and are reached by about 2 miles of old trail from the upper workings of the Mastodon mine. The showings are old ones that were originally reached by a switchback trail from La Forme Creek. They have been explored by eight trenches and a short adit. Most of the work was done many years ago, but some trenching was done by the present owners about 1953.

Regionally, the showings are near the southeast end of a lens of limestone and dolomite extending northwestward as far as Carnes Creek. Near the Lead King showings the rocks strike almost east-west and dip gently to the north into the hill. To the west on the southwestern side of the lens of limestone and dolomite, the strike changes gradually to northwest. To the north the strike changes rapidly to about north 10 degrees west and the dip steepens to about 50 degrees to the east. The rocks are. isoclinally folded and strongly sheared, but details of the structure are not known. Probably a regional strike fault follows the eastern side of the limestone-dolomite lens and passes near the Lead King showings.

Rocks exposed near the Lead King showings are prey dolomite and dark-grey phyllite. Most of the dolomite is more or less silicified, and some bands are so siliceous that they resemble grey or buff quartrite. Locally lenses of grey phyllite are found in the dolomite, and some phyllite at a distance from dolomite contains layers of grey limestone up to several feet thick. The showings are in and along the east side of a steep draw running southward to La Forme Creek. The dolomite in which the showings are found is the upper of two masses that wedge out eastward into grey phyllite. They form the southeast end of the lens of limestone and dolomite already referred to. Near the showings the upper mass is 150 to 200 feet thick, thins gradually to the east, and thickens rapidly to the west.

The showings are of sphalerite and galena, principally in silicified dolomite. Four or five lenses of sulphides are exposed along the dolomite band for about 200 feet. No pattern of mineralization is recognized, and continuity between the showings has not been established. The easternmost showing, near the crest of the ridge east of the draw and near the eastern limit of good rock outcrops, consists of small lenses of white quartz in dolomite containing scattered galena. The lenses are concentrated in a poorly defined zone a few feet wide and several feet long. A few hundred feet to the north, irregular lenses of galena occurring in siliceous dolomite form another poorly defined zone several feet long and a few feet wide. The best showings arc about 150 feet to the west and 100 feet lower in a small bluff on the east side of the draw. Bands of mineralized siliceous dolomite dip gently to the north. One containing scattered galena is about 3 feet thick and continues for 10 to 15 feet along the strike. A sample across 3 feet of this band assayed: Gold, nil; silver, 0.3 oz. per ton; lead, 25.03 per cent; zinc, 9.6 per cent. Another band a few feet below and to the west contains fairly massive yellow to brownish sphalerite. It is 3 feet thick, not more than 10 feet long, and appears to be localized in the crest of a tight fold plunging about 25 degrees to the north. A sample across 3 feet of this band assayed: Gold, nil; silver, nil: lead, 2.50 per cent; zinc, 32.0 per cent.

Little Slide

(51” 118” SE.) Three claims, Little Slide No. 1, Little Slide No. 2, and Little Slide No. 3, on the east fork of La Forme Creek are held by record by E. M. Shea, of Salmon Arm. The claims are on the northeast side of the creek between 2½ and 3% miles east of the Mastodon mill. The claims were located to cover two showings of lead-zinc mineralization. In 1959 the old trail along the east fork of the La Forme Creek was cleaned out, side trails to the showings were built, and several small open-cuts were made.

The first showing on the Little Slide No. 1 claim is at an elevation of about 5,700 feet, almost 3 miles east of the Mastodon mill. Rocks near the showing are grey-banded limestone, light-grey massive dolomite, and green and grey phyllite. The calcareous rocks form a band about 100 feet thick which strikes northwest parallel to the contour of the hill and dips 30 to 45 degrees to the northeast into the hill. Above the calcareous rocks are green phyllites, and within them are layers and lenses of grey phyllite. The rocks are cut by a steeply dipping irregular mafic dyke containing coarse phenocrysts of plagioclase and pyroxene.

The showing consists of five or six white quartz veins containing galena, sphalerite, and small amounts of chalcopyrite. The veins, which transect the limestone and dolomite, strike between north 25 degrees east and northeast and are vertical or dip very steeply to the northwest. They are 20 to 30 feet apart and very irregular in thickness. The largest is 10 feet thick at one point and thins rapidly both upward to the northeast and downward, forming a lens about SO feet long. Sulphides occur as irregular clusters with erratic distribution in the quartz. The largest vein is not well mineralized. Two smaller veins to the northwest contain a fair proportion of sulphides in clusters between barren sections. In one vein a sample across 34 inches of the best mineralization assayed: Gold, trace; silver, 10.9 oz. per ton; copper, 0.26 per cent; lead, 21.02 per cent; zinc, 2.0 per cent, A sample across 14 inches assayed: Gold, trace; silver, 4.4 oz. per ton; copper, 0.03 per cent; lead, 10.51 per cent; zinc, 0.3 per cent.

The second showing is on the Little Slide No. 3 claim about half a mile southeast of the first. The showing crosses a creek, one of the main tributaries of the east fork of La Forme Creek, at an elevation of about 5,600 feet. Galena and sphalerite occur as replacements of limestone and dolomite in a sequence of calcareous rocks and grey and green phyllites. The rocks dip 35 to 45 degrees to the northeast. The sulphides occur as discontinuous layers in limestone and as irregular disseminated lenses in dolomite. The highest-grade mineralization is in a hand of limestone 6 to 8 feet thick which lenses out in dolomite, on the northwest side of the creek, in the form of an isoclinal anticline plunging about 35 degrees to the north. A lens of rusty phyllite lying between the limestone and dolomite occupies the crestal zone of the anticline and pinches out along the limbs. Sphalerite occurs in small lenses at the crest of the fold on the phyllite-dolomite contact. A sample across 2 feet in the crest of the fold assayed: Gold, *nil;* silver, trace; lead, 0.03 per cent; zinc, 28.8 per cent. Sulphides are also found in the limestone and in dolomite on the northeast side of the limestone. The total width of mineralized rock is about 20 feet, and mineralization continues to the southeast along the strike from the crest of the anticline a distance of about SO feet. Farther to the southeast there are no outcrops. A sample across 2 feet of well-mineralized limestone on the northwest side of the creek assayed: Gold. nil; silver, 0.1 oz. per ton; lead, 6.17 per cent; zinc, 9.8 per cent. Another sample across 11 feet of mineralized dolomite adjacent to the limestone assayed: Gold, *nil;* silver, 0.2 oz. per ton; lead, 0.77 per cent; zinc, 2.1 per cent. Another sample across 6 feet of mineralized limestone and dolomite on the southeast side of the creek assayed: Gold, *nil;* silver, trace; lead, 2.96 per cent; zinc, 6.5 per cent.

SICAMOUS*

Molybdenum

Malakwa (Southwest Potash Corporation)

(50° 118" N.W.) Company office, 718 Granville Street, Vancouver 2. This property of ten claims, held by option, is about 4 miles to the northwest of Malakwa railway station, 12 miles east of Sicamous. Access is by secondary road leading to the Knuff ranch and then up the mountainside. Some reconnaissance geological mapping was done and 140 feet of packsack diamond drilling. A crew of three men was under the supervision of D. Chapman, engineer in charge.

MANNING PARK†

Zinc-Copper

Big Ben

(49" 120" S.W.) This group of eight recorded claims is owned by B. E. Williams, of Keremeos. It is reached by a trail on the west side of Cambie Creek, the headwaters of the Similkameen River, and is about 3 miles north of the Hop&Princeton Highway.

The property is described as the Sparkler group in the Annual Reports of 1925, p. 212; 1927, p. 248; 1928, p. 265; and as the Big Ben group in Geological Survey of Canada Memoir 243, p. 113. The present claims, a relocation of the original Big Ben group, are the Hope-Summit Nos. 1 to 8.

The geology in the vicinity is shown on Map 888.4, Princeton sheet, accompany*ing* Memoir 243. The property lies within a southeastward trending band of Jurassic(?) and Lower Cretaceous Dewdney Creek sediments and pyroclastics. About a half-mile to the northeast the Dewdney Creek group is in fault contact, along the Chuwanten fault, with rocks of the Pasayten group. The near-parallel Gibson fault lies about 1 mile to the southwest. The Chuwanten and Gibson faults are part of the Hozameen fault system, which in turn is thought to be an extension of the faults along the Fraser River. Appreciable mineralization has been found along the Hozameen and Fraser River fault systems.

Most of the rock and mineral exposures are within a distance of some 1,400 feet along Big Ben Creek and about 500 feet along Cameron Creek, 2,500 feet north (Fig. 19). The rocks are thin-bedded and massive lithic tuffs and tuffaceous

* BY David Smith.
† By N. D. McKechnie.

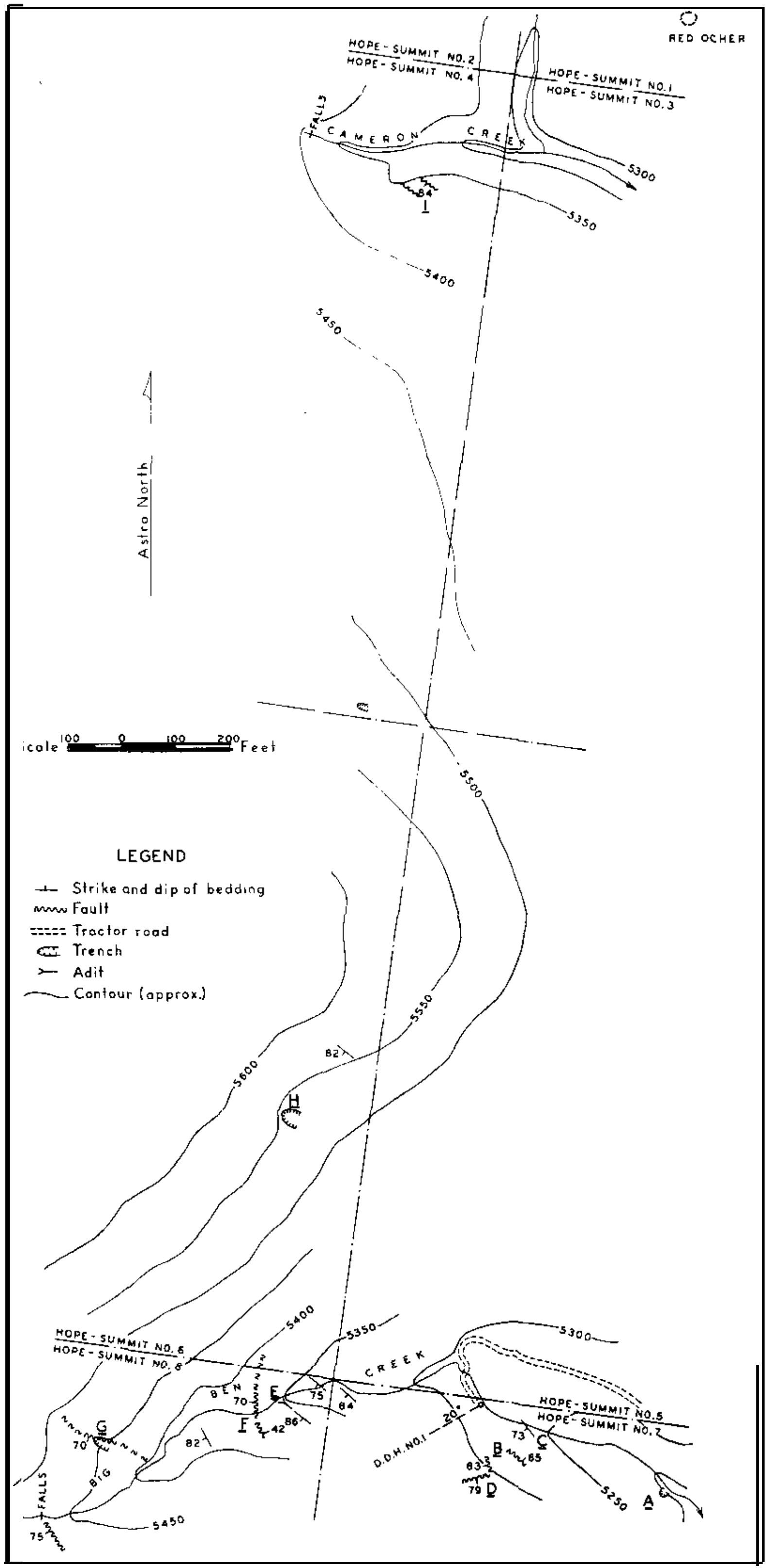


Figure 19. Part of Big Ben group, Similkameen Mining Division.

sandstone, arkose, and argillite. They are intruded by narrow sills of gabbro, exposed at falls on Cameron Creek. None of the rocks are much altered.

The bedded rocks form a northwest-striking monocline dipping 70 to 8.5 degrees southwest. Faults are numerous but generally small. Four principal directions of faulting were recognized: bedding plane faults, which are the strongest and most numerous; faults striking near north-south and dipping steeply west; faults striking northwest and dipping steeply northeast; and faults striking near east-west and dipping steeply south. The most prominent fault observed was a bedding-fault zone about 30 feet wide on the south bank of Cameron Creek.

Mineralization consists of pyrite, pyrrhotite, arsenopyrite, sphalerite, and chalcopyrite as stringers, scattered small aggregates, and lenses. Some of the stringers show a banding, with pyrite forming the outer bands, sphalerite the inner, and chalcopyrite veining both. Stibnite is reported but was not recognized by the writer. Well mineralized sections commonly are more or less porous.

The principal exposures of mineralization are marked on Figure 19 by the letters A to I.

A: Thin threads of sulphide, chiefly pyrite, in white tuffaceous sandstone. Width exposed, 2.4 feet. Assay: Gold, trace; silver, trace; copper, trace; zinc, 0.06 per cent.

B: Sphalerite and pyrite in thin-bedded shaly siltstone in the footwall of a northwest-striking northeast-dipping shear.

c : Pyrite, pyrrhotite, and chalcopyrite in coarse lithic tuff. Width exposed, 2.5 feet. Assay: Gold, trace; silver, 0.02 oz. per ton; copper, 0.22 per cent; zinc, 0.65 per cent.

D: Pyrite, pyrrhotite, arsenopyrite, chalcopyrite, sphalerite as thin stringers in coarse lithic tuff at the intersection of a north-striking west-dipping fault and an east-striking south-dipping fault. The actual intersection was concealed in the bottom of the trench, Chunks of massive sulphides on the dump were said by Mr. Williams to have been taken from deeper in the cut, at the intersection of the faults.

E: A small sulphide lens in the face of an adit 6 feet long. The lens was 1.4 feet wide at the widest place, and was exposed for the length of the adit, striking north 55 degrees west and dipping 85 degrees northeast. Assay: Gold, 0.01 oz. per ton; silver, 1.0 oz. per ton; copper, 0.13 per cent; zinc, 0.06 per cent; a sample of the wallrock yielded 0.04 per cent copper.

F: Two weak faults with sulphide stringers up to less than 2 inches wide in the wallrocks.

G: Bedding-plane fault with sulphides; hangingwall of grey lithic tnff shows noticeable sphalerite. A 6-foot width of the hangingwall bed assayed 3.39 per cent zinc. A sample of sulphides from the fault assayed: Gold, trace; silver, 1.6 oz. per ton; copper, 0.17 per cent; zinc, 6.30 per cent across 4 inches.

H: Caved pit in lithic tuff with scattered sulphides. A grab sample assayed: Gold, trace; silver, 0.1 oz. per ton; copper, 0.03 per cent; zinc, 1.80 per cent.

I: A strong bedding-plane fault zone with scattered stringers of sulphides in the fault.

The sulphide occurrences are associated with fractures. It is probable that the lenticular occurrences represent tension fractures associated with one or more of the faults. None of the lenses seen gave promise of appreciable size and assays were uniformly low. However, it is possible that larger lenses might be found by exploration along the stronger faults, particularly the one exposed at point I.

7

SKAGIT RIVER*

Copper

A.M. (The Consolidated Mining and Smelting Company of Canada, Limited) (49° 121° S.E.) This property, comprising eight Crown-granted and fifty recorded claims, is astride the divide on the west boundary of Manning Park, about 4 to 6 miles by road from the Hope-Princeton Highway 26 miles east of Hope. A crew of twenty-three men under the direction of A. C. N. deVoogd, geologist, and A. L. Burrows, engineer, did 4,241 feet of diamond drilling in seventeen holes on four zones, built 2,300 feet of tractor-road and 1,500 feet of trail for drill access, and geologically mapped a good deal of the surface area.

The property, located in 1930, is mentioned briefly in the Annual Reports for 1930, 1931, and 1933. The geology is described in some detail in the Annual Report for 1938 and in greater detail, as exploratory work progressed, in the Reports for 1949 and 1954. The latter two accounts contain sampling results.

The property, optioned from Canam Copper Company Ltd., was abandoned in November.

The general geology of the region is described in Summary Report 1922, Part A, pp. 88-126, and Map 737.4, Hope Sheet, 1944, of the Geological Survey of Canada.

The writer spent three days in August examining, with the aid of an outcrop map provided by Mr. deVoogd, outcrops in the vicinity of the principal workings and at the neighbouring Invermay showings.

The rocks are sedimentary, chiefly siltstones, of the Upper Jurassic(?) Dewdney Creek group. These are intruded by a large stock of quartz diorite which trends south to southwest and by later sills, dykes, and small bosses of diorite and gabbro. The sediments are steeply folded about northwest-trending northwest-plunging axes. The intrusive rocks are massive and appear to be younger than the folding. Faults are numerous but no large displacements have been recognized.

The property lies about 4 miles northeast of the Hozameen fault, which is thought† to be part of the Fraser River fault system, extending some 150 miles to the northwest.

The mineralization occurs in a pipe-like zone of brecciated sediments shaped as indicated in Figure 20 and having a maximum length of about 1,200 feet and a width of about 400 feet. It plunges steeply northwest between the surface at 5,900 feet elevation and No. 6 level at 5,475 feet, turning steeply southeastward from there to No. 10 level at 4,880 feet. As described in the previous Reports, the breccia consists of angular to sub-rounded sedimentary fragments, most under 1 foot in length but including some much larger blocks. Bedding attitudes within the larger blocks parallel those in the unbrecciated wallrock. This is well illustrated in No. 6 level crosscut where, passing from the main pipe through smaller brecciated zones toward unfractured sediments, strikes and dips show perfect regularity across the axis of an anticlinal fold. The breccia matrix is composed of the secondary minerals calcite, quartz, chlorite, carbonate, alkali feldspar, white mica, and kaolin. Tourmaline is found in fractures in both fragments and matrix. Chalcopyrite, the mineral of principal interest, occurs with pyrrhotite and pyrite and accessory magnetite, molybdenite, uraninite, sphalerite, arsenopyrite, galena, and scheelite. Almost all mineralization occurs in the matrix.

A similar breccia is exposed on surface 2,000 feet north of the main pipe. In it the writer found two blocks, 6 by 12 inches and 3 by 6 feet respectively, of

* By N. D. McKechnie.
† Rice, H. M. A., Geol. SW"., Canada, Mem. 243, p. 52.

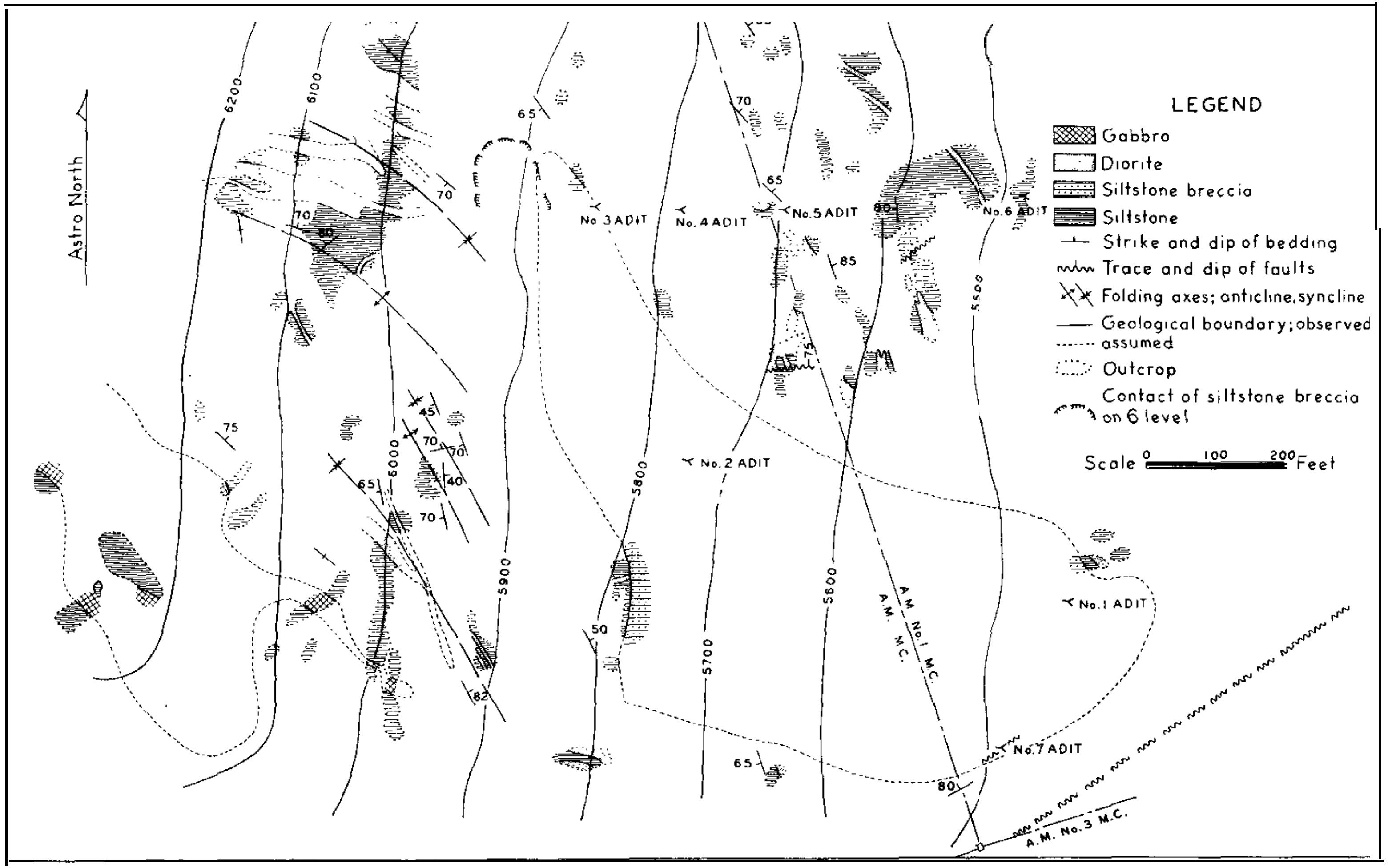


Figure 20. Surface geology of part of A.M. group. From company outcrop map.

grey crystalline rock of medium-grained porphyritic texture and composed of plagioclase feldspar, alkali feldspar, quartz, pyroxene, chlorite, sericite, and a little tourmaline. A rock of this type is noted in the 1949 Annual Report as occurring in the main breccia pipe at two points. It was there considered to represent recrystallized feldspathic sediment. Although some of the feldspar in the writer's specimens is evidently secondary, the blocks may represent an earlier and still unidentified intrusive rock.

In No. 6 level crosscut, between 90 and 160 feet east of the footwall of the main pipe, tourmalinization is most marked along near-vertical shears striking north 10 degrees east and north 60 degrees east. At the Invermay showings, 1 mile northwest of the main breccia pipe, chalcopyrite, pyrrhotite, and pyrite are found in a breccia in the quartz-diorite stock. Here a similar relationship of tourmaline to the same shear directions is well shown.

Figure 20 illustrates the relationship of the main breccia pipe to the surrounding rocks and structures. Geological continuities and fold axes are as interpolated by the writer from the outcrop map. The pipe lies within a zone of close folding, with which it plunges steeply northwest to about the elevation of No. 6 level. However, the reversal in plunge to southeastward below No. 6 suggests that the formation of the breccia pipe was only partly controlled by fracturing due to folding. Other facts possibly related to the origin of the breccia include the following. The diorite intrusives occur as sills or as fillings of fractures related to the sills, and the gabbro boss is of irregular shape, with large inclusions of sediments and a sill apophysis. This indicates that at the time of intrusion the area was one of dilatation when relief of stress would largely be by fracturing and brecciation. The common presence of tourmaline in the A.M. breccia in sediments and in the Invermay breccia a mile away in quartz diorite, along parallel shear directions, strongly suggests some history, at least, in common. The marked parallelism between bedding planes inside the breccia pipe and those outside is hard to reconcile with the hypothesis offered in an earlier Report that the breccia is a sharpstone conglomerate. The distribution of sulphides is shown in Figure 13 of the 1954 Report to be around the periphery of the pipe rather than through the mass as a whole. This could have been brought about by a late and minor pre-sulphide movement of the breccia as a unit, a movement which probably would be concentrated near the contacts with the unbrecciated sediments and leave the interior relatively unaffected.

It is indicated that the breccia is tectonic in origin, and not formational. It is further indicated that the breccia and the folding had a common origin rather than that the breccia formed as a direct consequence of folding and therefore was limited in extent by it. The latest folding and the brecciation could be the product of a strong transverse movement on the north-south fault along the contact between the Dewdney Creek group and the Hozameen group 1 mile due west of the property.

HOPE*

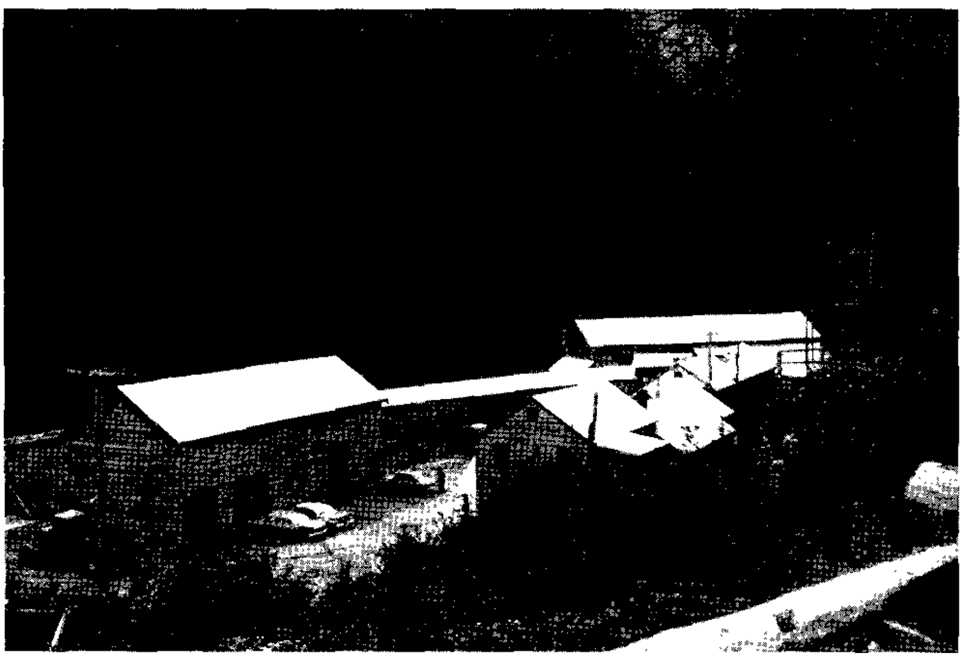
Nickel-Copper

Pride of Emory (Giant Nickel Miner Limited)

(49" 121" S.W.) Company office, 844 West Hastings Street, Vancouver 1; mine office, Hope. W. Clarke Gibson, president; J. M. McDearmid, manager; J. Ehlers, mine superintendent. The property is at the head of Stulkawhits (Texas) Creek, which flows eastward into the Fraser River about 6 miles north of Hope. From a point on the Tram-Canada Highway 10 miles north of Hope, a good gravel road 5.1 miles long leads up Stulkawhits Creek to the mill

* By A. R. C. James.

View south in Manning Park from Valley View Lookout.



Giant Nickel Mines Limited. **Mill.**

and surface buildings at the 2600 adit portal. A branch road from this point gives access to the 3550 adit portal.

The Pride of Emory showing was found in 1923 by Carl Zofka, and since that time development and production have been carried on by several different companies.

B.C. Nickel Mines, Ltd., developed the property from 1933 to 1937. Two adits were driven at the 3275 and 3550 levels. 130,000 feet of diamond drilling was done, and 5,556 tons of ore was shipped.' In 1938 a new company, Pacific Nickel Mines Limited, was formed, but the property remained inactive until 1951, when geophysical surveys were conducted by Newmont Exploration Company and McPhar Geophysics. As a result of this work, Pacific Nickel Mines Limited and Newmont Mining Corporation formed a new company, Western Nickel Limited. Under Newmont management, this company continued the development of the mine from 1952 to 1954. A new adit at the 2600 level was driven 6,000 feet, a 57-degree raise was driven to the 2950 level, and further underground and surface drilling was done. The property remained dormant from October, 1954, to April, 1957, when The Granby Consolidated Mining Smelting and Power Company Limited was appointed to conduct the management of the mine. This company prepared the property for production. The road from the mine to the highway was rebuilt throughout, and numerous new surface buildings and a concentrator were built near the 2600 level portal. Production started in January, 1958, but, owing to economic difficulties, was suspended in July, 1958, after 131,133 tons of ore had been mined. Again the property remained inactive, until in April, 1959, the present company took over and recommenced production on July 5th.

The ore occurs in a number of separate orebodies, the principal ones being the Pride of Emory, the Brunswick Nos. 2 and 5, and the 2663, which was mined out in 1958. The first three orebodies mentioned are mainly above the 3550 level. The orebodies are pipe-like in form and occur in an irregular northerly plunging mass of ultrabasic rock, approximately 2 square miles in area. They comprise concentrations of sulphides, of which pyrrhotite, pentlandite, and chalcopyrite are the most common, in the ultrabasic rocks. The mine is developed from two adit levels -the 3550 level, with portals on both west and east sides of the mine, and the 2600 level, which is the main haulage level. An ore-pass and an internal inclined shaft join the two levels. In 1959 all the ore was mined from stopes in the Pride of Emory and the Brunswick Nos. 2 and 5 orebodies above the 3550 level. The Brunswick No. 2 orebody was developed and put into production in the latter half of 1959, and a raise was driven to surface from this orebody.

By the end of the year all mining was being done by longhole blasting methods, the ore being loaded into cars by mucking-machines at draw points on the 3550 level. The lower section of the Pride of Emory orebody was mined out, and development work was in progress at the year-end to begin mining the upper section of this orebody, which is offset from the lower section. A raise was completed through this orebody to the surface.

The following development work was done in 1959: Drifting, 356 feet; raising, 921 feet; diamond drilling, 2,628 feet.

The mine is ventilated by natural means, augmented by a Canadian Blower and Forge fan, size 48, powered by a 40-horsepower electric motor, that is located at the west portal on the 3550 level. This fan exhausts about 46,000 cubic feet of air per minute. Air is drawn in at the 2600 and 3550 east portals.

In the mill the ore is treated by selective flotation, a separate nickel and copper concentrate being obtained. The nickel concentrate is put through an oil-fired rotary dryer in order to reduce the moisture content to the required limits. A total of 124.500 tons was milled from July 1st to the end of 1959.

The number of men employed at the mine was 136, of whom eighty-two were employed underground. A fatal accident occurred on July 9th when William Austin was killed by a fall of rock in the Brunswick No. 5 stope. A report on this accident is given elsewhere in this Report.

[References: *Minister* of Mines, B.C., Ann. Rept., 1954, pp. 161-163; *Geol. Surv.,* Canada, Mem. 190, 1936.1

NORTH VANCOUVER*

Iron

Copper Duke

(49" 123° S.E.) Company office, 450 S.E. Marine Drive, Vancouver 15. G. H. D. Hubbs, president. Western Canada Steel Limited holds an option to purchase this Crown-granted mineral claim one-half mile east of Lynn Creek and 7 miles north of Burrard Inlet. Access to the property is by 3½ miles of trail from the Lynn Creek intake dam.

About fifty years ago open-cuts and short adits explored an occurrence of magnetite and copper showings. In 1957 the magnetite occurrence was rediscovered, and in the following year a magnetometer survey was made.

In 1959 a diamond drill and supplies were flown in by helicopter. A total of 550 feet of drilling was completed in six holes, five of which cored magnetite ore. Except for an appreciable amount of sulphur occurring as pyrrhotite, the ore is reported to be free of impurities.

HOWE SOUND*

Copper

Britannia (Howe Sound Company (Britannia Division))

(49° 123° N.E.) Head office, 500 Fifth Avenue, New York, N.Y.; mine office, Britannia Beach. William M. Weaver, Jr., president; Frederick A. McGonigle, vice-president; A. G. Kirkland, general manager of mines; D. W. Pringle, general superintendent. This property reopened in January. Considerable rehabilitation was necessary before milling recommenced in February. Ore was obtained from remnant pillars in the Victoria and No. 8 orebody areas and was mined by shrinkage, cut-and-fill, and filled square-set mining methods. Some exploration was done on the 4100 level in the Victoria mine, where 2,957 feet of drifting and crosscutting was done in an easterly direction to investigate an area in the vicinity of the Britannia shear. Additional exploration and development was done on the 4600 and 4800 levels of the No. 8 mine.

During the year milling methods were changed from wet to dry feed in the initial circuit. The ore milled was 300,946 tons, from which copper, zinc, and pyrite concentrates were recovered. During the period that the Tacoma smelter was closed by a strike of the workmen the copper concentrates were stockpiled on the property. The average number of men employed was 380.

LANG BAY†

Germanium

Taiga Miner Ltd.

(49° 124° N.E.) Company office, 617, 837 West Hastings Street, Vancouver 1. F. C. Buckland, president. The company holds by record 136 claims on Lang Creek, which flows

* By J. E. Merrett.
† By N. D. McKechnie.

southeast into Lang Bay, in the Strait of Georgia, about 14 miles southeast of Powell River. The southern end of the property is crossed by the Powell River Highway, and the power-line to Powell River crosses the middle of the claims in a northwesterly direction, about a mile up Lang Creek from the highway. Good to passable gravel and dirt roads traverse the ground west of the creek.

Showings on Lang Creek near the power-lie are described in the 1949 Annual Report, page 218.

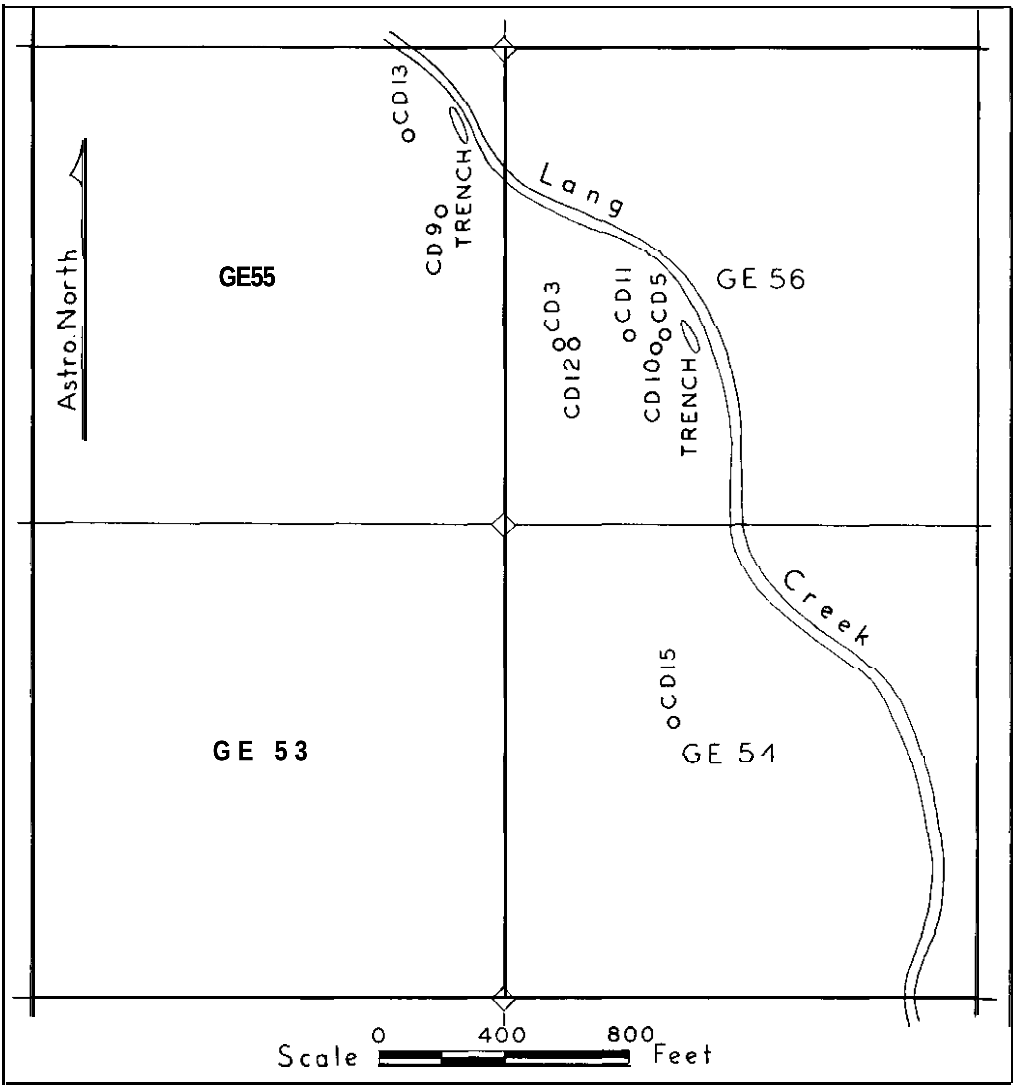


Figure 21. Taiga Mines Ltd., Lang Bay. Distribution of core drill-holes and trenches

The rocks are soft undisturbed shales, siltstones, sandstones, and conglomerates of Tertiary age underlain by older granodiorite and volcanic rock. The granodiorite is exposed just northeast of Lang Creek and the volcanic rocks about 2 miles west. The exact size and shape of the sedimentary basin are not known. Most of the property is covered by overburden, and rock exposures inland are confined to the channel of Lang Creek and a small stream about half a mile to the west. The germanium is associated with lignite coal and carbonaceous material that occur as threads, stringers, and small isolated masses in the sediments. The largest exposure of coal is in sandstone in the west bank of Lang Creek just downstream from the power-line. It is 5 feet long and up to 2 inches thick.

The bedding dips at low angles, as much as 15 degrees, and, in general, westward on the Lang Creek side.

Work in progress consisted of bulldozer trenching and the drilling of boreholes. Fourteen holes had been drilled at the time of the writer's visit and one was being drilled in overburden. Of these, core had been taken in seven, all of which were drilled on the west side of Lang Creek on the G.E. 55 and G.E. 56 claims (Fig. 21). The hole designated as CD 15 was still in overburden. Trenches were dug, as shown in Figure 21, at two places on the west bank of Lang Creek, on claims G.E. 55 and G.E. 56, about 2 miles upstream from the highway.

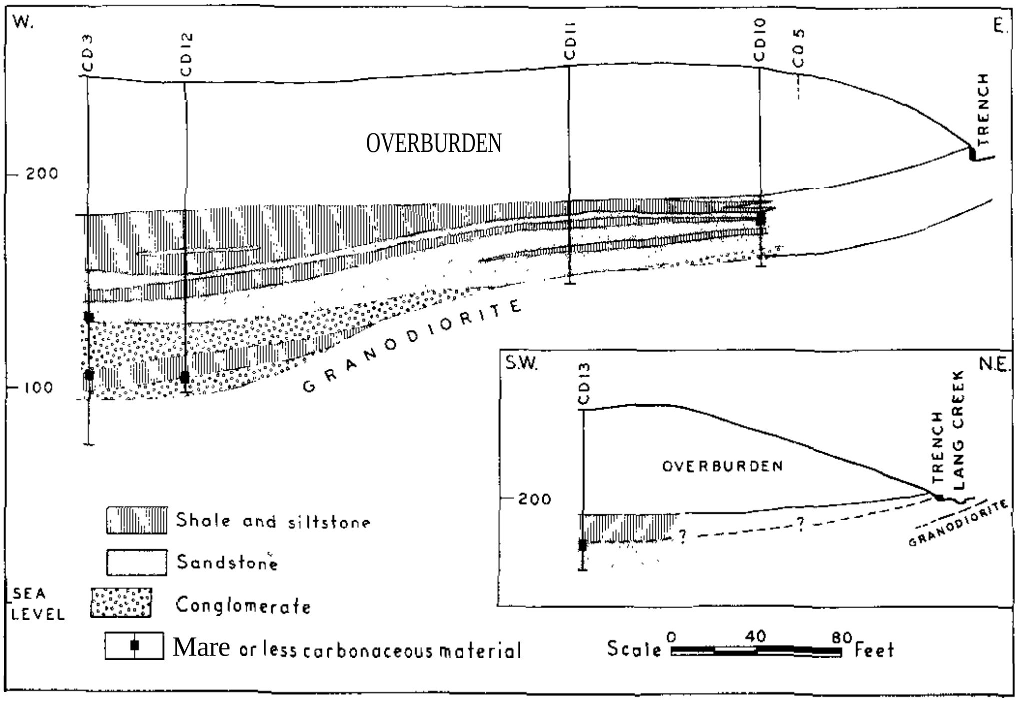


Figure 22. Taiga Mines Ltd., Lang Bay. Sections through core drill-holes.

The trench on G.E. 56 exposed 5½ feet of carbonaceous shale with coal stringers. The trench on G.E. 55 exposed similar material interbedded with sandstone. The sections (Fig. 22) show the relationship of these showings to occurrences of carbonaceous material in the drill cores. Carbonaceous material was found in the following sections of drill cores, starting from the trench on G.E. 55:—

Hole No.	Footage	Lithology
CD 10	67.5–77.0	Carbonaceous sandstone with scattered threads and stringers of coal.
CD 11	74.5–76.5	Sandstone with scattered threads and blebs of coal.
	81.0	Coal threads in siltstone.
CD 12	136.0–140.0	Sandstone with a few coal blebs.
CD 3	101.0–102.0	Sandstone with a few carbonized twigs.
	110.0–115.0	Coarse sandstone with very sparse carbonaceous threads.
	139.0–141.5	Coarse sandstone with numerous grains and clusters of marcasite and scattered thin carbonaceous bands.
CD 13	61.0–64.5	Siltstone with scattered carbonized stems.

The sections of Figure 22 indicate that the distribution of carbonaceous material is erratic. The ratio of core recovered to footage drilled in the carbonaceous sections did not show any appreciable footage of lost core.

In hole CD 3 at 143.0 to 146.0 feet a reddish-brown oxidized sandstone, with angular grey cherty grains distributed through the oxidized material, was encountered. Company officials said that appreciable germanium assays had been obtained in samples of this material.

Core for hole CD 5 was not available, and hole CD 9 was reported to have entered granodiorite immediately beneath the overburden.

Samples were taken of representative material in the trenches and in the carbonaceous sections of the drill cores, and semi-quantitative spectrographic analyses were made. The figures quoted indicate limits determined by visual estimates of the spectrograms.

Place	Width Samples	Material	Germanium
Trench, G.E. 55 claim—			Per Cent
Near south end	1.3 ft.	Carbonaceous shale and coal	*Nil*
	1.5 ft.	Sandstone, beneath shale	*Nil*
Near middle	1.5 ft.	Upper carbonaceous shale and coal	*Nil*
	1.3 ft.	Sandstone	*Nil*
	1.4 ft.	Lower carbonaceous shale and coal	0.008–0.075
Trench, G.E. 56 claim	4.0 ft.	Shale with coal	0.005–0.045
Hole CD 3	143–146 ft.	Red oxidized sandstone	*Nil*
Hole CD 10	70–74 ft.	Shale with coal threads	0.003–0.03
Hole CD 11	84–86 ft.	Shaly sandstone with coal threads	0.017–0.15
Hole CD 13	62–66 ft.	Siltstone with coal threads	0.003–0.03
Lang Creek below power-line	2 in.	Coal	0.014–0.12
	3 ft.	Sandstone enclosing coal	*Nil*

MALASPINA INLET*

Copper

Copper King (Norco Resources Ltd.) (50° 124° S.W.) Company office, 612, 837 West Hastings Street, Vancouver 1. Robert Kennedy, president. This property, comprising sixty-six mineral claims, is east of the head of Theodosia Inlet, an extension of Malaspina Inlet, 25 miles north of Powell River. It is reported that 6 miles of road had been constructed from tidewater to the mineral occurrence.

TEXADA ISLAND*

Iron

Texada Mines Ltd. (49° 124° N.W.) Registered office, 626 West Pender Street, Vancouver 2. A. D. Christensen, San Francisco, president; B. L. Alexander, general manager; J. Kenneth Halley, chief engineer; J. Yuill, mine superintendent; L. D. Smillie, mill

* By J. E. Merrett.

superintendent. This property, comprising eight Crown-granted and ten recorded mineral claims, is at Welcome Bay, 3 miles northwest of Gillies Bay on the southwest coast of Texada Island.

Magnetite was mined in pits having 20.foot benches and a berm of 30 feet for every 100 feet of depth. Waste rock was stripped where necessary. Vertical holes were drilled with Gardner-Denver rotary drills and blasted electrically, using a mixture of ammonium nitrate and diesel oil as an explosive.

The broken ore or waste was loaded by 2½-cubic-yard 80D Northwest shovels on to Kenworth and Euclid dump trucks of 22 and 27 tons capacity respectively and trucked to the waste dumps or to the crushing plant.

The 55 level adit, 2,200 feet in length, driven from the shore to explore beneath the Prescott and Yellow Kid ore zones, provided access for diamond-drill investigation of these zones.

A large waste stripping programme was commenced, with 240,420 solid cubic yards being removed from the Paxton pit, 79,598 solid cubic yards from the Prescott pit, 409,856 solid cubic yards from the Yellow Kid pit, and 25,054 solid cubic yards stripped from miscellaneous pits.

A wet magnetic separation was used to recover magnetite concentrate, and chalcopyrite was recovered by flotation methods. The magnetite concentrate was dried in a rotary kiln, then stockpiled for shipment to Japan. Shipments of chalcopyrite concentrate were made both to the Tacoma smelter and to Japan.

Production: Iron concentrate, 422,567 tons; copper concentrate, 3,878 tons. The average number of men employed was 172.

LASQUETI ISLAND*

Copper

Matteer (49" 124" SE.) A small crew under the direction of Dr. C. A. Ryan, 718 Birks Building, Vancouver, stoped chalcopyrite ore between the main adit and the surface outcrop on this property on the northeast side of Lasqueti Island, immediately west of the former St. Paul workings. A small concentrating plant was erected, and 67 tons of ore was shipped to the Tacoma smelter.

MENZIES BAY *

Copper

Chalco (50° 125" S.E.) *This* property, formerly known as the Coronation group, comprises four recorded claims located one-half mile west of the Island Highway at Menzies Bay, 12 miles north of Campbell River. The main outcrop is at 500 feet elevation and is accessible by logging-roads. The claims are owned by Seymour Campbell, 4344 West Eleventh Avenue, Vancouver, and were under lease to James A. Farrell, James A. Robb, and George D. Moore. At the end of the year the leasers transferred their lease and option to purchase to the Geojimal Mining Development Co. Ltd., 314-316 Standard Building, Vancouver.

Copper mineralization occurs as narrow flat-lying bands of chalcocite associated with fine-prained black basalt in an amygdaloidal volcanic rock.

In 1953, 543 feet of diamond drilling was done by Indian Mines (1946) Ltd., but with *negative results.* Additional development was done by Argus Consolidated Mines Limited in 1955, when 5 tons of high-grade copper ore was shipped to the Tacoma smelter. In 1959 the leasers drove a 40-foot-long adit following two narrow parallel chalcccite stringers. From this work a shipment of about 18 tons of

* Bv J. E. Merrett.

sorted ore was trucked to the Cowichan Copper Co. Ltd. dock at Hatch Point. The ore averaged about 24 per cent copper and was destined for a Japanese smelter.

VANCOUVER ISLAND

PORT HARDY (50° 127° N.E.) *

Copper-Zinc

Frances (The Consolidated Mining and Smelting Company of Canada, Limited)

This property, comprising eight recorded claims, is located on a logging spur road 6 miles south-southeast of Port Hardy. It is reached by travelling 9 miles by public and private roads. It is owned by J. Nanson and G. K. Storey, of Port Hardy, and was optioned by The Consolidated Mining and Smelting Company of Canada, Limited. The mineral deposit is an occurrence of chalcopyrite, sphalerite, and pyrite in skarn zones at the footwall and hangingwall contacts of a limestone band in Karmutsen volcanics.

A crew of five men was employed constructing 1,380 feet of access road, excavating 13 cubic yards of rock cut, and trenching by bulldozer 4,775 cubic yards of surface material.

The option was terminated in September.

BENSON (ELK) LAKE (50° 127° S.E.) †

Iron

Empire Development Company Limited

Company office, 736 Granville Street, Vancouver 2; mine &ice, Port McNeill. George C. Lipsey, general manager. This property includes the old Merry Widow and Independent groups, which were owned and developed by Quatsino Copper-Gold Mines Limited. Quatsino Copper-Gold holds a 40-per-cent interest in Empire Development Company Limited, which was formed for the mining of iron ore. The property is operated by Mannix Company Limited, the other principal shareholder in Empire Development; company office, 546 Howe Street, Vancouver 1. A. Ostgard replaced A. Shaak as project manager. The mine is on the north and east slopes of Merry Widow Mountain, on the south side of Benson River in the Qnatsino-Nimpkish area of Vancouver Island. It is reached by a 25-mile road from Port McNeill, on the east coast of Vancouver Island,

The following notes on the geology of the iron deposit are from information supplied by John Lamb, the mine geologist. The rocks are divided into the older Karmutsen volcanic group, the Quatsino formation of limestone with minor volcanic rocks, and the younger Bonanza group of lavas, pyroclastics, and minor sediments. They are intruded by numerous fine-grained green dioritic dykes and sills, locally termed " greenstone dykes," and by younger Coast intrusions which range in composition from granodiorite to gabbro and form a stock west of the ore zone. Epidote-garnet-actinolite skarn is the common metamorphic rock and is developed in the greenstone dykes as well as in the intruded rocks. There appears to be some relationship between the distribution of skarn and that of the greenstone dykes.

The volcanic and sedimentary rocks form a west-dipping monocline striking northwest to north-northwest. Faulting with a trend of northeast to north-northeast has been recognized near the ore zone. The principal orebodies occur in two neighbouring zones-the Merry Widow and the Kingfisher. The Merry Widow zone consists of a series of lenses of magnetite in banded volcanic rocks passing into limestone striking east of north and dipping 30 to 50 degrees eastward. The King-

* By J. E. Merrett.
† By J. E. Merrett and D. McKechnie.

fisher bodies, entirely in limestone, are two pipes plunging southeastward at about 70 degrees. The trend of mineralization from Merry Widow through Kingfisher parallels the zone of faulting. The magnetite in places shows definite layering, and locally bedding may be traced into more or less massive magnetite. Botryoidal magnetite has been found in the Kingfisher bodies. Rare chalcopyrite as threads and blebs occurs with pyrite and pyrrhotite in the magnetite.

Magnetite is mined by conventional open-pit benching methods in two pits on the Merry Widow zone at an elevation of 2,500 feet. Three-inch vertical blast-holes on a 7- by 7-foot pattern are drilled by Gardner-Denver rotary drills using 600-cubic-feet-per-minute portable rotary air compressors. According to the need, blasting is done with 40, 60, or 70 per cent Forcite and Hydromex. The broken ore is loaded by two 2½-cubic-yard P. & H. shovels onto Euclid 25-ton-capacity end-dumping trucks. The ore is trucked approximately one-half-mile to a crushing plant containing a 42- by 48-inch Pioneer primary jaw crusher with a 5-inch setting. Tbe crushed material passes over a 3-inch grizzly, the undersize from which is conveyed directly to the storage pile. The oversize is conveyed to a 48- by 48-inch maximum strength electromagnetic cobber pulley. The magnetic portion is conveyed to the ore storage pile and the waste to a waste dump. The stockpiled ore is withdrawn through a lo-foot-diameter reclaiming tunnel and conveyed to the skip measuring-pocket at the head of a double reversible tram-lie of 2,870 feet slope length. The ore is trammed in skips of 7.3 long tons capacity to a 6,000-ton stockpile at the mill at 800 feet elevation. The ore is withdrawn from the stockpile by way of a reclaiming tunnel and conveyed to the concentrator where, by crushing, screening, dry and wet magnetic separation, and dewatering, a --'%-inch magnetite concentrate is produced for truck shipment to the boat-loading dock at Port McNeill.

In 1959, 805,735 cubic yards of ore and waste was mined, to produce 393,558 tons of concentrate. Tbe number of men employed averaged 175.

Copper

Quatsino Copper-Gold Mines Limited

This is the same property as that on which the Merry Widow and Kingfisher iron deposits are being operated by Mannix Company Limited for Empire Development Company Limited. It is immediately south of the Old Sport group owned by Coast Copper Company, Limited, a subsidiary of The Consolidated Mining and Smelting Company of Canada, Limited. A reciprocal option agreement exists, involving exploration rights to copper mineralization on Quatsino property by Consolidated and exploration rights to iron mineralization on Coast Copper property by Quatsino.

Mineralization similar to that of the Old Sport ore zone is being explored. It consists of chalcopyrite, magnetite, pyrrhotite, and pyrite in skarn zones in Quatsino limestone. A crew of seven men under the direction of W. T. Irvine, geologist, did approximately 9,000 feet of diamond drilling in eight holes.

NIMPKISH LAKE (50" 126° S.W.) *

Iron

Nimpkirh, Klaanch, etc. (Nimpkish Iron Mines, Ltd.)

Company office, 202, 850 West Hastings Street, Vancouver 1; mine office, Camp A, Beaver Cove. S. V. Wines, project manager; D. Burns, mine superintendent; R. Bick, mill superintendent. This company is jointly owned by Standard International Mines, a Canadian subsidiary of Standard Slag Co. of Youngstown, Ohio, and International Iron Mines, a Canadian company. The property comprises two Crown-granted and eight recorded

* By J. E. Merrett and N. D. McKechnie.

claims on the southwest side of Nimpkish River north of Teisum Creek. Access to the property is by 6 miles of road south from the south end of Nimpkish Lake or by 26 miles of logging railway south from Beaver Cove on the east coast of Vancouver Island.

The magnetite occurs in an area about 600 feet square on the west side of the Nimpkish River, as three massive concentrations in tuffaceous and other volcanic rocks along an irregular north-south contact between limestone and basaltic laws. The limestone and volcanic rocks are intruded by granodiorite. The most southerly and northerly of the three orebodies are small; the central body is a larger U-shaped mass with granodiorite in the core. This is the principal source of ore. The bodies have been found to range from 150 to 200 feet in depth, with walls that dip inward at about 70 degrees to form steep troughs. According to the mine superintendent, magnetite has been found to occur in limestone only in limited amounts. Skarn wallrock is common and in places forms a breccia healed with magnetite. Limestone in contact with magnetite has been altered to marble. The magnetite is very noticeably porous, a fact which suggests that the deposit may have been formed at medium to low pressures. The magnetite. is veined by stringers and irregular masses, suggestive of vug fillings, of pyrite, chalcopyrite, and pyrrhotite.

The company estimates ore reserves of the order of 1,500,000 tons.

Mining is by conventional open-pit methods, maintaining an 18-foot bench. Drilling is done with two hydraulically controlled Gardner-Denver air-track drills. The explosive used in dry holes is a mixture of ammonium nitrate and diesel oil, whereas 40 per cent Forcite is used in wet holes. Two Northwest shovels of 1½- and 2-cubic-yard capacities are used to load the broken material onto five 15-ton Euclid rear-dump trucks.

The ore is trucked to a dry magnetic separation plant on the southwest side of Nimpkish River and is delivered to a 42- by 30-inch Kue-Ken primary crusher. The product, minus 5 inches in size, is stockpiled by radial stacker over an 8-foot 6-inch-diameter Rosco reclaiming tunnel. The stockpiled material is conveyed to a double-deck screen, the plus ½-inch products being crushed to minus %-inch size in a gyratory crusher. The crusher discharge feeds directly to two Stearns W.D. (dry) magnetic separators. The non-magnetic portion is rejected to the waste stockpile and the magnetic portion is united with the initial undersized screen product. The concentrate is conveyed across the Nimpkish River to a dry storage shed over another I-foot h-inch Rosco reclaiming tunnel. The storage discharge is fed by conveyor to an 8- by 12-foot Marcy rod mill for grinding to minus 20 mesh. The rod-mill discharge is fed to two 60-inch Stearns W.E.D. (wet) double-drum magnetic separators. The magnetite concentrate is then dewatered on a horizontal Dorr-Oliver-Long filter and conveyed to the stockpile or to railway cars. The concentrate is conveyed by the Canadian Forest Products railway to a newly constructed loading dock at Beaver Cove for shipment to Japan.

During 1959 the milling plant and dock-loadinp facilities were constructed and milling commenced in mid-November; 50,000 cubic yards of waste material was removed, 12,800 tons of ore was mined, and 8,123 tons of concentrate produced. The average number of men employed was forty-five.

NOOTKA SOUND (49° 126° N.W.) *

Iron

Hualpai Enterprises Ltd. Company office. Box 1088, Alberni; mine office, Head Bay. This private company has leased from Canadian Collieries Resources Limited property including the Stormont, Glengarry, and Texas Fraction Crown-granted claims, approxi-

* By J. E. Merrett.

mately 1 mile north of Head Bay on Tlupana Arm on the west coast of Vancouver Island.

The geology is described in the Annual Report for 1956, pages 131 to 133.

Mining is done by conventional open-pit benching methods using two air-track drills for drilling, 40 per cent Forcite for blasting, and a power-shovel for loading the broken material onto two Kenworth diesel trucks. The ore is trucked 1 mile to the mill to be crushed by a diesel-powered 24- by 30-inch primary jaw crusher. The crushed rock is conveyed to the concentration and secondary crushing plant, which is equipped with a primary vibrating screen, a 10- by 14-inch jaw crusher, a secondary screen with water sprays, three dry magnetic pulleys, a cone crusher, a classifier, and a Dings wet magnetic separator. Conveyor belts are used to carry the ore to the desired locations. The concentrated ore is trucked to the loading dock, where a conveyor supported by a logging A-frame carries the concentrate to ocean-going freighters.

In 1959, 125,715 tons of ore and waste was mined, from which 62,500 tons was milled. This produced 25,000 tons of magnetite concentrate. The number of men employed averaged fifteen.

DELLA LAKE (49” 125” S.W.)*

Copper

Big Interior Group Company office, 404, 510 West Hastings Street, Vancouver 2. G. L. Mill, manager. A Toronto syndicate, under the direction of Andrew Robertson, formed the Big Interior Prospecting Syndicate and the Nine Peaks Grubstake Syndicate for the purpose of exploring and developing four Crown-granted and thirty-two recorded claims comprising the Big I, Helen, A.R., and Leaddie groups in the area of Big Interior Mountain, in Strathcona Park, 8 miles northwest of the west end of Great Central Lake.

A supply camp was established on Great Central Lake, from which point the property was serviced by helicopter. Since October 1st, 1959, a crew of eight men completed 2,600 feet of diamond drilling in two holes on an occurrence of disseminated pyrrhotite with minor chalcopyrite in a cirque on Big Interior Mountain.

TSOLUM RIVER (49” 125” N.W.)†

Copper

Domineer (Mt. Washington Copper Co. Ltd.) Company office, 402, 1111 West Georgia Street, Vancouver 5; mine office, P.O. Box 956, Courtenay. G. C. Murray, president; Heinz Vreeman, superintendent. The property comprises seventy claims, of which four are Crown granted, on the northeastward slope of Mount Washington, 15 miles northwest of Courtenay. Access is by public motor-road to the Comox Logging Company gate near the southeast end of Wolf Lake. From there, logging-roads and a short connecting road lead to the camp at about 4,000 feet elevation.

Noranda Exploration Company, Limited, under an option agreement, continued surface work consisting of bulldozer stripping, trenching, and shallow diamond drilling.

The general geology of the region is outlined in Geological Survey of Canada, Summary Report, 1930, Part A, pages 56 to 78. Work done on the property is briefly summarized in the Annual Reports for 1956, page 119, and 1957, page 69.

Unaltered shales and sandstones of the Nanaimo series are exposed at an elevation of about 3,300 feet on the road leading to the camp. Higher along the

* By J. E. Merrett.
† By N. D. McKechnie.

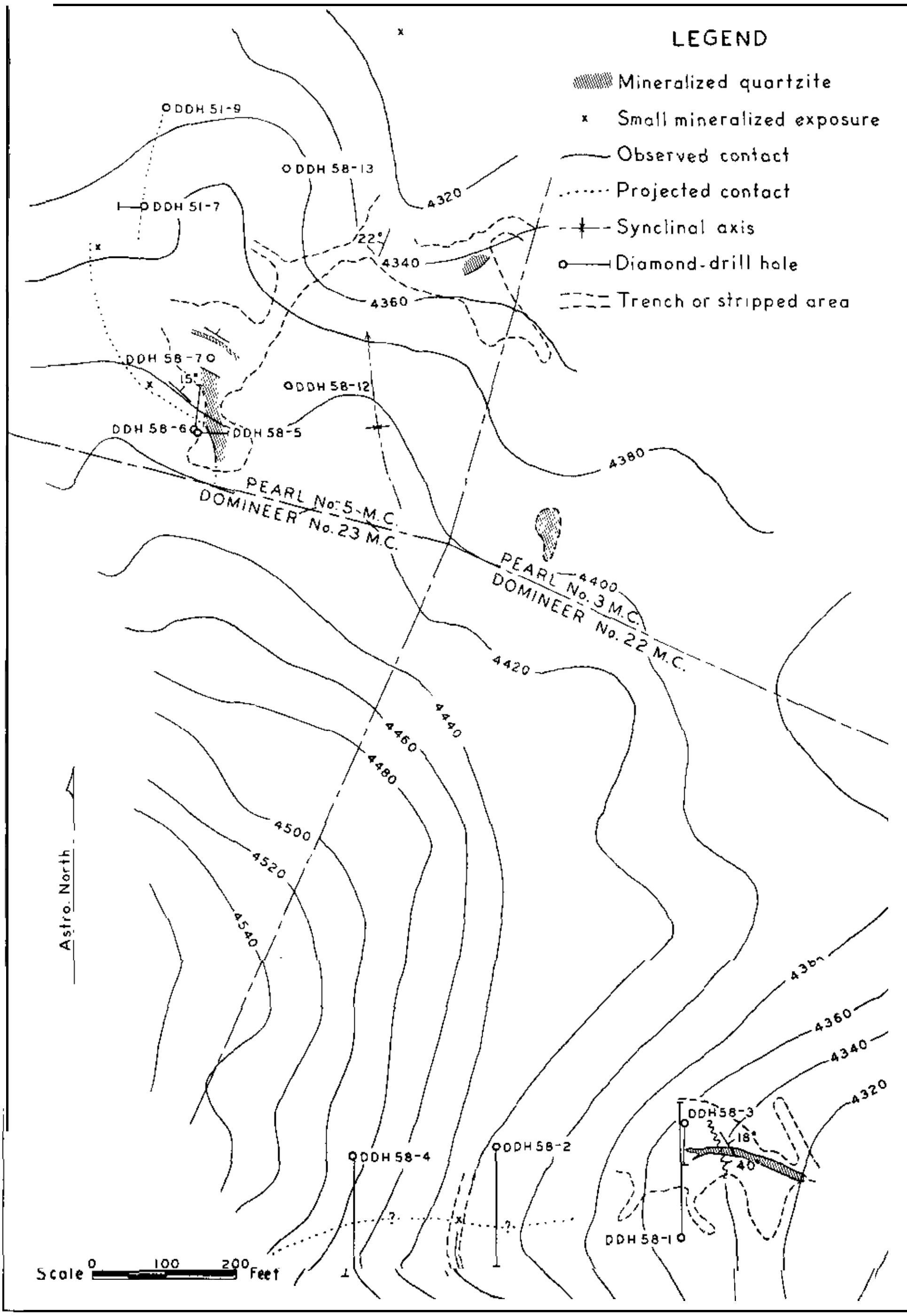


Figure 23. Mount Washington Copper Co. Ltd. Plan of showings.

road amygdaloidal basalts of the Vancouver series are exposed, and these are succeeded, at about 3,400 feet, by shales, dark quartzites, tuffs, and fine agglomerates. These rocks contain the principal mineralization.

The mineralization is exposed by surface stripping and trenching in two areas -one, the larger, near the southeast comer of the Pearl No. 5 mineral claim and the other about 900 feet southwest of this comer on the Domineer No. 22 mineral claim (Fig. 23). In the larger area it is found in a bed of quartzite 10 to 18 feet thick overlain by argillite and coarse crystal tuff. The beds strike northwest and dip 10 to 20 degrees northeast. Strikes and dips in the first area show that a north-northwesterly striking synclinal axis may lie near the southeast corner of the Pearl No. 5. A similar quartzite bed 8 to 12 feet thick is exposed in the Domineer No. 22 area. An exposure shown on one of the company maps, but not seen by the writer, in the trench immediately west of diamond-drill hole 58-2 indicates a possibility of two quartzite horizons here, one about 30 feet above the other. There is not enough information to show whether or not the thick quartzite beds in the two areas represent the same bed. The apparent presence of more than one horizon in the Domineer No. 22 area and the small exposure of quartzite just north of diamond-drill hole 58-7 in the Pearl No. 5 area show that several horizons may have been mineralized.

The mineralization is fracture filling, possibly accompanied by some replacement, and consists of sulphides with more or less quartz. The most prominent sulphide is chalcopyrite, with pyrite and a little arsenopyrite. Magnetite is prominent, as small grains partially altered to limonite, in the bedded rocks, but none was seen in the mineral specimens collected.

HERBERT INLET (49° 125" S.W.)*

Gold

Berton Gold Mines Ltd. Company office, 610 Jervis Street, Vancouver 5; mine office, Herbert Inlet via Tofino. B. L. Clayton, president; J. C. Jackson, manager. This company owns twenty-one Crown-granted and two recorded claims on the south slope of Abco Mountain at the head of Herbert Inlet on the west coast of Vancouver Island. The former company operating this property was known as Abco Mines Limited.

Commencing in March, 1959, a crew of four men constructed a loading dock on Herbert Inlet, 1½ miles of truck-road from the dock to the bottom of the tram-line, installed a 3-inch air-line from the road end to the 2400 level portal, and erected a cook-house and bunk-house at the 2400 level.

TRANQUIL INLET (49° 125° S.W.)*

Gold

Tofino Mines Limited This property, 2% miles north of the head of Tranquil Inlet on the west coast of Vancouver Island, is owned by Moneta Porcupine Mines, Limited, and is under lease to Allied Mining Services Limited, 425 Howe Street, Vancouver 1. David A. Sloan, manager. A rough road, 2 miles in length, extends north from a point one-half mile upstream from the mouth of Tranquil River to the east end or bottom of the tram-line to the 1500 or bottom level.

It was reported that a raise had been driven 165 feet on the vein to connect the 1500 level to the 1700 level a short distance in from the portal of the 1700 level.

* BY J. E. Merrett.

NITINAT (48° 124° N.W.)*

Copper

Nadira Mines Limited

Company office, 620 Howe Street, Vancouver 1. Oswood G. McDonald, manager. This property, comprising fifty-two recorded claims, encompasses the Horse Creek drainage basin west of Parker Creek, a south-flowing tributary of Nitinat River. It is approximately 6 miles due west of the west end of Cowichan Lake. Access is by way of private logging-roads.

A crew of three men was employed surface stripping and mapping mineral outcrops.

Avallin Mines Limited

Company office, 620 Howe Street, Vancouver 1. Oswood G. McDonald, manager. The property, held by record, consists of seventy-eight claims situated about half a mile southeast of Nitinat River between Tenas and Granite Creeks. One man was employed surface stripping at various locations on skarn zones containing chalcopyrite.

COWICHAN LAKE (48° 124° N.E.)†

Copper

Blue Grouse (Cowichan Copper Co. Ltd.)

Head office, 620 Howe Street, Vancouver 1; mine office, Lake Cowichan. Oswood G. McDonald, president and general manager: A. H. Harder replaced J. R. Billingsley as mine manager in September; G. E. Apps, mine superintendent. The property consists of three Crown-granted and sixty recorded claims. It includes two old properties, the Blue Grouse and Sunnyside, on the south side of Cowichan Lake about 3 miles by road northwest of Honeymoon Bay.

The mine is developed by two adits—the main haulage or 1100 level and an upper level known as the 1340 level. Ore was mined by shrinkage stoping and was obtained from the E orebody from the 1100 level to above 1340 level, from the J and M orebodies below 1340 level, from the G and H orebodies above 1340 level, and from No. 5 pit extending from above 1340 level to the surface. Additional ore was obtained by slashing in the G north zone and Sunnyside open pits. The major production was from the H orebody.

On the surface, diamond drilling was done to investigate a geophysical anomaly on the hilltop south of the E ore zone.

Underground and above the 1100 level, diamond drilling was done between the M and K orebodies to investigate the continuity of some of the known ore horizons. At the north end of the 1100 level, drilling was directed downward to investigate and develop the K orebody below the level.

On the Sunnyside section, exposures of mineralized skarn were investigated by an adit driven some 200 feet into the hillside and by some surface diamond drilling. The geology in and near the adit is shown in Figure 24. The principal rock is basalt. Limestone is exposed as indicated. The bedded rocks strike north 30 to 35 degrees east and dip steeply to the southeast. They are cut by dykes of feldspar porphyry trending northwest and dipping steeply northeast; the dykes are similar to the porphyry in the Blue Grouse workings. A fine-grained dark dioritic dyke is exposed on surface about 80 feet northeast of the porphyry. Skarn is exposed on surface on the west side of the large limestone lens at the elevation of the adit and two places east of the adit. It is erratically mineralized with pyrite, pyrrhotite, and chalcopyrite. In the adit irregular patches and lenses of mineralized skarn occur both in

* By J. E. Merrett.
† By N. D. McKechnie and J. E. Merrett.

basaltic rocks and in porphyry. Both porphyry and skarn contacts are offset slightly by post-mineral faults. The porphyry in the adit is not exposed on surface, and the contacts in the adit are erratic so its attitude is uncertain. Surface diamond drilling was done after the writer's visit, and the results are not known.

A zone of strongly evident skarn alteration is associated with the mineralization at the Blue Grouse workings. It forms a belt about 100 feet wide with an attitude,

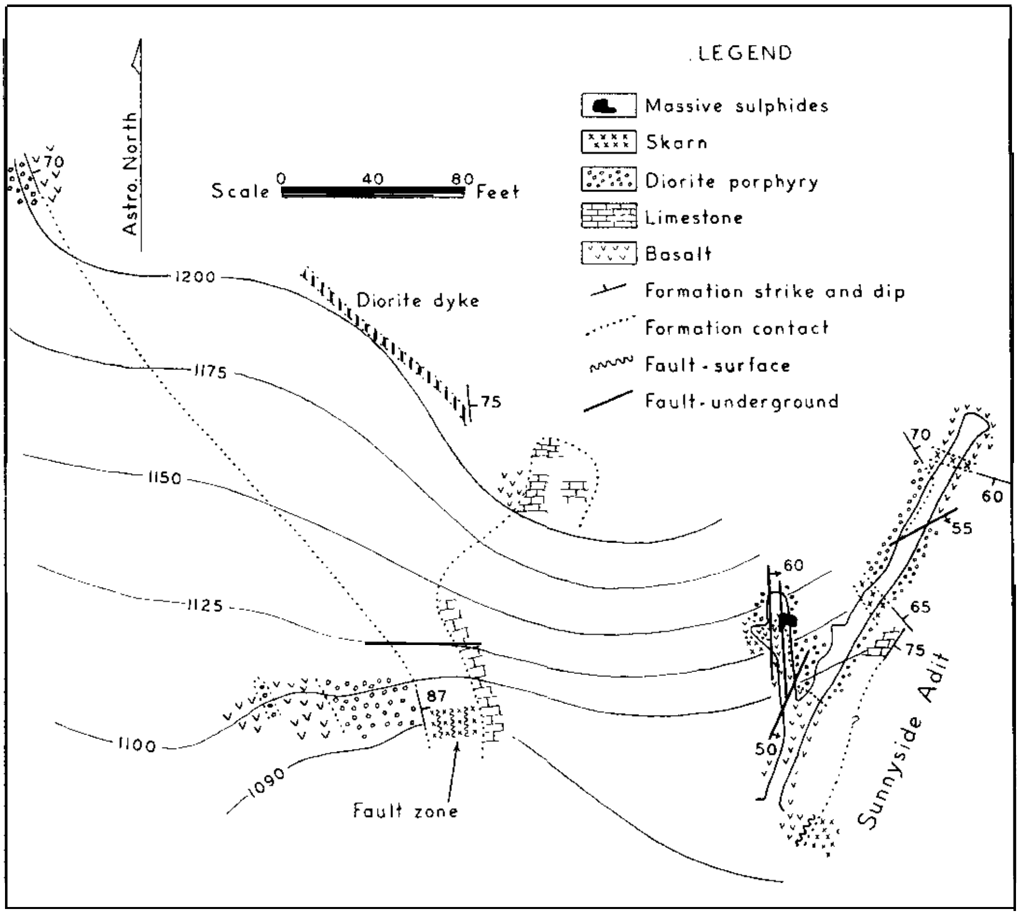


Figure 24. Cowichan Copper Co. Ltd. Sunnyside adit and vicinity.

over fairly marked topographic relief, that corresponds quite well with the shear striking north 10 degrees west and dipping 45 degrees west that has been postulated as a possible controlling structure (*see* Annual Report, 1956, p. 121). The zone was mapped by plane-table, and although it was found to weaken about 1,200 feet north of the Sunnyside workings, it was definitely trending toward them.

The following summary provided by the management shows details of the work done during the year:—

Drifting and crosscutting	ft.	1,878
Raising	ft.	2,413
Diamond drilling	ft.	5,369
Waste removed	tons	5,436

A total of 86,106 tons was milled, containing an average of 2.72 per cent copper. Concentrates were shipped to Japan from a loading-dock at Hatch Point at the head of Saanich Inlet.

KOKSILAH RIVER (48" 123" N.W.)*

Copper

King Solomon (Cellardor Mines Ltd.)

Company office, 620 Howe Street, Vancouver 1. Oswood G. McDonald, president. This company controls the King Solomon, Queen of Sheba, Koksilah, and Bluebell Crown-granted claims and a large surrounding group of recorded claims. The property is at about 1,000 feet elevation, north of the Koksilah River, about 7 miles south of Duncan. It is reached by 5 miles of road from a point on the highway 2 miles south of Duncan. The four original claims were Crown granted more than fifty years ago.

Old workings, consisting of two shafts and two short adits, are on chalcopyrite-bearing zones in volcanic and cherty sedimentary rocks of the Vancouver group; a lower exploratory adit is 660 feet long. Surface work was done on the recorded claims in 1956 and the Crown-granted claims were acquired in 1957. In 1959 a self-potential survey was run over an area more than 2,500 feet square. Some bulldozing was done, workings were dewatered, and 2,100 feet of diamond drilling was done in thiieen surface holes, chiefly on the King Solomon and Bluebell. A geologist from Japan spent a good deal of time on the ground. A crew of about four men was employed.

PORT RENFREW (48° 124° N.E.)†

Iron

Bugaboo Creek Iron (Noranda Exploration Company, Limited)

British Columbia office, 202, 2256 West Twelfth Avenue, Vancouver 9. B. 0. Brynelsen, manager. Seven Crown-granted claims and fractions, located on Bugaboo Creek about 10 miles northerly from Port Renfrew, were optioned by Noranda Exploration Company, Limited, from H. W. Cathcart, 1274 Johnson Street, Victoria. Access is by way of 5 miles of rough truck-road up Gordon River and 6 miles of good-grade. pack-trail. Additional access is by way of helicopter, two landing-strips having been constructed for this type of aircraft.

M. M. Menzies, chief geologist, supplied the following information concerning the property.

The ore deposit consists of massive magnetite occurring within zones of pyroxene skam formed along or near the contacts of the Upper Jurassic Coast intrusions with Triassic limestone. Two relatively high-grade orebodies, the Daniel and the Conqueror, have been located. Some sulphur is present in the form of pyrite and pyrrhotite, but other impurities are negligible.

In 1959 a loo-foot-square grid survey was completed on two claims. In addition to some outside prospecting, dip-needle and magnetometer surveys were made over the Daniel and Conqueror orebodies.

Thirteen EX diamond-drill holes totalling 2,889 feet of drilling were completed on the Daniel orebody, where the average depth of overburden was 56 feet. On the Conqueror orebody, where the average depth of overburden was 43 feet, 3,700 feet of EX core drilling was done in fifteen holes.

* BY M. s. Hedley.
† By J. E. Merrett.

Some work was done to improve the pack-trail, and the helicopter landing area was built on the Conqueror orebody.

JORDAN RIVER (48° 124° S.E.)*

Copper

Sunloch and Gabbro (Sunro Miner Limited)

Head office, Tadanac; mine office, River Jordan. The property is on the Jordan River about a mile upstream from the mouth and is reached by a road which leaves the Victoria Highway about one-half mile east of the River Jordan Post Office. The original showings were diamond drilled in the past and were. explored by adits from the Jordan River Canyon 2 miles upstream from the river mouth and at elevations of from 500 to 1,000 feet above sea-level. Work was begun in 1917 and resumed at intervals. Three principal mineralized zones, designated upstream as the Cave, Central, and River zones, were defined. The results of the work to 1950 and the geology of the deposit are fully described in the Annual Report for 1950, pages 180 to 193.

In 1957 an adit was started from the east side of Jordan River at an elevation of about 100 feet above sea-level and driven to a total length of 7,805 feet beneath the surface showings. The rock sequence in the adit corresponds to that on surface. The northerly gabbro band, which is about 1,700 feet wide on surface, is 2,400 feet wide in the adit. A quartz porphyry intrusive, 35 feet wide between faulted contacts, is exposed 600 feet in from the portal, and a strong unmineralized fault zone striking a little east of north and dipping steeply west is exposed at about 5,950 feet from the portal. The Cave zone was encountered at 6,900 feet and the River zone at 7,400 feet; some intervening mineralization may represent the Central zone. The River zone was drifted on for 400 feet with results comparable to those of the earlier work.

* By N. D. McKechnie.

REPORTS ON GEOLOGICAL, GEOPHYSICAL, AND GEOCHEMICAL WORK

Reports accepted to the end of 1958 for credit on assessment requirements for properties held under the Mineral Act and the Placer-mining Act since January 17th, 1947, and reports on geochemical surveys accepted since April 6th, 1951, are listed in the Annual Report for 1958. A copy of each report may be examined in the office of the Mining Recorder for the mining division in which the property is. A second copy of each report is filed in the office of the Chief of the Mineralogical Branch, Department of Mines, Victoria.

The property name is that which appears to be in most common use. It is not feasible to list all the claim names in each property. The author of each report is given and the principal for whom the report was written.

REPORTS CREDITED FOR ASSESSMENT, 1959

Geographic Position		Property Owner or Principal Author of Report Date of Submission of Report	Kind of Work		
1° Quadr.	Quarter		Geological	Geophysical	Geochemical
48° 124°	N.W.	O.G.M. Group Nadira Mines Limited. D. A. Sloan. December 4, 1959.	×	....	....
49° 115°	N.W.	P.M.L. Nos. 732 and 733 George Robert Castles. R. K. McConnell, Jr. November 1, 1959.	....	×	....
49° 116°	S.E.	Tigar 1-8 Claims A. M. Howell. Franklin L. C. Price. June 17, 1959.	....	×	....
49° 117°	S.E.	Boy 1-4 Fractions The Consolidated Mining and Smelting Company of Canada, Limited. W. T. Irvine. April 16, 1959.	....	....	×
49° 119°	S.E.	Tip, Nip, Drip, and Pen Claims Anarchist Chrome Co. Ltd. J. E. Louttit. January 8, 1959.	....	×	....
49° 120°	N.W.	K.M. Group The Granby Consolidated Mining Smelting and Power Company Limited. Keith C. Fahrni. March 4, 1959.	....	×	....
49° 120°	S.W.	Dee Mineral Claims The Granby Consolidated Mining Smelting and Power Company Limited. Keith C. Fahrni. March 30, 1959.	....	×	....
49° 120°	S.W.	Joyann Group The Granby Mining Company Limited. Keith C. Fahrni. December 9, 1959.	....	×	×
49° 120°	N.W.	Salem and Pine Claims The Consolidated Mining and Smelting Company of Canada, Limited. D. W. Heddle. April 9, 1959.	....	×	....
49° 120°	S.E.	Regal Group The Granby Consolidated Mining Smelting and Power Company Limited. Keith C. Fahrni. March 4, 1959.	....	×	....

REPORTS *CREDITED FOR* ASSESSMENT, 1959—*Continued*

Geographic Position: 1° Quadr.	Geographic Position: uarter	Property / Owner or Principal / Author of Report / Date of Submission of Report	Kind of Work: Geological	Kind of Work: Geophysical	Kind of Work: Geochemical
49° 121°	S.E.	?anam Copper Claims The Consolidated Mining and Smelting Company of Canada, Limited. J. Richardson. January 26, 1959.	×	—	—
49° 123°	N.E.	?ound Copper Syndicate Group Sound Copper Syndicate. A. C. Skerl. September 10, 1959.	×	—	—
50° 119°	S.W.	?hip Claims P. Gouthro. Jack A. Millican. September 24, 1959.	×	—	—
50° 120°	S.W.	?O and MS Groups Neil H. McDiarmid. Franklin L. C. Price. August 26, 1959.	—	×	—
50° 120°	S.W.	?U 1–20 Mineral Claims Sheba Copper Mines Limited. Franklin L. C. Price. January 3, 1959.	×	—	—
50° 120°	S.W.	HS 1–12 Mineral Claims Georgian Mineral Industries Limited. F. J. Hemsworth. March 23, 1959.	—	×	—
50° 120°	S.W.	?B Group Northwestern Explorations, Limited. C. S. Ney. January 26, 1959.	×	×	×
50° 120°	S.W.	Dunmore Mines Group Dunmore Mines Ltd. Henry L. Hill. April 8, 1959.	—	×	—
50° 120°	S.W.	Art Group The Granby Consolidated Mining Smelting and Power Company Limited. Keith C. Fahrni. January 14, 1959.	—	×	—
50° 120°	S.W.	Betty Lou and Lou Groups Canex Aerial Exploration Ltd. Clive W. Ball. November 12, 1959.	×	—	—
50° 120°	N.W.	Cherry Creek Property Noranda Exploration Company, Limited. A. D. K. Burton. February 26, 1959.	×	—	—
50° 120°	S.W.	Etta and Nora Mineral Claims Noranda Exploration Company, Limited. M. M. Menzies. June 8, 1959.	—	×	—
50° 120°	N.E.	Fat Chance New Jersey Zinc Exploration Company (Canada) Ltd. E. Livingston. April 20, 1959.	×	×	—
50° 120°	S.W.	Gnawed Mountain Group Kennco Explorations (Western) Limited. R. W. Stevenson October 19, 1959.	×	×	×
50° 120°	S.W.	Hank Group I. Shulman. C. C. Rennie. January 13, 1959.	—	×	—
50° 120°	S.W.	Lis Mineral Claims Georgian Mineral Industries Limited. F. J. Hemsworth. March 23, 1959.	—	×	—

REPORTS CREDITED FOR ASSESSMENT, 1959—*Continued*

Geographic Position: 1° Quadr.	Geographic Position: Quarter	Property / Owner or Principal / Author of Report / Date of Submission of Report	Kind of Work: Geological	Kind of Work: Geophysical	Kind of Work: Geochemical
50° 120°	N.E.	Pip Mineral Claims A. Millham. W. I. Nelson. May 19, 1959.	—	×	—
50° 120°	S.W.	Sam Mineral Claims Georgian Mineral Industries Limited. F. J. Hemsworth. March 23, 1959.		×	—
50° 120°	S.W.	Tyner Lake Property Noranda Exploration Company, Limited. M. M. Menzies. January 26, 1959.	×	×	—
50° 120°	S.W.	Vanex Holdings Vanex Minerals Limited. Henry L. Hill. April 13, 1959.	—	×	—
50° 120°	S.W.	Viking Group Kamloops Copper Company Ltd. Harvey H. Cohen. March 23, 1959.	—	×	—
50° 121°	S.E.	Dodo Group Rio Tinto Canadian Exploration Ltd. L. B. Gatenby. April 8, 1959.	×	×	×
50° 122°	S.W.	Mac Nos. 1 and 3 A. C. Skerl. A. C. Skerl. April 10, 1959.	×	—	×
51° 122°	S.W.	Copper 1–4 and PM 1–3 Claims New Jersey Zinc Exploration Company (Canada) Ltd. R. C. Macdonald. September 21, 1959.	—	×	×
52° 119°	N.E.	Barron Group G. C. Short. J. F. V. Millar. July 9, 1959.	×	—	—
52° 122°	N.E.	Brooks, Atlas, Buster, and Hill Mineral Claims Canex Aerial Exploration Ltd. D. W. Smellie. November 27, 1959.	—	×	—
53° 121°	S.W.	Special Placer Mining Lease 5866 Paudash Mines Limited. J. M. Murchison. December 10, 1959.	—	×	—
53° 122°	N.W.	Mon Mineral Claims Totem Minerals Limited. R. A. Knutson. October 28, 1959.	—	×	—
55° 123°	N.E.	Gold Placer Lease 1440 E. B. Smith. B. C. Macdonald. August 26, 1959.	×	—	—
57° 130°	N.E.	Hans Groups I, II, and III Totem Minerals Limited. R. A. Knutson. August 6, 1959.	—	×	—
57° 132°	N.E.	Conwest-Balsom Group American Metal Climax, Inc. P. O. Hackey. March 16, 1959.	×	—	—
59° 129°	S.W.	Canada Girl 1–8 Mineral Claims Kennco Explorations (Western) Limited. J. R. Woodcock. June 30, 1959.	×	×	×
59° 129°	S.W.	Vines Claim Group Totem Minerals Limited. R. A. Knutson. October 19, 1959.	×	×	—

Placer

CONTENTS

ATLIN *

SQUAW CREEK (59° 137" N.E.)

Ad Astra Minerals Ltd. Head office, 526 Northern Hardware Building, Edmonton, Alta. R. C. Sissons, president; R. G. McPhie, managing director and operations manager. This company owns one special placer lease and four placer leases on Squaw Creek near the British Columbia-Yukon border. It is reported that about 5,000 cubic yards of material was removed by hydraulic sluicing during 1959. An average crew of five men was employed between June 28th and October 16th, when the camp was closed. A D-S tractor was used to remove overburden and tailings. Access to the property is by a 16-mile road which leaves the Haines Road at Mile 106 and runs through Yukon Territory to a point on Squaw Creek near the British Columbia-Yukon border.

* By W. C. Robinson.

SPRUCE CREEK (59° 133" N.W.)

Spruce Creek Placers

This company, formerly Enterprise Placers, employed six men on a dragline operation on Spruce Creek during the summer. Work was hindered during 1959 by the occurrence of several slides which partially buried equipment. Further advance up the creek will bring the operation to a slight widening of the creek valley, and the danger from slides should be reduced. Maynard Wilson was in charge of the operation.

D. K. Falconer worked alone on a drift on his lease.

PINE CREEK (59° 133" N.W.)

Karl Sieger worked his lease near Discovery. He is drifting, and it has been reported that he is in about 180 feet.

The Matson brothers did some drilling on their leases during the summer.

BIRCH CREEK (59" 133" N.E.)

Placer leases owned by Terry and Carriere were worked by three men from June to September.

WRIGHT CREEK (59" 133" N.E.)

Dan Langevin worked alone on his lease.

MCKEE CREEK (59° 133" S.W.)

Three men, Joe and Louis Piccolo and Oscar Carlson, hydraulicked a considerable amount of gravel on McKee Creek.

Bruce Morton hydraulicked some gravel on his placer claim.

OMINECA*

GERMANSEN RIVER (55° 124" N.W.)

Gene Jack rebuilt a dam on Plug Hat Creek and made repairs to ditches in preparation for work next season on A. Pendle's hydraulic property (old de Ganahl pit), The property is on the north side of Plug Hat Creek about 1 mile from Germansen Landing.

On the placer lease owned by Mrs. R. M. Tait on the Germansen River about 6 miles from the mouth, W. McNab and J. Fuite operated a dragline and sluice-box. A D-8 tractor was used to clear and strip the ground in preparation for mining.

MANSON CREEK (55" 124" N.W.)

Charles Nolan and two men sluiced gravel from the lease jointly owned by H. Chow and C. Nolan on Manson Creek, about 5 miles up from the mouth. A TD-18 tractor was used for stripping and a TD-14 overhead loader was used for handling the material to be sluiced.

Evan Ostjord, with the aid of one man, did some sluicing on his lease directly below the ground worked by C. Nolan.

LOST CREEK (55" 124° N.W.)

Bill Hykaway worked alone on his placer lease on Lost Creek.

* By W. C. Robinson.

CARIBOO*

HIXON CREEK (53° 122" S.W.)

Hixon Placers Inc.—Company office, 2032 Thiid Avenue, Seattle, Wash.; mine office, Hixon. H. W. Hargood, president; C. J. Norris, superintendent. This property, consisting of twenty-one placer leases, is 3 miles up Hixon Creek from the highway. In 1959, 40,000 yards of overburden was hydraulicked. A total of 1,800 feet of pipe-line was laid for sluicing on the north side of the creek. An additional 200 feet of flume was built. Two bridges were repaired and replanked. A crew of eight men was employed in September.

WILLOW RIVER (53° 121" S.W.)

McJana Placers.-This company, under the supervision of R. E. MacDougall, continued to hydraulic in the southwest side of the upper end of the Lowhee pit. A No. S monitor with a 7-inch nozzle was used, and a crew of four men was employed.

Mosquito Creek.-Jack Gunn worked his lease in the upper part of Mosquito Creek and hydraulicked 12,000 yards of gravel with a No. 4 monitor.

Big Valley Creek.—C. Fisher sluiced gravel on his lease on the south side of Big Valley near Nine Mile Lake.

Coffee Creek.-Arthur Delorme erected sluice-boxes, flumes, and a new cabin on his lease at the lower end of Coffee Creek.

Pundata Creek Placers Ltd.-This company drilled ten test-holes and bulldozed 1% miles of rough road at Pundata Creek.

George and Little Creeks.--James Lahay ground-sluiced and built a wingdam.

Devils Lake Creek.-H. McGowan sluiced gravel in a small gulch near the headwaters of Devils Lake Creek.

WILLIAMS CREEK (53° 121" S.W.)

Kumhila Exploration Co. Ltd.—Ray Wallace, superintendent. This company operated a dredge and washing plant on its lease on Williams Creek about three-quarters of a mile downstream from Barkerville. A diesel-powered Bucyrus dragline with a S-cubic-yard bucket feeds gravel to a floating steel-pontoon washing plant. Initially a considerable amount of waste gravel was stripped by scrapers, and from the level where the dragline was operating it was reported to be 37 feet to the deepest bedrock. The plant worked on a three-shift basis, treating approximately 3,500 cubic yards of gravel per day. A crew of twenty-four men was employed. On October 10th, shortly before the end of the season, due to an unfortunate combination of circumstances, the washing plant capsized and sank in its pond. Fortunately all persons were able to leave the plant before it sank. The circumstances of this incident are described elsewhere in this Report under the heading "Dangerous Occurrences." An attempt at salvage was made, but cold weather rapidly set in and the plant remained in the frozen pond. It is intended to resume attempts at salvage next spring.

*By A. R. C. James.

Arthur Pederson ground-sluiced on the west side of Williams Creek one-quarter mile below the old Richfield court-house.

Rodonsik and Larsen hydraulicked on the east bank of Williams Creek opposite old Richfield court-house.

Nick Broswick ground-sluiced 1,600 yards of gravel on the east side of Williams Creek one-quarter mile north of Mink Gulch.

ANTLER CREEK (53° 121° S.E.)

Beggs Gulch.—Harry Wade did some prospecting and ground-sluicing on his lease at the lower end of the gulch.

Stephen Gulch.—Harold Tinsing built a cabin, ground-sluiced 2,500 yards, and did some prospecting on the Driscoll lease about 1 mile up Stephen Gulch.

China Creek.—John Kelly ground-sluiced on the south side of the creek.

Cunningham Creek.—Daniel Jorgensen did some stripping by bulldozer and ground-sluicing.

Canadian Creek.—A. McGuire did 300 feet of ground-sluicing and sank a 20-foot shaft.

LIGHTNING CREEK (53° 122° S.E.)

Grub Gulch.—Frank Freeman and John Hind hydraulicked with a No. 1 monitor at the lower end of Grub Gulch.

KEITHLEY CREEK (52° 121° N.E.)

Keithley Creek.—Lee Fournier ground-sluiced on his lease in the Placer Engineers pit at Four Mile Creek.

E. Lang and G. A. Goldsmith continued driving a drift to explore some gravel previously found by churn-drilling. At the time of the writer's visit in July this drift was 90 feet long. A total of 52 feet of drifting was completed in the year. This lease is about 1,700 feet below the junction of Snowshoe and Keithley Creeks.

Garcon C. Mitchell did maintenance work on his lease at the junction of Snowshoe and Keithley Creeks.

T. E. Kinvig built a boomer dam on his lease on Little Snowshoe Creek.

Keystone Placers.—A. E. Sandbag and M. Sinclair drilled a series of churn-drill holes on their lease on French Snowshoe Creek.

Rollie Creek.—G. McDonald and C. Hemgord continued driving a rock tunnel started by A. E. Sandbag in 1957. The tunnel was completed to a point 260 feet from the portal and then a short raise was driven into a gravel zone indicated by previous drilling. This work was done on the Sandberg lease.

QUESNEL RIVER (52° 121° N.W.)

Cedar Creek.—P. Ogden erected sluice-boxes and ground-sluiced cm his lease to the north of Cedar Creek.

N. Evans Atkinson did some testing and development work on his lease near the mouth of Cedar Creek.

COLUMBIA RIVER*

KIRBYVILLE CREEK (51° 118° N.W.)

West Columbia Gold Placers Ltd. Company office, 2360 Abbott Street, Kelowna. J. H. Buckland, president. This company owns Special Placer Mining Lease No. 462, an area of 3.9 square miles on the west side of the Columbia River at the confluence of Kirbyville Creek and opposite the mouth of Goldstream River. The lease is reached by boat from Mile 56 on the Big Bend Highway, north of Revelstoke. The property is serviced by a raft and high line across the Columbia River. During high water in the spring the raft was swept away and the A-frame, supporting the cable on the west bank, was damaged. No drilling was done during the year as equipment could not be moved across the river.

CRANBROOK†

Nero (49° 116° S.W.) This claim is owned by D. J. Oscarson, of Kimberley, and is located near the falls on the Moyie River, 17 miles southwest of Cranbrook. It is operated by two groups of men who subleased the claim in 1958. Since. that time both groups have been driving small tunnels toward the bed of an old course of the river. The tunnels were formerly called the Nero No. 1 and No. 2, but the names were changed to Monilee No. 1 and No. 2 in July, 1959, to avoid confusion with former workings in the area.

T. O. Bloomer and partner advanced Monilee No. 1 tunnel 121 feet through rock during 1959, and a further 30 feet through the stream gravel. It is estimated a further 60 feet of drifting is necessary to reach the objective.

P. Kotush and two partners advanced Monilee No. 2 tunnel 155 feet, and the face is now approximately 55 feet from the old river bed.

FORT STEELE†

Boreas Mines Limited (49° 115° N.W.) Company office, 525 Seventh Avenue West, Calgary, Alta.; J. E. Treacy, president. This property is near the mouth of Fisher Creek, a tributary of Wild Horse River, 5 miles northwest of Fort Steele. Exploratory drilling that was begun in October, 1958, was discontinued early in January, and since that time there has been no known activity on the property. A watchman was kept on the property to look after the equipment and the buildings.

KIMBERLEY†

LISBON CREEK (49° 115° N.W.)

This claim is near the confluence of Lisbon and Perry Creeks, 9 miles south of Kimberley. Access is by a road leading southwest of Wycliffe. R. L. Ralph and R. E. Williams, of Kimberley, subleased Placer Mining Lease No. 769 in 1959 and drove a 75-foot tunnel alongside Lisbon Creek. A small trestle and dam were also built across the creek.

* By J. E. Merrett.
† By D. R. Morgan.

Structural Materials and Industrial Minerals

CONTENTS

ASBESTOS

Cassiar Asbestos Corporation Limited*

Mount McDame (59° 129° S.W.). Head office, 1001, 85 Richmond Street West, Toronto, Ont.; mine office, Cassiar. F. M. Connell, president; J. D. Christian, general manager; N. F. Murray, general superintendent. The property is 86 miles by road southwesterly from Mile 648.8 on the Alaska Highway. It consists of forty-two Crown-granted and four recorded claims. The mine is on McDame Mountain at an elevation of approximately 6,300 feet. The plant-site and townsite are at 3,500 feet elevation in Troutline Creek valley.

Ore was mined from the 6170, 6140, 6110, and 6080 levels during 1959. The Cassiar orebody is roughly elliptical in shape, elongated in a northerly direction, and dips at an average of 40 degrees eastward into McDame Mountain. The ore is high-quality cross-fibre chrysotile asbestos, occurring as fracture fillings in myriad joints within a serpentinized ultrabasic sill.

With the exception of 15,690 tons of ore obtained through underground development work, the asbestos was mined by open-cut methods. In 1959 mining was carried on from March 25th to November 6th. During that time 351,016 tons of ore and 1,313,299 tons of waste were broken. The aerial tram-line operated from April 6th to November 4th and carried 348,664 tons of ore; an additional 15,690 tons of ore was carried by trucks. Underground exploration on the 5700 level consisted of 2,096 feet of drifting and 1,448 feet of crosscutting.

In 1959, 366,775 tons of ore was milled to produce 33,122 tons of fibre during 327 days of mill operation.

Throughout the year an average crew of 400 men was employed.

Plant expansion in 1959 included a revision to the mill, which consisted of the addition of new screens, collectors, and fans. The mill building was extended upward to accommodate this new machinery. A new 60- by 140-foot warehouse building and a new lodge were erected. Two classrooms were added to the school building and extensions added to the nurse's quarters and several private dwellings.

* By W. C. Robinson.

At the mine the " surge pile " project, which will provide surge capacity ahead of the tram-line, was nearly completed in 1959, and a "rock rejection " project, which will discard waste ahead of the tram-line, was started.

BARITE

Mountain Minerals Limited* Company office, Meech Building, P.O. Box 273, L&bridge, Alta.; quarry office, Brisco. R. A. Thrall, managing director; William MacPherson, superintendent. This company owns and operates two barite properties in the Windermere Valley south of Golden-one at Brisco (50” 116” N.E.) and the other at Parson (51° 116° SW.). A full description of the properties is given in the 1958 Annual Report.

The Brisco operation was active for ten months during 1959, with activities confined mainly to quarrying. A four-man crew produced 9,320 tons of barite, which was crushed near the quarry-site, and shipped to the company's processing plant at Lethbridge. A great deal of difficulty was experienced in quarrying due to the occurrence of faults and the continuing erratic pinching and swelling of the barite body. As a result, the size of the quarry is restricted considerably and the quantity of available barite remaining is very limited and is rapidly nearing depletion. Six holes were drilled, with a total footage of 1,350 feet, to test the continuation of the deposit to greater depth. A change to underground mining is expected at a future date.

At the Parson operation, activities were directed mainly to driving a new adit drift from the floor of the lower quarry. The drift follows the vein in a southerly direction. It was advanced 410 feet. and a 45-foot raise was driven from it to the surface. The drift was driven under contract. Two men were employed and produced 3,517 tons of barite, all from the excavation of the drift. Four holes totalling 715 feet were diamond drilled from the surface.

Baroid of Canada, Ltd.* Company office, 44 King Street West, Toronto, Ont.; J. A. Martino, president; T. A. Studer, mine manager. This company operated two barite quarries in the Golden Mining Division for a short period during 1959 following agreements with the owners. The operations were on the Larrabee property near Invermere (50” 116” S.E.) and the Silver Giant property at Spillimacheen (50” 116” N.E.).

The Larrabee property comprises four mineral claims on the south side of Toby Creek, 8 miles west of Invermere. The property was formerly held by the Larrabee Mining and Exploration Company, of Calgary, and was prepared for production in 1958. The present company commenced quarrying on the property in August, 1959, and continued until October 27th, when operations were temporarily suspended for the winter owing to the condition of the road from Invermere to the quarry becoming unfit for ore transportation. During the period the quarry was working, six men, employed on contract, produced 2,426 tons of barite. Most of the production was obtained from the upper quarry, but activities were suspended toward the end of October and a new quarry was prepared at a lower elevation on the mountainside. The production from both the quarries was trucked to a railway siding at Goldie Creek, near Invermere, and shipped by rail to the company's processing plant at Onaway in Alberta. All the barite was shipped in a crude state.

The Silver Giant property is on the west side of Jubilee Mountain, 8 miles by road from Spillimacheen station on the Kootenay Central Railway. It is owned by

* By D. R. Morgan.

Giant Mascot Mines Limited and was mined for lead and zinc in the years 1908, 1916, and 1947 to 1957. Baroid of Canada, Ltd., entered an agreement to produce barite from the property in 1959, and early in November commenced quarrying from an old open pit half a mile from the mill-site. They continued quarrying for six weeks and then suspended further operations for the winter. During the time the quarry was operating, six men, on contract, produced 600 tons of barite, which was trucked to a railway siding at Spillimacheen and shipped to the company's processing plant at Onaway. The barite was shipped in a crude state. The agreement is understood to cover a ten-year contract, and includes the production of barite from surface stripping and underground mining. The company also received an option to purchase the mining property within the next three years.

BUILDING-STONE

Kootenay Granite Products Limited*

Sirdar (49" 116" SW.). Company office, 1410 Fourth Street S.W., Calgary, Alta.; quarry office, Sirdar. R. Staal, superintendent. This company operates a quarry and processing plant 2 miles north of Sirdar, about 100 yards off the Creston-Kootenay Bay Highway. Mining at a surface quarry is done with jacklegs, and the rock is scraped to a grizzly by a two-drum hoist. Plans are to install a three-drum slusher hoist to increase scraping efficiency.

The plant consists of a crushing, screening, and bagging circuit to produce five sizes of grits. The sizes and uses are as follows: +10 mesh to $-\frac{1}{8}$-inch chick, sander, and monumental grit; +%-inch to $-\frac{3}{16}$-inch chicken grit; $+\frac{3}{16}$-inch to --'%-inch turkey grit; $+\frac{1}{4}$-inch to $-\frac{5}{16}$-inch roofing and stucco grit; $+\frac{5}{16}$-inch to -'/-inch construction grit. Larger-sized material can be produced on demand. Distribution has been mainly to the prairies.

Valley Granite Products Limited†

Cheam View (49" 121" S.W.). Company office, 410 Mayfair Avenue, Chilliwack; plant, Cheam View. K. Jessiman, general manager. The quarry is on the west side of the Tram-Canada Highway, 11 miles northeast of Rosedale. Granite rock is quarried by vertical-hole benching using jackhammers. Broken rock is transported by lift loader to the feed grizzly over a Telsmith 14- by 12-inch jaw crusher. The product from the jaw crusher is conveyed to a 1-8 Traylor gyratory crusher and thence to a two-deck Dillon vibrating screen. The oversized particles, $+\frac{5}{16}$ inch in size, are returned to the gyratory crusher. Undersized material is conveyed to a storage hopper feeding a 40-foot oil-fired drier. The dried material is conveyed to a Niagara 2- by h-foot six-deck screen.

Part of the sized product goes directly to bin storage, part goes to a revolving screen for further separation and storage, and the undersize is conveyed to a dry ball mill. The ball mill product is conveyed to a Hummer two-deck screen in closed circuit with the ball mill. The plant produces turkey, chicken, and bird grits, stucco dash, sand-blasting materials, and filler for asphalt roofing.

Three separate cyclone dust-collecting units were installed in circuit with the crushing, screening, and drying sections.

On March 31st operations were temporarily suspended when a slide of rock, which occurred in conjunction with a blast, dislodged the jaw and gyratory crushers. Fourteen men were employed except during December, when the crew was reduced to seven.

* By I. D. McDonald.
† By J. E. Merrett.

Little Mountain **Quarry.***—Chilliwack (49° 121" SW.). This pit is on the north slope of Mount Shannon about 1 mile northeast of Chilliwack. It is operated by the Chilliwack Dyking District Board. Rock is blasted in the quarry by municipal employees as required for dyke repairs, No rock was quarried during the year, but a small amount of broken rock was removed.

Sumas Mountain Quarry.*—Matsqui (49° 122" S.E.). This quarry is on the northwest slope of Sumas Mountain, 2½ miles east of Matsqui station on the Canadian National Railway. It is owned by the Dyking Commission. No rock was broken during the year.

Gilley **Bros.** Limited *—Pitt River (49° 122" S.W.). Company office, 902 Columbia Street, New Westminster. J. H. Gilley, general manager; James Gilley, production supervisor; Francis J. MacDonald, superintendent. The quarry is on Pitt River immediately south of its confluence with Munro Creek. Quartz diorite is quarried in 40-foot benches using an air track for drilling. The vertical drill-holes are spaced according to the desired fragmentation for market requirements. Broken rock is loaded by diesel-driven shovels onto 12-cubic-yard trucks and is transported to the crushing plant, which consists of a 42- by 60-inch jaw crusher discharging over a 6-inch grizzly. The oversized material is carried by conveyor-belt to loading scows. The undersized material (—6-inch) is stockpiled. Hydro-electric power for the plant operation is produced on the property. The quarry produces rock for jetties, dykes, and concrete aggregate. Twenty-three men were employed. Production was 150,000 tons.

Indian River Quarries Limited."-Granite Falls (49° 122" S.W.). Company office, 1255 West Pender Street, Vancouver 1. This property on the northeast shore of Indian Arm was inactive until December, when McKenzie Barge and Derrick Co. (1957) Ltd., of Vancouver, recommenced quarrying to produce jetty rock for the Tsawwassen pier.

Enemark **Construction** Limited*—Indian Arm (49" 122° S.W.). Company office, Port Mellon; quarry, Clementine Creek, Indian Arm. T. Enemark, manager. The quarry is immediately south of the mouth of Clementine Creek, due west of the north end of Croker Island. Quartz diorite is quarried by vertical-hole benching using an air track. A jackhammer is used to drill holes for secondary blasting. The material produced is loaded by diesel-driven shovels onto 12-cubic-yard trucks and transported to scows. The rock is being used as jetty rock on the Tsawwassen pier.

Vancouver Granite Co. Limited*—Nelson Island (49" 124" N.E.). Company office, 744 West Hastings Street, Vancouver 1; quarry, Nelson Island. W. C. Ditmars, president. Dimension stone for building purposes and monuments, jetty rock, and rubble are mined at this quarry. The rock is drilled to size following a mineral fracture pattern, blasted and wedged for removal. Three 20-ton-capacity derricks are used to move the rock from the pit to scows for shipment to the Vancouver plant, where it is cut and finished. Approximately 2,000 tons of stone was produced during the operating period from May 1st to November 20th. Six men were employed.

* By J. E. Merrett.

CEMENT*

British Columbia Cement Company Limited.—Bamberton (48" 123" N.W.). Head office, 540 Burrard Street, Vancouver 1. Gordon Farrell, president; B. Franklin Cox, vice-president and general manager; R. E. Haskins, general superintendent. This company operates a cement plant with a rated capacity of 3% million barrels per year at Bamberton.

Lafarge Cement of North America Ltd.—Lulu Island (49" 123" S.E.). This company operates a cement plant with a rated capacity of 1% million barrels per year on Lulu Island.

CLAY AND SHALE

Clayburn-Harbison Ltd.† (49" 122" S.E.) Head office, 850 West Hastings Street, Vancouver 1; plants, Kilgard and Abbotsford. Gordon Farrell, president; R. M. Hungerford, general manager; G. H. Peterson, manager. Two plants are operated by this company-one at Kilgard where sewer-pipe, flue-linings, and lightweight aggregate are manufactured, and the other at Abbotsford where face brick and refractories are made.

In the Kilgard plant, clay is pre-dried in a 150-foot rotary kiln and stockpiled. The dried clay is mixed with water and grog. This product is extruded through dies to form sewer-pipe and flue-lining. The formed ware is dried and burned in down-draught beehive kilns fired with natural gas.

In the Abbotsford plant, bricks are dry-pressed or extruded through dies, then hand-set on cars and passed through a drier. The dried bricks pass into a 300-foot-long tunnel kiln, where they are burned. Some shale used in the manufacture of refractories is precalcined in the rotary kiln at Kilgard, which is also used for the bloating of certain shales.

Clay and shale are mined from certain bands of the Huntingdon formation in Sumas Mountain. This material is produced from two open pits and two underground operations. The Selby open pit, with an exposed shale face 30 feet high, is 2½ miles northeast of Abbotsford. A new open pit was started in the vicinity of the old Kilgard No. 9 mine. This pit has a face 25 feet high. In both pits clay is mined in benches by drilling and blasting vertical and horizontal holes.

A new adit, 50 feet long, was commenced in the open pit east of the main adit and above the Richmix clay pit. In the main adit, room-and-pillar mining was continued in a northerly direction up the dip of the clay formation. Haulage-ways are timbered by conventional methods, while the connecting side drifts are roof-bolted for ground support. The drifts are driven 16 feet wide and the pillars maintained 60 feet wide. Holes are drilled with tungsten-carbide-tipped augers driven by air-operated drills. Stumping-powder and 30 per cent Stopeite are used to blast the shale. The broken material is slushed up ramps and into muck-cars.

During 1959, 36,254 tons of clay and shale was mined. With the opening of the No. 9 pit, the mining crew was reduced to ten men and sixty-five men were employed in the two plants. A strike of the workmen suspended the operations for a three-month period.

Richmix Clays Limited† Kilgard (49° 122" S.E.). Office and plant, 2890 East Twelfth Avenue, Vancouver 12; quarry, Kilgard. G. W. Richmond, manager. Surface mining of clay was carried on intermittently at this property. Clay is drilled and blasted,

* BY I. W. McCammon.
† By J. E. Merrett.

then loaded by a diesel shovel onto trucks and transported to the Vancouver plant or to markets. During 1959, 4,000 tons of fireclay was shipped, and two men were employed at the pit.

Lafarge Cement of North America Ltd.*-Fort Langley (49” 122° S.E.). The clay pit and slurry plant on the Fraser River in Matsqui Municipality, opposite Silverdale, remained idle throughout 1959.

Bear Creek Brick Company*

Surrey (49” 122° S.W.). Head office, Victoria Tile & Brick Supply Co. Ltd., Vancouver; plant, Archibald Road at Mahood Creek. Surrey Municipality. James McBeth, plant manager. Clay is excavated from a shallow pit adjacent to the plant by a %-yard gasoline shovel. It is transported to a covered air-drying area. Bricks and tile are formed by a stiff-mud extrusion process, dried in an oil-fired controlled-temperature drying-room, and burned in rectangular oil-fired kilns. A crew of six men was employed. In 1959 approximately 670 tons of clay products was produced.

Haney Brick and Tile Ltd.*

Haney (49” 122” S.W.). Company office and plant, Haney. E. G. Baynes, president; J. Hadgkiss, managing director. Clay is excavated from two locations adjacent to the plant. Plastic clay is obtained from a low pit face, where it is removed by a %-cubic-yard gasoline-driven shovel. A less plastic clay is obtained from a bench above the pit. The clays are transported by truck to a covered air-drying area. They are further dried in a rotary wood-fired kiln and conveyed to a dry-pan for grinding. Brick and tile are formed by a stiff-mud extrusion process and dried in a controlled-temperature drying-room. The products are burned in down-draught beehive kilns. During 1959, 9,500 tons of clay products was produced. Thirty men were employed.

Mainland Clay Products Limited*

Barnet (49” 122” S.W.). Head office, 8699 Angus Drive, Vancouver 14; plant, Barnet. Clay is excavated from a pit adjacent to the plant and is transported to a covered air-drying area. Some fireclay is obtained from Kilgard. Dry-pressed common brick, Roman brick, and firebrick are formed and dried in a heated drying building and then burned in rectangular oil-fired kilns. Three men were employed. The production in 1959 was 2,736 tons.

B.C. Clay Products Limited*

Surrey (49” 122” SW.). Head office, 3439 Euclid, Vancouver 16; pit, Archibald Road at Mahood Creek, Surrey Municipality. Clay is excavated from a small pit opposite the Bear Creek Company plant. In 1959, 500 tons of clay was excavated and trucked to the Vancouver plant for the manufacture of flower-pots.

British Columbia Lightweight Aggregates Ltd.†—Saturna Island (48” 123” N.E.). In September, 1959, this company began production of bloated shale lightweight aggregate. Raw shale is mined beside the plant and is bloated in an oil-fired rotary kiln. The plant and quarry are at Lyall Harbour.

Deeks-McBride Ltd. (Clay Division).†—Bazan Bay (48° 123" N.E.). This company operated a brick and tile plant at Bazan Bay, near Sidney, until November, 1959, when the plant was closed down.

* BY I. E. Merrett.
† BY J. W. McCammon.

Baker Brick & Tile Company Limited.*-Victoria (48” 123” SE.). Office and works, 3191 Douglas Street, Victoria. Blocks, flue-lining, drain-tile, and flower-pots were manufactured from local surface clay by this company during 1959.

DIATOMITE*

The largest diatomite deposits known in British Columbia are found along the Fraser River between the big bend, 8 miles north of Quesnel (53° 122” S.E.), and Alexandria (52” 122” N.W.), 24 miles south of Quesnel. Except for a few small exposures, particularly on Lot 6182, the diatomite is on the west side of the river. The ground where the diatomite occurs has been disrupted by faulting and sliding, and as a result the diatomite is now in disconnected blocks at various elevations. It seems most likely, however, that originally the beds were laid down at about the same elevation in a series of lakes formed by obstructions in the Tertiary Fraser River. The diatomite is thought to be of lower Upper Miocene age. Apart from unconsolidated Recent and Pleistocene material, the only overlying rock found was flat-lying plateau basalt. The diatomite overlies older Tertiary clays, sands, and gravels. Microscopic examination of samples from the various outcrops indicates that all outcrops are essentially alike. The diatomite consists almost exclusively of various sizes of *Melosira granulata* diatoms, usually very small, with variable amounts of clay, silt, and volcanic ash. The most important deposits are on Lot 6182, on the west bank at the big bend, on Lot 906, and in the vicinity of Buck Ridge post office. Analyses of samples taken at the different showings are presented in a table on page 166.

Lot 6182 (52” 122” S.E.)

Three patches of diatomite are exposed on Lot 6182 on the east bank of the Fraser, at the lower end of the big bend. Two of these can be reached by means of a short road that branches northwestward from the old route of Highway No. ‘2 at the sharp hairpin bend near the start of the climb to Moose Heights.

The area containing the diatomite is badly disrupted by slumping and possibly also by major faulting. As a result, the diatomite is in rather small disconnected blocks and is at least 150 feet below its probable original topographical position.

The first exposure is 500 feet northwest of the highway at an elevation of 1,970 feet, approximately 400 feet above the river. It consists of a quarry opening that is 77 feet long, 40 feet wide, and 20 feet high. In the quarry face the diatomite body is seen to be a rounded mound with an uneven upper surface covered by a thin layer of unsorted sand, gravel, and clay. The base is covered. The diatomite mass is badly broken and the bedding is greatly disturbed. The diatomite ranges in colour from almost white, through grey to buff. Scattered interbeds of grey clay are present, and there is an irregular rusty streak across the top of the quarry face. A few deciduous leaf fragments were noted in one zone near the top of the face. Sample No,. 1 was taken from top to bottom of the accessible face of the quarry.

The second exposure is at the end of the road 600 feet northwest of the first one. A former excavation has now slumped, but a patch of diatomite 5 by 15 feet is still visible. What is probably another side of this same occurrence can be seen 200 feet to the north, where diatomite is exposed in a small slide at the top of a gully. The diatomite in this exposure is similar in appearance to that in the first.

The third exposure is in the upper part of a large active slide on the river bank, 1,800 feet northwest of the second exposure. It forms part of the top of a narrow bench about 330 feet above the river. The mass of diatomite is at least

* By J. W. McCammon.

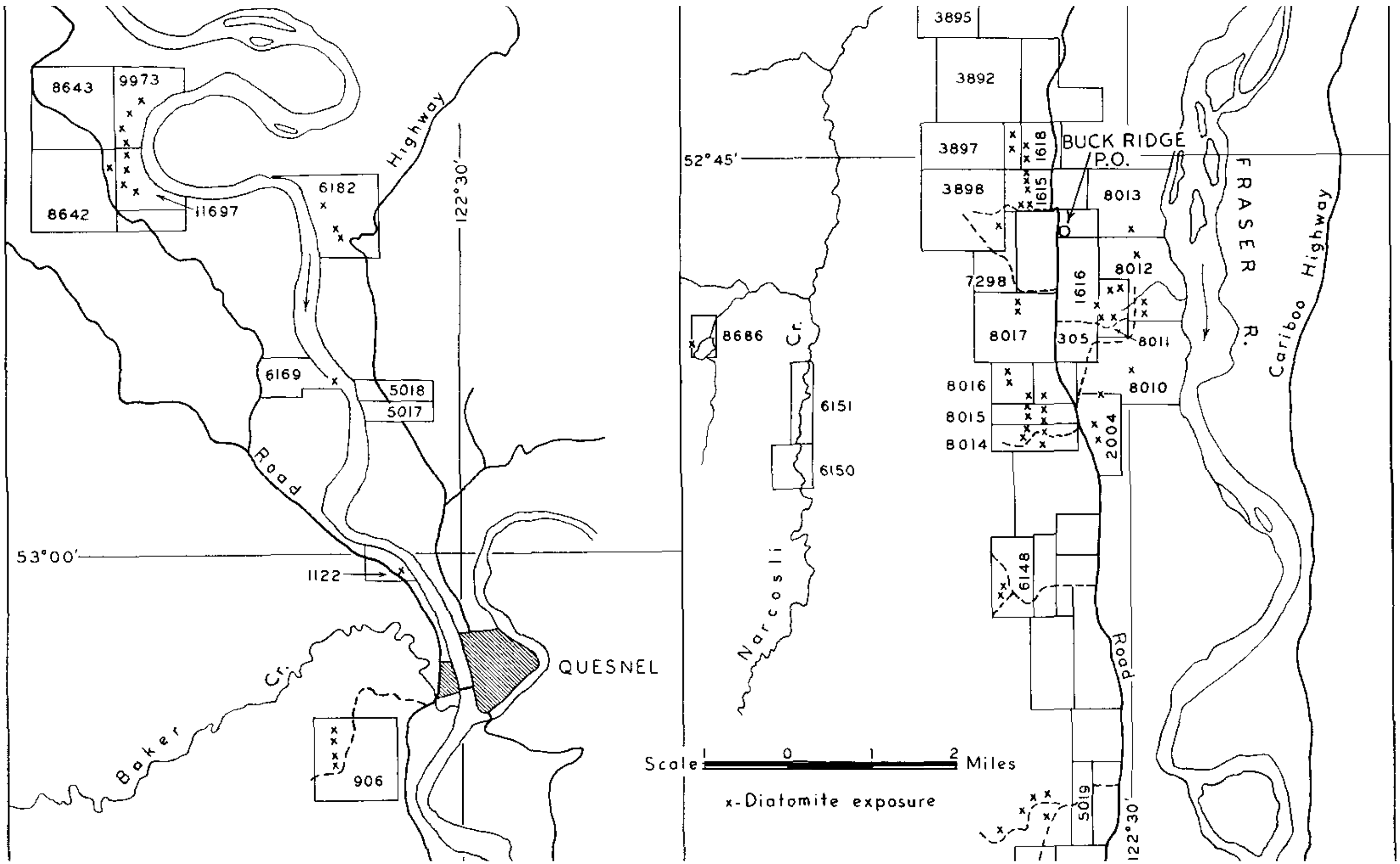


Figure 25. Diatomite occurrences in the Quesnel area.

20 feet thick and is exposed for 110 feet along the bench. The diatomite is similar in appearance to that in the other two exposures.

A few small patches of diatomite were found in the walls of a gully between the last two exposures.

Traverses were made north along the river bank around the " big slide " to the upper end of the big bend and also to the south and east of Lot 6182, but no more diatomite was found.

Periodically over the past several years, Fairey & Company Limited has shipped small lots of diatomite from this property to its plant in Vancouver. The material is used to make insulating brick.

An examination was made of the river bank, all road cuts, and the creek gullies on the east side of the Fraser from the big bend south to Marguerite, but no more diatomite was found. Eardley-Wilmot, however, mentions an exposure of 5 to 6 feet of diatomite underlying 150 feet of clay and gravel along the river on Lots 5017 and 5018 and also a lens 15 feet long and 5 feet thick exposed in a railway cut in the old brickyard on Lot 385.

Lots 9973 and 11697 (53° 122° S.E.)

One of the most extensive deposits of diatomite in the area is on Lots 9973 and 11697 along the west bank of the Fraser at the south curve of the big bend. The deposit can be reached by a short road that branches east off the plywood company logging-road to Cottonwood Canyon, 4.6 miles from the junction of the logging-road and the main road from West Quesnel to Blackwater.

At the bend active undercutting by the river is causing a section of the bank more than 2 miles long and half a mile wide to slump and slide down toward the water. The stable top of the bank is about 750 feet above water-level. The diatomite is found in discontinuous blocks in the upper part of the moving ground 565 to 700 feet above the water.

In 1955 Western Diatomite Company built approximately 2 miles of tractor-roads and dug several trenches on the property. Since then most of the roads and trenches have slumped badly. The locations of the roads and all the diatomite outcrops that could be found are shown in Figure 26.

The diatomite showings are largest in the southern part of the area and dwindle to small thin isolated patches to the north. No complete section through the diatomite from top to bottom was found. The disrupted nature and slumping of the blocks, lack of accurate horizon markers in the diatomite, and poor exposures prevent accurate estimation of the extent of the deposit. As nearly as could be determined, the original base of the diatomite must have been at about 2,140 feet elevation, and it is thought the small patches of material found below this level have slid. The diatomite lies on a bed of light-grey clay below which is a thick sequence extending down to river-level that consists of beds of sand, gravel, and clay with some volcanic ash. None of the beds are well cemented, except for a thin dark-brown layer a short distance below the presumed base of the diatomite. This layer consists of small sub-angular to rounded pebbles of quartz, chert, and other materials firmly cemented by iron oxide. The position of the original top surface of the diatomite is not known. Diatomite now visible is overlain by thin layers of glacial till or soil. The highest elevation measured on a diatomite upper surface was 2,280 feet at A in Figure 26. Thus the diatomite originally may have been 140 feet thick, and, since the upper contact in similar and presumably related deposits a few miles to the south is at 2,350 feet elevation, the total thickness could have been over 200 feet. The thickest continuous section actually measured was at A, where 83 feet of beds was visible. Other thick sections were 55 feet at B

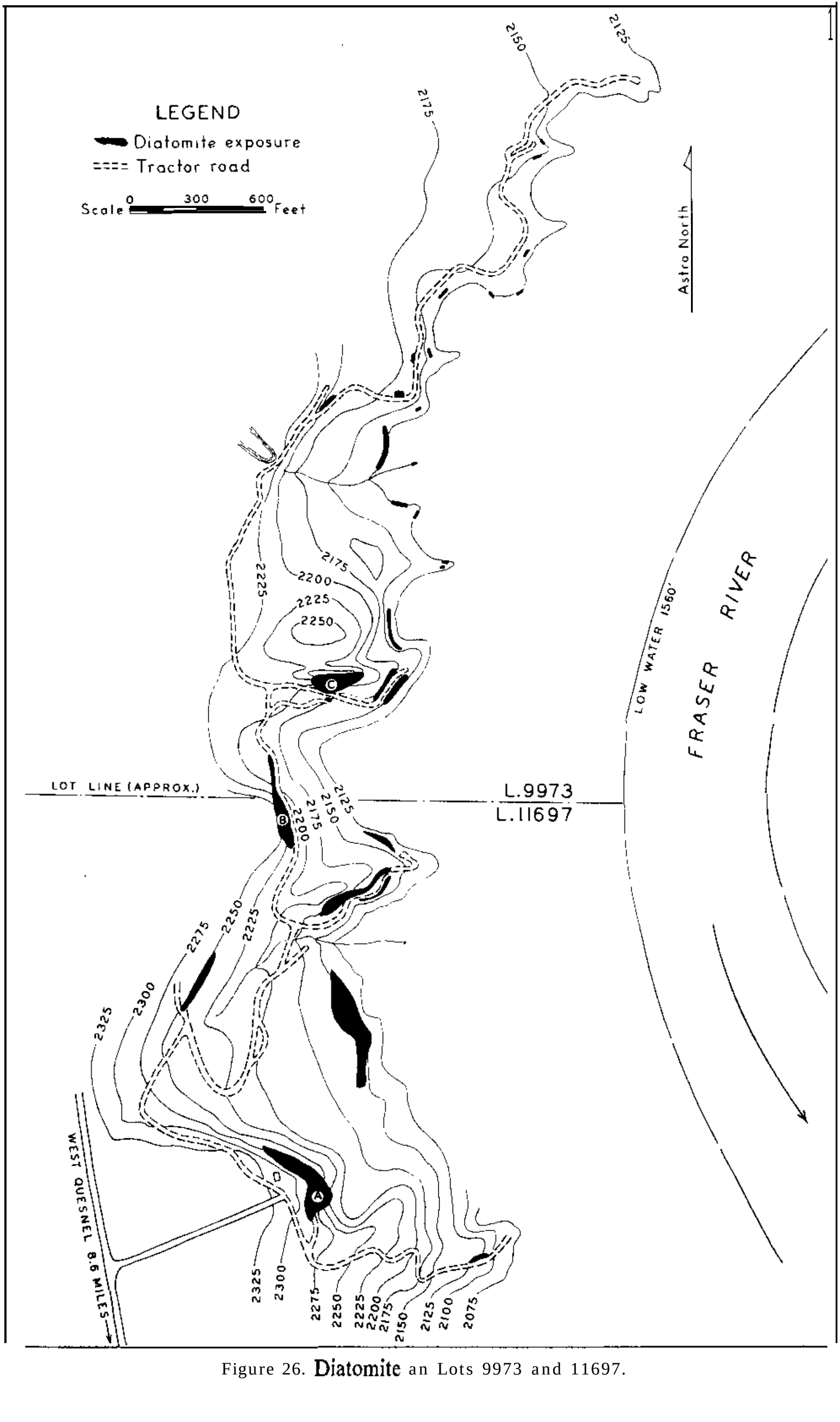


Figure 26. Diatomite an Lots 9973 and 11697.

and 80 feet at C (see Fig. 26). Erosion has removed much of the diatomite, which has been replaced by a heterogeneous fill of sand, gravel, clay, and till. Many of the exposures when traced laterally are found to be terminated by this type of material, and it is difficult to determine whether the contact is a result of erosion and fill or of slumping.

The diatomite is pale buff to white, the colour depending largely on the dryness and length of time of exposure to the weather. Samples from many parts of the area were examined microscopically and found to be so much alike that no separation of horizons was possible. The bulk of the diatoms present are Melosira granulata of different sizes, mostly very small. Silt, clay, and volcanic ash are present in variable amounts. In clean outcrop faces a few thin beds of ash and clay and occasional small lenses of sand can be found. Brown layers, 4 to 8 inches thick, occur in several outcrops. Four such layers were visible at A, but in other outcrops no more than one or two were found. The layers consist of pumicite and silt with a few diatoms, all cemented by iron oxide. The composition of the layers varies, but individual layers vary laterally also, both in content and in thickness. As a result, it was not found possible to correlate the layers in different outcrops.

Carbonized leaf impressions were found in several places, most abundantly at points A and B. A collection from the central part of the exposure at A was sent *to* G. E. Rouse, of the University of British Columbia, who identified the following: *Taxodium dubium* (Stern.) Heer; *Quercus convexa* Lq.; *Quercus hannibali* Dorf.; Quercus *obtusa* Kn.; Quercus cf. *simulata* Kn.; *Betula Thor* Kn. In addition, the following microfossils were identified: *Picea* sp. *(large* form); *Tsuga granulosa* Pot.; *Tsuga* sp. *canadensis* type; *Pinus* spp. (at least two distant species); *Pseudotsuga* sp.; *Taxodium hiatipites* Wode.; *Cupressaceous* pollen, probably *Thuya*, possibly *Juniperus; A bies* sp.; *Castanea* sp.; *Ilex* sp.; Quercus sp.; *Alnus* sp.; *Pterocarya stellatus* Pot.; *Melosira paucipunctata* Lohman; *Melosira granulata* (Ehren.) Ralfs.; *Melosira granulata* cf. *punctata* Bail.; *Melosira undulata* (Ehren.) Kutzing; *Fragilaria virescens* Ralfs.; *Coscinodiscus* cf. *punctatus* Ehren.; *Coscinodiscus* sp.; *Surirella* sp. cf. *fluminensis* Grun. Regarding the age, Dr. Rouse states: " The collection of leaves is too small to be accurately used alone for dating, although the assemblage would suggest a late Miocene or early Pliocene age. The whole Quesnel flora resembles most closely those reported from 49 Camp, Trout Creek, Payette, Latah, Mascall, and Grand Coulee, all of which have been given an Upper Miocene age. However, in view of the general southward migration of floral components during the later Tertiary, the Quesnel flora may actually be somewhat older than those of Washington, Oregon, and Nevada. On the other hand, there is a possibility that the Quesnel flora may represent Mio-Pliocene time, or even earliest Pliocene." Dr. Rouse concludes that in his opinion the Quesnel flora investigated is lower Upper Miocene in age, corresponding most closely to the Mascall and Blue Mountain floras of Oregon; the latter have been assigned to the early Barstovian stage of the Miocene epoch.

Samples for analysis were taken at points A and B. At A the section is 83 feet thick. Five samples, listed in the accompanying table (p. 166), were taken as follows: No. 2, top 22 feet; No. 3, next 22 feet below; No. 4, next 13 feet below; No. 5, next 16 feet below; No. 6, bottom 10 feet-base not exposed. An iron-band layer separated each sample. Two samples were taken at B-No. 7, across 25 feet of beds above a prominent iron band, and No. 8, across 8 feet of beds exposed below the iron band.

In the area from the big bend south to Lot 906, only two small diatomite occurrences were found. In the southeast corner of Lot 6169, two or three diatomite lenses, about 3 feet thick and 15 feet long, outcrop in the sand and gravel high up the river bank. Near the southeast corner of Lot 1122 a short road branches north from the Blackwater road to a group of houses near the river. A rounded hummock of diatomite covered by drift is cut by this road 100 feet from the main road. The diatomite exposure in the cut is 8 feet thick and 20 feet long. A larger bank of diatomite is exposed in an excavation behind a house 100 yards northwest of the road cat. A few small blocks of dirty diatomite can be seen in exposures scattered along the river bank in the same lot.

LOT 906 (52" 122" N.W.)

One of the oldest recorded occurrences of diatomite in this area is on Lot 906, 2 miles southwest of Quesnel. Trenches, one small cliff, and spoil from animal burrows indicate the presence of diatomite along a distance of 3,000 feet in a north-south direction in the western part of the lot. A good logging-road from West Quesnel passes across the most southerly exposure 2.2 miles from the Baker Creek bridge.

The diatomite is in an area of hmnmocky ground immediately in front of low cliffs of flat-lying olivine basalt. The nature of the topography and the disturbed bedding of the diatomite indicate there has been some slumping. However, the occurrence of olivine basalt in contact with and overlying diatomite in two places shows that vertical movement has been very limited, and thus the diatomite must be near its original topographic position.

The exposures of diatomite lie along the hillside approximately on the 2,300-foot contour, 750 feet above the Fraser River. The lowest exposure seen is the most southerly. It is in a cut along the edge of the logging-road. In the cut three separate patches of diatomite are visible. In each, broken pieces of diatomite are mixed with rock fragments, earth, and other debris. The diatomite is apparently talus derived from the main cliff exposure uphill and 500 feet to the northwest.

The cliff exposure is where the initial diatomite discovery was made. Reports on and photographs of it have been published by both Reinecke and Eardley-Wilmot. When examined for this report, a thickness of only 34 feet of diatomite was visible. The base was covered and the top was overlain by vesicular olivine basalt. A 6-inch-thick brown iron band stood out prominently near the bottom of the diatomite. Microscopic examination showed this band consisted mainly of pumicite with some diatomite and silt, all strongly stained with limonite. Scattered thin clay beds and deciduous leaf impressions are also present in the deposit. Eardley-Wilmot took samples every 5 feet down the face of the cliff. He found little variation in the diatoms, although toward the bottom there was a tendency for a decrease in size of the individuals and an increase in the number of broken diatoms. His analyses of the samples are shown in the accompanying table, as follows: No. 9, top 10 feet; No. 10, 10 . 20 feet; No. 11, 20 to 25 feet; No. 12, 25 to 30 feet; No. 13, 30 to 35 feet; No. 14, 35 to 45 feet; No. 15, bottom 5 feet.

During the winter of 1958-59 some exploration work was done on Lot 906. A dozen trenches were dug with a bulldozer, as shown in Figure 27. Ten of the trenches uncovered diatomite. In all of them the material had the same general appearance and was usually badly broken up, although in a few places regular bedding was visible. A prominent iron band was noted in three trenches. A tractor-road built to gain access to the northern trenches ended at a cleared area 150 feet square. The entire floor of this area was in diatomite, but it was not certain whether this was in place or had been bulldozed down from the IS-foot-high bank of the diatomite exposed along the southwest edge of the clearing.

Nowhere among the exposures was the true base of the diatomite seen. However, about halfway along the tractor-road and 200 feet south of a cut in diatomite,

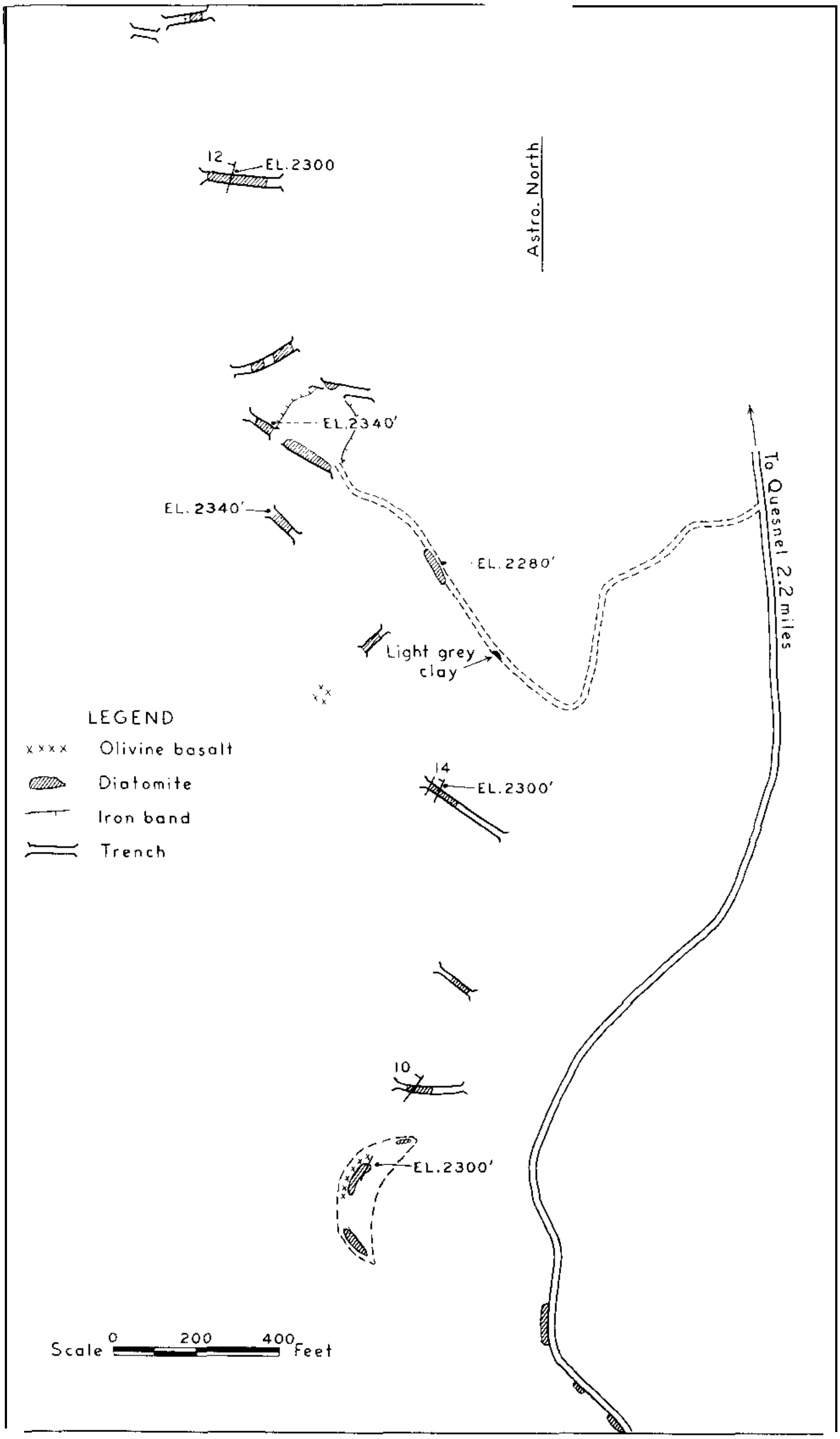


Figure 27. Diatomite on Lot 906.

some light-grey clay, very similar to that underlying the diatomite at the big bend, was exposed.

Traverses north to Baker Creek, south for 1 ½ miles, and up and down the logging-road failed to disclose any other diatomite showings near by.

No diatomite was found in the area from Lot 906 south to Narcosli Creek. It has been reported that a bank of diatomite occurs near the head of the small creek 1% miles south of Higdon Creek, but this was not found.

BUCK RIDGE AREA (52" 122" N.W.)

The largest known concentration of diatomite in the region is in the vicinity of Buck Ridge Post Office, on the west side of the Fraser River 17 miles south of Quesnel. A good gravel road from West Quesnel to the Alexandria ferry crossing passes through the centre of the area. The diatomite has been found in separate but relatively closely spaced showings in road cuts, natural exposures, wells, drill-holes, and the spoil from animal burrows for 9 miles along the river. Most of the showings are in a north-south line one-half to 1 mile west of the road. They are along the edge of rather flat rolling bench land where the ground begins to rise steeply to the rim of the plateau to the west. The slope is broken by a series of small, narrow, elongate ridges parallel to the river, and the exposures are commonly found along the east sides of these ridges. Other exposures are in small gullies on the bench, three-quarters of a mile east of the road, and along the east edge of the bench, near the top of the bank where the steep drop to the river begins.

There obviously has been considerable movement of ground in the area, both by faulting and slumping, and as a result few of the diatomite bodies are in their original topographic positions. In addition, much erosion has taken place since the diatomite was laid down. These two factors, combined with poorness of exposures and lack of reliable horizon markers, make it difficult to estimate the amount of diatomite present, Except for one locality in the centre of the unnumbered lot between Lots 3897 and 1618, where, at 2,350 feet elevation, basalt overlies diatomite, a few inches to a few feet of unconsolidated overburden overlies the visible diatomite. Thicker layers of overburden have been encountered above diatomite in several wells-70 feet at the northeast corner of Lot 8017, 16 feet near the north central part of Lot 8017, 20 feet near the east edge of Lot 7298, and 20 feet near the southeast corner of Lot 3898. The base of the diatomite was not seen anywhere, but it is reported that drill-holes have encountered clay beneath it. The greatest thickness of diatomite seen was 25 feet on Lots 1615 and 6148; however. drilling has proved thicknesses of 30 to 55 feet on Lots 8014, 8015, 8016, and 8011, with the bottom not reached in some holes.

The diatomite is creamy white to buff, the colour varying slightly from place to place and from horizon to horizon and depending partly on the moisture content and length of time of exposure to the weather. Microscopic examination of samples from the various showings and from different horizons in them showed that all are much alike in composition, the main variable being the amount of silt and ash present. The diatoms are mostly varieties of Melosira granulata of different sizes, generally small, with a few scattered boat-shaped and disk types. A considerable number of diatoms are broken. Scattered thin layers of clay occur as interbeds, and iron bands similar to those described at the big bend are to be seen in a few showings.

The best-known diatomite occurrence east of the road is on the Lepetich farm at the junction of the southeast corner of Lot 1616 and the mid-western side of Lot 801 1. The elevation is 2,080 feet, 620 feet above the river. Several exposures can be found in a gully across the corner of Lot 1616 and along a steep bank around the southwest end of a pond on Lot 8011. A number of holes have been drilled and pits dug to explore the extent of the deposit. The work indicates that at least 10 acres of ground is underlain by a bed of diatomite that averages 30 feet thick and is overlain by 4 to 12 feet of overburden. When examined it was found the workings were caved, and the thickest section visible was 6 feet in the face of an old open-cut. In the face the diatomite beds were moderately disturbed. One iron-band layer was visible. A foot of sand and gravel overlies the diatomite, and 3% feet of soil and clay is above the sand and gravel. Sample No. 16 was taken from top to bottom of the 6-foot exposed face. More diatomite is exposed in the bank of an east-west gully that crosses the north end of Lot 8011, 600 yards northeast of the deposit just described. Visible outcrops are few, but Mr. Lepetich has traced the deposit by digging and drilling for nearly one-quarter mile along the gully. The indicated thickness is about 30 feet.

In the southwest corner of Lot 8012 diatomite is exposed in a road cut and in slides at intervals for 500 feet along the top of the steep slope to the river. The most northerly exposure is at 1,800 feet elevation in a road cut 100 yards south of Hodson Creek. Five feet of diatomite can be seen in the cut, but it is not known what the total thickness is. Material from this deposit was quarried and made into refrigerator deodorant. A few other small outcrops of diatomite have been found in slides along the bank to the north in both Lots 8012 and 8013.

The only other reported diatomite showings east of the road are small scattered ones in the mid-western part of Lot 8010 and in the north central part of Lot 2004.

The best exposed and most accessible diatomite is in the central part of Lots 8014 and 8015, where two elongate zones are indicated. The first zone is on flat ground at 2,180 feet elevation one-quarter mile west of the main road. Part of the area is under cultivation and part is bush covered. The zone is at least 500 feet wide and can be traced by surface indications for more than half a mile from the south boundary of Lot 8014 north through Lot 8015 into the south end of Lot 1617. The thickness has not been accurately established, but Cummings found depths of over 9 feet using a hand-auger on Lot 8015, and Mr. Heaton, owner of Lot 8014, reports one drill-hole showed 40 feet of diatomite on his lot. The second zone is 500 feet west of the one just described. It is on the east slope of a low ridge at the start of the main rise up to the edge of the plateau. An old quarry, from which a few carloads of diatomite were shipped several years ago, has been dug into the bank just north of the mid-point of the boundary-line between Lots 8014 and 8015. Slumping has filled much of the quarry, and only 6 feet of diatomite could be seen. It is reported that drilling has shown the total thickness here to be greater than 25 feet. Sample No. 17 was taken across the 6 feet of beds exposed in the quarry. Cummings published analyses of samples from different layers in the quarry that showed silica ranging from 68.6 to 80.1 per cent, alumina ranging from 10.6 to 5.5 per cent, and Fe_2O_3 ranging from 4.42 to 1.72 per cent. Pits and drill-holes indicate that the diatomite zone is at least 200 feet wide at the quarry. Good exposures of the same zone can be seen in logging-roads 500 and 1,000 feet south of the quarry. In the road cuts, only the top of the diatomite is visible and the depth has not been tested. Basalt outcrops at 2,400 feet elevation one-quarter mile southwest of and 170 feet above the quarry. The intervening ground is drift covered and no contact was found. North of the quarry, exposures are poor; however, the ridge continues, and Mr. Lepetich reports that he has traced the diatomite by auger-holes through Lots 8015, 8016, and 1617 to the south boundary of Lot 8017.

Near the centre of Lot 8016 a bulldozer cut along the side of a low ridge has exposed a mound of diatomite 18 feet thick for 100 feet in a north-south direction. The deposit can be traced 150 feet to the south, 50 feet to the west, and 500 feet to the north by bits of diatomite in gopher-holes and the roots of overturned trees. The bottom part of the face in the cut was covered, and it is not known what the real thickness of the diatomite is. Only the upper 8 feet of the face could be examined, and sample No. 18 was taken across the 8 feet. The diatomite seen was badly broken up and contained a considerable amount of clay.

On Lot 8017, near the centre of the north boundary, diatomite is exposed in an old root cellar and at the edge of a shallow excavation by an abandoned house 100 feet northeast of the cellar. A well, 100 yards south of the cellar, is said to have reached diatomite at 16 feet depth. Nothing else is known of this occurrence.

The road past the school along the south side of Lot 1615 cuts a small patch of diatomite at the first curve, 1,500 feet west of the main road. More diatomite is exposed in a bulldozer cut 100 yards south of this road, just inside the east boundary of Lot 3898.

An extensive diatomite zone can be traced for more than half a mile from the centre of the west half of Lot 1615 northwest along the west side of Lot 1618 and into the unnumbered lot between Lots 1618 and 3897. The best exposure on the zone is at the south end at an old sawmill-site on Lot 1615. An S-foot-deep cut has been bulldozed along the edge of a low ridge and a 7-foot-deep trench 15 feet long has been dug perpendicular to the face of the cut. Diatomite is exposed for the entire 15 feet from the bottom of the trench to the top of the cut. A l-foot-thick rusty band crosses the face 4 feet below the ground surface. Sample No. 19 was taken across 10 feet from the bottom of the trench to the base of the rusty band. A second trench 100 feet southeast of the one just described and 10 feet below it exposes 11 feet of diatomite. Sample No. 20 was taken across 4 feet from the bottom of the trench to a prominent iron band. Diatomite can be traced in cuts and pits 200 feet east and 200 feet west from the main pit. To the north it is exposed in pits, logging-roads, the roots of overturned trees, and in animal burrows for one-half mile. At an old mill-site in the centre of the unnumbered lot west of Lot 1618, more than 6 feet of light-coloured blocky diatomite with the base unexposed is cut by a logging-road. Basalt is exposed 10 feet above the diatomite at an elevation of 2,340 feet.

No solid diatomite outcrops were found between those just described and Narcosli Creek to the north, although in a few places near the centre of Lot 3892 and near the north edge of Lot 3895 small pieces of diatomite were found mixed with the soil.

Between the Buck Ridge area and the Alexandria ferry two more occurrences of diatomite were found-one. on Lot 6148 and the other in unsurveyed land west of Lot 5019. In the southwest corner of Lot 6148 a logging-road cut exposes diatomite more than 4 feet deep for 100 feet along the side of a north-south ridge. Sample No. 21 was taken from top to bottom of the face of the cut. About 100 yards to the south, more exposures can be seen around an old sawmill-site and on a bare grassy knoll. The diatomite at this spot is at least 25 feet thick. The outcrops are at approximately 2,250 feet elevation. West of Lot 5019 a bank of diatomite is exposed beside a pond 100 yards north of an abandoned mill-site 1½ miles from the main road. Northeast of the pond three more patches of diatomite are cut by the logging-road at quarter-mile intervals. In all of the exposures the diatomite is badly broken up and contains considerable amounts of clay.

The plywood company logging-road west of Narcosli Creek cuts through a patch of diatomite beside Webster Lake on Lot 8686, about halfway between mile-posts 19 and 20. Crushed diatomite is exposed in the cut for 110 feet along the road and to a depth of 3 feet. Sample No. 22 was taken along 100 feet in the cut. This exposure is at about 2,600 feet elevation, considerably higher than any of the other deposits examined. It is probably an isolated occurrence not directly related to the others. No more diatomite was seen, although it has been reported on Lots 6150 and 6151 on Narcosli Creek.

Diatomite Analyses

Sample No.	Lot	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	H_2O
1	6182	72.89	8.55	3.50	0.51	1.12	11.09
2	9973	58.28	15.92	7.65	0.63	1.22	13.15
3	9973	67.68	11.09	5.51	0.71	0.93	11.90
4	9973	74.09	7.43	3.14	0.46	0.83	11.30
5	9973	73.46	7.38	3.64	0.46	1.26	10.96
6	9973	70.68	9.40	4.29	0.51	1.02	11.24
7	9973	72.88	8.29	3.50	0.46	0.83	11.30
8	9973	72.74	8.45	3.36	0.46	0.96	11.35
9	906	65.70	13.23	5.97	0.90	1.28	7.56
10	906	70.46	12.60	4.50	0.85	0.95	7.68
11	906	76.86	7.00	3.06	0.62	0.73	7.88
12	906	69.02	13.16	4.24	1.02	0.44	7.20
13	906	73.19	8.98	4.36	0.79	1.14	6.40
14	906	72.76	10.77	4.03	0.68	1.31	6.72
15	906	72.44	7.91	4.03	1.24	1.05	7.12
16	8011	74.37	6.45	2.65	0.71	1.30	13.26
17	8015	71.88	10.23	2.72	0.36	0.78	12.55
18	8016	72.34	7.95	3.64	0.56	1.40	12.48
19	1615	68.80	8.84	3.50	1.73	0.88	12.86
20	1615	66.55	10.84	4.58	1.07	1.07	13.03
21	6148	65.40	9.34	4.08	1.98	0.96	14.84
22	8686	64.12	10.36	4.36	2.62	2.19	12.46

A composite sample consisting of half of each of samples 1 to 8 and 16 to 22 was made up, pulverized, and tested for pozzolanic value. The results are presented on page 180.

[References: *Geol. Surv., Canada,* Mem. 118, 1920, pp. 2, 3, 65, 76–80, 121; *Geol. Surv., Canada,* Map 12-1959; *Mines Branch, Ottawa,* Publ. No. 691, Diatomite, by V. L. Eardley-Wilmot, 1928, pp. 5, 45–51, 82, 94, 154, 155, 164; *Minister of Mines, B.C.,* Ann. Rept., 1947, pp. 209–211; *B.C. Dept. of Mines,* Bull. 3, 1940, pp. 5, 15, 16, 20, 21, 30.]

GYPSUM

Western Gypsum Products Limited* Windermere (50° 115° S.W.). Company office, 306 Electric Railway Chambers, Winnipeg 2, Man.; quarry office, Athalmer. A. E. Portman, superintendent. This company operates a large gypsum deposit on the north side of Windermere Creek, 8 miles east of Windermere. The gypsum is quarried, crushed near the quarry-site, and trucked to Athalmer for shipment by rail.

The 1959 production was mined from the No. 2 quarry, which was prepared for production in 1958. The deposit in this quarry is of considerable magnitude, and it is estimated there is sufficient gypsum exposed at present for three years' operation. The pit is 400 feet long by 300 feet wide with the walls sloped back to a 45-degree angle. The gypsum is extracted in 15-foot lifts and loaded onto trucks by a power-shovel. Two Euclid trucks are used for transporting the gypsum to the crushing plant, and six other trucks are used for transporting the crushed

* By D. R. Morgan.

gypsum to Athalmer. The total production was 127,710 tons, of which 98,104 tons was shipped from Athalmer and the remainder was stockpiled.

Other activities on the property included the construction of a large garage near the No. 2 quarry, the installation of a new conveyor system to move quarry fines to the same area as the crusher fines, and improvements to the road leading to the quarry. Diamond-drill holes totalling 14,000 feet were completed during further exploration.

Preparations were being made at the end of the year to move the crusher to a new site near the Wilmer railway crossing, and a new private road was in course of construction to connect the present company road to the new mill-site.

Roam Creek*

Canal Flats (50° 115° S.W.). This property comprises eight mineral claims located near the confluence of Roam Creek and Lussier River southeast of Canal Flats. It is accessible by means of a good 18-mile-long logging-road leading from the No. 95 highway, 4 miles south of Canal Flats. The property is held under option by J. Crockart, of Calgary.

Gypsum, Lime & Alabastine Limited entered an agreement to examine the property in 1959. A contract drilling company was engaged, which completed 944 feet of " AX " core drilling using a party of four men for a two-month period. The claims appear to cover a showing of typical Windermere gypsum.

LIMESTONE

Limestone in the Kamloops Area†

The known limestone occurrences in the Kamloops area consist of irregular discontinuous lenses in the Permo-Carboniferous Cache Creek group of rocks. These are indicated in Figure 28, taken from Geological Survey of Canada Map 886A, Nicola Sheet, with some modifications.

The lenses are largest and most abundant in the area of the Harper ranch between Paul Lake and the South Thompson River, 11 miles northeast of Kamloops.

At locality No. 1 (*see* Fig. 28) limestone forms a narrow elongate ridge trending northerly up the hillside. The exposure is 750 feet long, averages 130 feet wide, and has an elevation difference of 380 feet between its base and top. The limestone is fine-grained light- to dark-grey rock containing scattered patches and irregular, roughly parallel, narrow bands of chert. Bedding is indistinct but seems to strike about north 10 degrees west and to dip steeply east. Three samples were taken in a line across the base of the outcrop: No. 1, across 70 feet on the west side; No. 1A, across a 20-foot cherty zone in the centre; and No. 1B, across 80 feet on the east side. The analyses of these and the other samples mentioned in this report are shown in the accompanying table on page 170.

The limestone at locality No. 2 consists of an irregular mass 2 miles long and at one place nearly 2 miles wide. It extends from the lowest exposure, on the south end, at 1,400 feet elevation up and over the end of a ridge at 3,300 feet elevation. The rock is medium- to fine-grained light- to dark-grey material with poorly developed bedding. Chert is abundant and occurs as nodules, as irregular patches up to 2 feet in diameter, and as discontinuous parallel bands 3 inches to 2 feet wide. Much of the chert is white, but some is dark reddish-brown. It is most abundant around the margins of the deposit. In the central part, zones 200 to 300 feet wide can be found that are completely free of visible silica. Fossil fragments were noted

* By D. R. Morgan.
† By J. W. McCammon.

along the southern and mid-eastern borders of the limestone. Sample No. 2 was taken across a 110-foot stratigraphic thickness of beds, at the lowest outcrops near the centre of the south boundary of the deposit. Goudge (Ref. 1) published analyses of three samples: No. 2A, from across 300 feet of beds one-third of the way up the face of the east side of the exposure; No. 2B, from across 200 feet of strata below 2A; and No. 2C, from across 100 feet on the peak near the mid-west part of the exposure.

Three large and several small limestone lenses are exposed on Mount Harper. In all of them the rock consists of medium- to fine-grained light- to dark-grey limestone containing scattered fossils and variable amounts of light-coloured chert in nodules and discontinuous thin bands. The chert appears to be concentrated near the edges of the lenses, the central sections being relatively chert-free. Sample No. 3 consisted of chips taken at random along the south face of the largest lens (*see* 3 in Fig. 28).

Granular medium- to light-grey limestone containing some chert forms the main mass of McGregor Hill, situated 2 to 3 miles east of the deposits just described.

Three small limestone lenses are exposed on the north side of Paul Lake near the west end. The largest and most easterly lens forms a steep-faced, rounded 650-foot-high knoll known locally as Gibraltar Rock. It consists of white limestone with few visible impurities. The centre lens is well-bedded blue to white fine-grained stone. The westerly lens consists of dark coarse-grained granular crinoidal limestone.

Two small lenses occur near the road 4 to 6 miles northwest of Paul Lake. The southern one consists of dark crinoidal limestone with scattered chert nodules; the other contains sugary white limestone with some light-coloured chert.

In the vicinity of Rayleigh, 9 miles north of Kamloops, four limestone showings were examined. A road cut 1.2 miles north of Rayleigh station passes through the west end of a 100-foot-wide lens of limestone that extends for 1,000 feet easterly up the bare hillside. The rock is grey and medium grained with white calcite veinlets and nodules and patches of chert. A mile and a half south of the station three narrow elongate lenses occur parallel to one another. The south lens averages 150 feet wide and is exposed for several hundred yards up the hillside, starting at an elevation 1,000 feet above the highway. The rock in the lens is poorly bedded, fossiliferous, dark-grey granular material with irregularly distributed patches and nodules of chert. Sample No. 4 was taken across the 150-foot width of the lens near the west end. The other two lenses are smaller and lower down the hill, the most northerly one terminating just 200 feet above the highway. A sample from this last deposit taken by Goudge (Ref. 1) is shown as sample No. 4A in the table.

North of Heffley Lake impure limestone interbedded with argillite and sandstone and cut by rusty dykes forms steep cliffs for a mile parallel to the road. The rock appeared to be so impure that it was not sampled.

Limestone is exposed beside a rough ranch road 3 miles northwest of Sullivan Lake. The lens is more than a mile long with a width ranging from a few feet to 200 feet. The rock is light grey to white and contains variable amounts of silica as quartz veinlets and thin parallel seams of light-coloured chert. A very small lens of impure limestone is exposed on the top of a ridge half a mile west of the road 5 miles south of the deposit just described.

Several pods and lenses of limestone occur on the hillside near Black Pines, a post office on the west bank of the North Thompson River 20 miles north of Kamloops. The most accessible one is over 1,000 feet thick and is skirted by the road for 1,500 feet at a curve a mile and a quarter south of the post office. The limestone extends for a mile up the hillside in a northwesterly direction. Along the

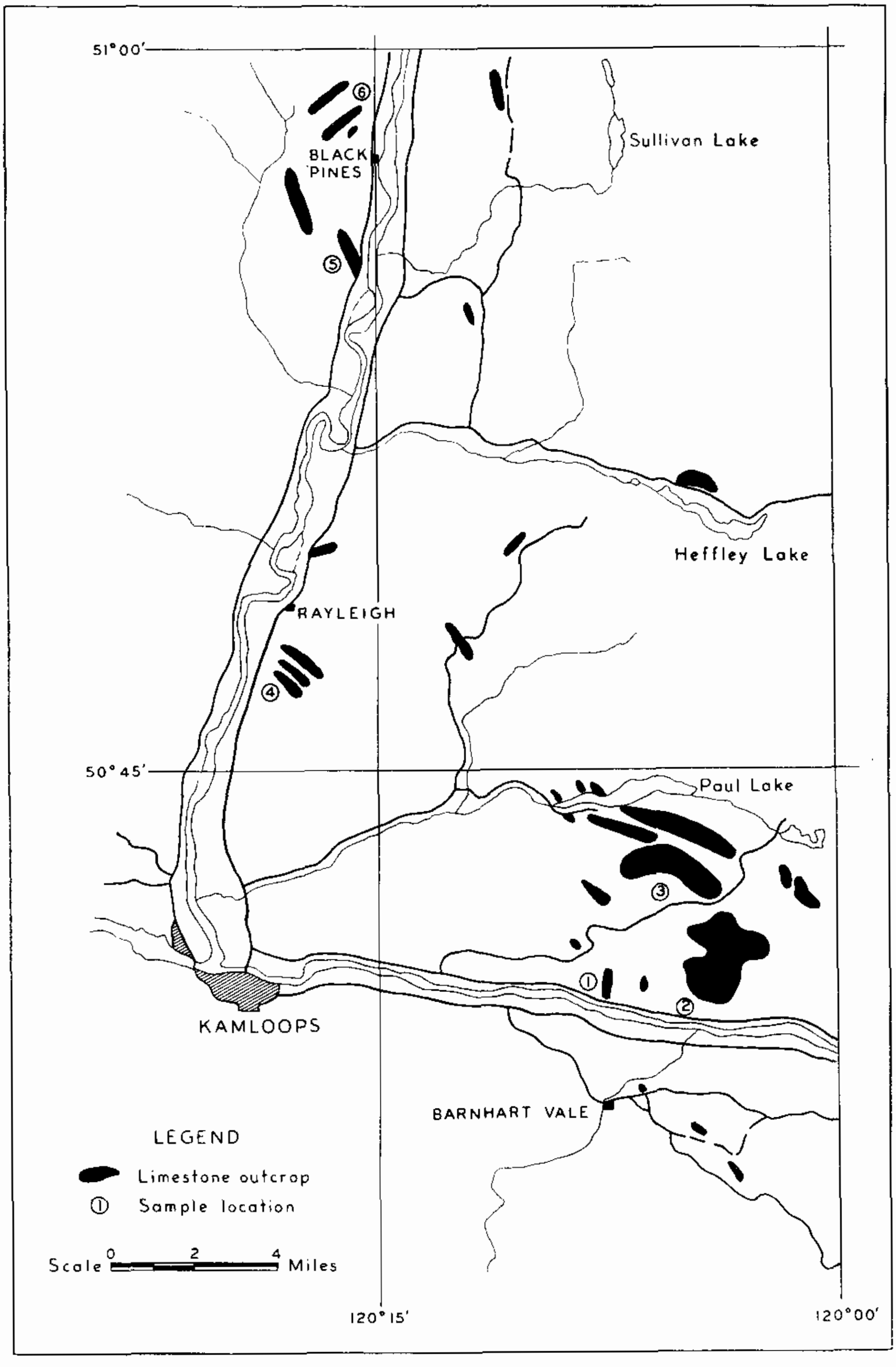


Figure 28. Limestone in the Kamloops area.

southwest margin the limestone contains thin brown interbeds of shale that show highly contorted minor folds. The central part and northeastern margin of the lens consist of light-grey to white rock that contains only minor amounts of visible impurities. Three samples were taken along the road cut: No. 5 was taken southwesterly across 400 feet starting at the northeast edge, No. 5A came from the next 400 feet to the southwest, and No. 5B came from the next 300 feet southwest of 5A.

Two cliffs of light-grey to white limestone are readily visible from the road at a point 4 miles farther north. The base of the exposures is 750 feet above the road. The southern lens can be traced only a few hundred feet up the hillside, but the northern one can be followed up to the top of the ridge at 4,200 feet elevation. The rock is granular to massive with scattered stringers and patches of chert and some fossils. Sample No. 6 consisted of chips taken across 500 feet at the base of the bluff on the northern lens. Cockfield (Ref. 2) mapped two additional bands of limestone on the top of the ridge near by, but these were not examined.

Three insignificant patches of impure limestone occur in beds of siliceous and limy argillite southeast of Barnhart Vale, 9 miles southeast of Kamloops.

Kamloops Limestone Analyses

Sample No.	Insol.	R_2O_3	Fe_2O_3	MnO	MgO	CaO	P_2O_5	S	Ig. Loss	H_2O
1	2.2	......	......	......	Trace	54.65	......	......	42.63	......
1A	14.7	......	......	......	Trace	46.62	......	......	36.38	......
1B	5.1	......	......	......	Trace	53.24	......	......	41.54	......
2	15.3	......	......	......	Trace	47.04	......		36.68	......
2A*	0.42	0.09	0.07	......	0.46	55.04	0.04	*Nil*	......	......
2B*	0.42	0.12	0.08	......	0.33	55.21	0.04	*Nil*	......	......
2C*	0.30	0.08	0.11	......	0.35	55.15	0.02	*Nil*	......	......
3	5.38	0.44	0.34	0.013	1.22	51.00	0.019	0.01	41.76	0.06
4	15.04	0.52	0.33	0.015	0.39	46.82	0.012	Trace	37.16	0.05
4A*	2.98	0.37	0.21	......	0.14	53.89	0.02	0.01	......	......
5	3.74	0.28	0.26	0.016	0.30	53.21	0.01	Trace	42.36	*Nil*
5A	5.62	0.30	0.30	0.026	0.10	52.21	0.01	*Nil*	41.53	0.03
5B	11.08	0.28	0.26	0.027	0.23	49.09	0.008	Trace	39.14	0.05
6	1.70	0.18	0.10	0.025	0.08	54.54	0.017	*Nil*	43.28	0.03

* By M. F. Goudge.

[References: (1) *Bureau of Mines*, Canada, Publ. No. 811, 1944, pp. 184, 215–217; (2) *Geol. Surv., Canada*, Map 886A.]

LIMESTONE IN THE WEST KOOTENAY AREA†

In the West Kootenay area the principal known limestone occurrences are in the vicinity of the north end of Kootenay Lake, southwest of Salmo, at the south end of Lower Arrow Lake, and at the south end of Christina Lake. The largest and purest deposits are at the north end of Kootenay Lake and near Salmo.

Two large bands of massive limestone, probably correlatives of the Lower Cambrian Badshot limestone, are exposed along the road near Marblehead, 4 miles north of the north end of Kootenay Lake. The first band can be seen in a road cut 0.3 mile north of Marblehead, where medium-grained white and bluish-grey and white striped limestone is exposed for 400 feet along the west side of the road in the cut and in an abandoned quarry. Except for some siliceous streaks, visible impurities are scarce. Canadian Granite and Marble Company, Limited, of Edmonton, quarried marble from the deposit with a channelling-machine. Production was reported intermittently from 1909 to 1936. The limestone is reported (Ref. 1) to be more than 500 feet thick and is of undetermined length. Goudge

† By J. W. McCammon.

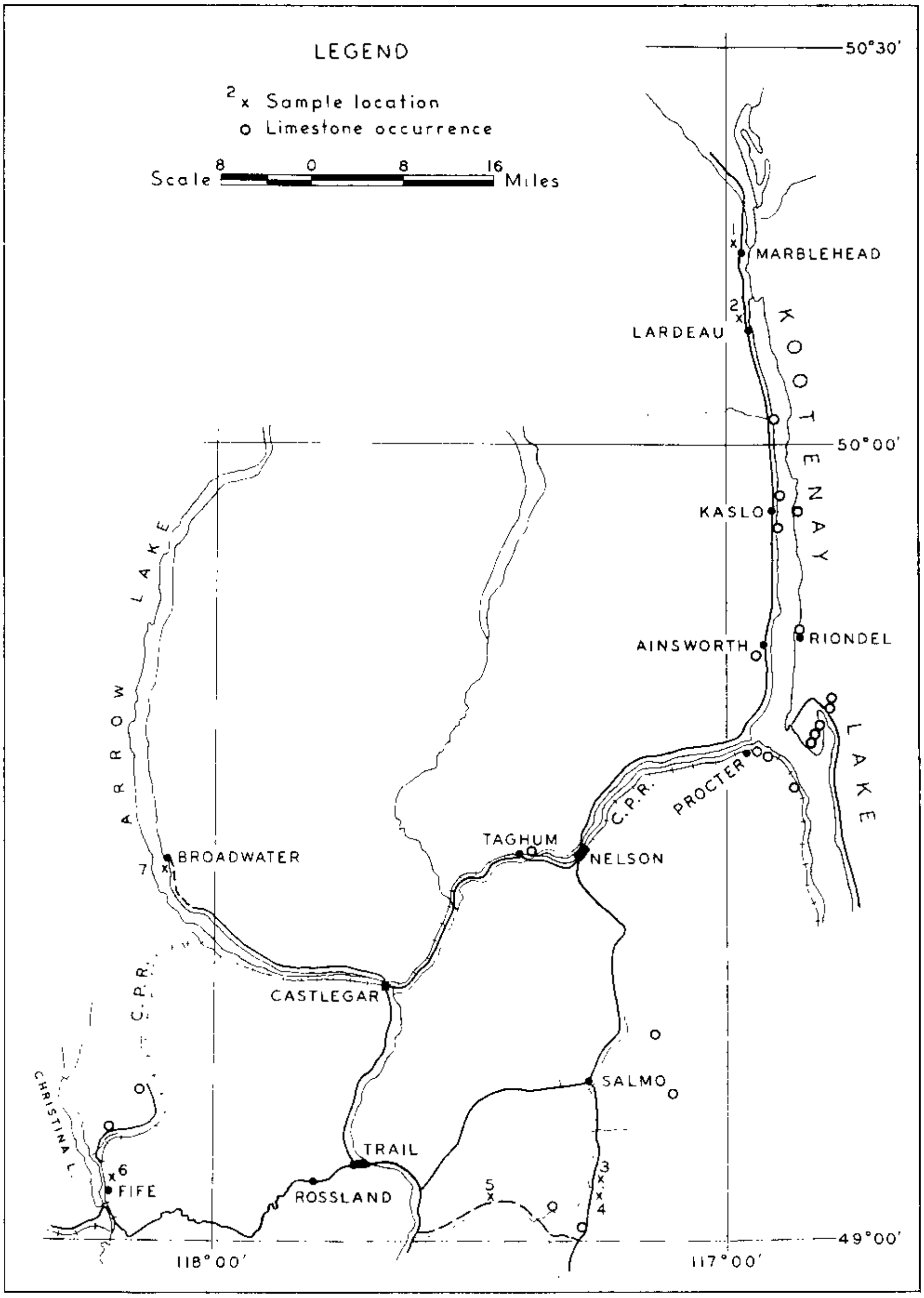


Figure 29. Limestone in the West Kootenay area.

(Ref. 1) published an analysis of a sample taken across 28 feet at the south end of the road cut. It is shown as No. 1 in the table that follows. The remains of an old lime kiln can be seen at the south end of the exposure.

The second band forms a steep bluff along the west side of the road 0.8 mile north of Marblehead. The rock is similar to that in the first band. The company mentioned above cuts marble blocks from within an underground chamber driven into the bluff at road level. Two adjoining openings, one 30 feet and the other 12 feet wide, lead into a single room about 30 feet high, over 100 feet long, and 60 feet wide. The extent of the band of limestone was not determined, but it is known to be large. A sample taken by Goudge that consisted of blue and white medium-grained rock from the upper part of the chamber had the analysis shown as No. 1A in the table.

One mile north of Lardeau is an abandoned quarry that was opened in a high steep face of limestone. The limestone is medium-grained striped grey and white rock with siliceous and argillaceous interbeds. This rock was quarried for flux for the Nelson smelter between 1896 and 1907. The analysis of a sample of the rock taken by Goudge and picked to omit the impure beds is shown as No. 2 in the table.

Limestone occurrences are numerous along the shores of the north end of Kootenay Lake, but they are small, impure, or difficult to quarry. Flux for the Nelson smelter was at one time quarried at the mouth of Schroeder Creek, about 8 miles north of Kaslo. Small quarries operated for short periods on the lake 1¼ miles north and 1 mile south of Kaslo. Marble was quarried from a deposit on the east side of the lake opposite Kaslo, where interbeds of limestone and dolomite occur cut by dykes and veinlets of quartz. Impure siliceous and mineralized limestone occurs in bands near Ainsworth, and similar material but in larger bands is found at Riondel. A sample of the purest part of the band at Riondel taken by Goudge contained 48.7 per cent CaO and 3.9 per cent MgO.

A wide band of siliceous dolomite interbedded with schist extends across the peninsula from Pilot Point to Crawford Bay and continues northward from there. The rocks are cut by quartz veins and dykes. It is unlikely that dolomite could be produced economically from this deposit.

Several bands of limestone and dolomite interbedded with schist and gneiss are exposed along the track southeast of Procter. All are narrow and impure.

Just east of Taghum, a railway stop 6 miles west of Nelson, limestone is exposed for 100 yards along a railway cut. The limestone consists of a 20- to 30-foot-thick layer interbedded with argillite and intruded by granitic rock. The limestone is impure and is altered along the contacts with the igneous rock. The exposure can be traced for a few hundred feet northeastward into the bush. There are three small abandoned quarries in the deposit.

Limestone and dolomite are relatively common in the Salmo area (Ref. 2), but many of the occurrences are not readily accessible. Some limestone for smelter flux has been produced from the Reno, Hunter V, and Double Standard mining properties. Samples were collected from several outcrops now accessible by road. Sample No. 3 was taken along 300 feet in a road cut on the road along the north bank of the South Salmo River at the base of the first rock bluff east of the Salmo–Nelway Highway. Sample No. 4 was taken across 125 feet of beds exposed in a bluff beside the old road 300 feet southeast of the present highway bridge over the South Salmo River. The rock consisted of thin-bedded white and blue limestone with thin siliceous and dolomitic interbeds.

Purex Lime Co. Ltd. (Ref. 3) drilled two holes between 400 and 600 feet deep in a limestone deposit beside the Salmo–Nelway Highway 1½ miles northeast of Nelway. Analyses of the cores showed the deposit consists of interbeds of limy argillite, impure limestone, dolomitic limestone, and some high calcium limestone. It would not appear economically feasible to produce a good grade of limestone from this deposit.

Grey limestone forms a band above the road along the north side of the Pend d'Oreille River starting 5 miles above the mouth of the river and extending for another 5 miles upstream. The band ranges from 400 to 3,000 feet wide and is from 100 to 600 feet above the road. It is readily accessible at several points. Two samples, consisting of chips taken at random over wide areas, were collected for analysis by J. T. Fyles. Sample No. 5 was from the hillside one-quarter mile west of Charbonneau Creek, and sample No. 5A was from the hillside 1 mile west of the same creek.

The Consolidated Mining and Smelting Company of Canada, Limited, has quarried limestone intermittently for more than forty-five years from a deposit at Fife, a Canadian Pacific Railway stop near the south end of Christina Lake. The main limestone band extends for about 2 miles northeastward up the hillside from the lake. It is exposed in a highway road cut beside the lake one-half mile north of Fife cut-off. In the cut the band is 90 feet wide and stands vertically. About a third of a mile farther north a second band of limestone is visible in a low road cut. The rock is highly contorted and sheared. The main band is well exposed in the quarries beside the railway track one-half mile north of Fife. The limestone is medium-grained bluish-grey- to white-striped rock with rusty and siliceous streaks and lenses and some irregular dykes. Fracturing and folding have been intense. Two long-abandoned quarries lie to the west of the track and two recently worked ones lie to the east of the track. The south quarry on the east side of the track is 350 feet long parallel to the strike of the beds, and is 90 feet wide at the face, which is more than 80 feet high. Sample No. 6 was taken across the face at floor-level. About 100 yards of rusty argillite separates this quarry and the one to the north. The quarry on the north, the most recently worked on the property, is 600 feet long, 90 feet wide, and has two benches, the upper with a 30-foot-high face and the lower with a 50-foot-high face. Sample No. 6A was taken across the face of the top bench. About one-quarter mile northeast of the track quarries the limestone was worked by means of glory-holes. The broken rock was removed through an adit driven beneath the glory-holes. An inclined tram was used to move the stone from the portal of the adit to bins on the track 600 feet below.

A few narrow bands of impure limestone are exposed in cuts along the new Trans-Provincial Highway up McRae Creek.

The old WS mine property, which is 400 feet above the highway 9½ miles up McRae Creek, is on limestone. The rock is very impure and does not appear to offer any possibilities of commercial limestone production.

West Kootenay Area Limestone Analyses

Sample No.	Insol.	R_2O_3	Fe_2O_3	MnO	MgO	CaO	P_2O_5	S	Ig. Loss	H_2O
1*	0.36	0.01	0.45	......	4.01	50.83	0.009	0.01	......	......
1A*	0.14	0.03	0.05	......	0.59	55.52	0.08	0.01	......	......
2*	2.40	0.19	0.33	......	3.49	50.34	0.06	0.01	......	......
3	3.28	......	......	......	1.92	52.00	......	......	......	......
4	3.74	0.12	0.09	0.007	2.83	50.40	0.037	Trace	42.79	0.09
5†	0.84	......	......	......	2.36	52.90	......	......	......	......
5A†	8.56	......	......	......	1.83	53.80	......	......	......	......
6	4.64	0.20	0.17	0.02	0.30	52.78	0.016	0.02	41.94	0.02
6A	3.66	0.34	0.29	0.016	0.30	53.21	0.030	*Nil*	42.30	0.07
7	6.62	0.26	0.20	0.045	0.35	51.55	0.016	0.03	41.06	0.13

* By M. F. Goudge.
† By J. T. Fyles.

Limestone is exposed for 500 feet along the shore of Lower Arrow Lake one-half mile south of Broadwater Post Office. The deposit consists of thin-bedded grey and white medium-grained limestone. Interbeds of shaly argillite occur along the south side of the limestone, and porphyry dykes are abundant along the north side. Outcrops can be easily traced for one-quarter mile east up the hillside but then become scarce. Old maps, however, indicate that the beds continue for nearly 5 miles to the crest of the ridge. The remains of an old kiln can still be seen at the edge of the lake. Sample No. 7 was taken across the entire lake-shore exposure, omitting the dyke rock and argillaceous material.

[References: (1) Bureau of Mines, Canada, Publ. No. 811, 1944, pp. 197-198, 206-212; (2) B.C. Dept. of Mines, Bull. No. 41, maps; (3) Minister of Mines, B.C., Ann. Rept., 1955, p. 94.1

Fraser Valley Lime Supplies*

Popkum (49" 121" S.W.). Head office, 905 Edmonds Street. Burnaby. Thomas Mairs, manager. The quarry and crushing plant are on the east side of the Trans-Canada Highway, adjoining the southernmost tip of Indian Reserve No. 1, three-quarters of a mile east of Popkum station on the Canadian National Railway. Limestone is quarried in 25-foot benches by horizontal jackleg-drilled holes. Broken rock is loaded onto trucks by a I-cubic-yard front-end loader and transported to the crushing plant. Agricultural lime and industrial tiller are produced. At the end of 1959 an extension to the crushed-lime storage warehouse, a dry-rock storage building, and a garage were under construction. A crew of seven men was employed. Approximately 7,000 tons of limestone was produced and crushed.

Beale Quarries Division* (Lafarge Cement of North America Ltd.)

Vananda (49" 124° N.W.). Head office, 744 West Hastings Street. Vancouver 1; quarry office, Vananda. Lafarge Cement of North America Ltd., owner; W. D. Webster. superintendent. The plant and quarry arc on the east coast of Texada Island, 1 mile southeast of Vananda. Limestone is quarried in 40-foot-high benches by vertical-hole drilling using a Joy Heavy-weight Champion drill. Secondary drilling is done with jacklegs. Primary blasting is done with a mixture of ammonium nitrate and diesel fuel and secondary blasting is done with 40 per cent forcite. The broken rock is loaded by a 3-cubic-yard Bucyrus shovel onto Euclid 63T trucks and transported to the crushing plant. Primary crushing is done by an Allis-Chalmers 48- by 60-inch jaw crusher. Secondary crushing is done by an Allis-Chalmers 36- by 48-inch secondary jaw crusher and a Pennsylvania impactor.

Screens are used to separate pulp rock 6 to 12 inches in diameter from cement rock three-quarters of an inch in diameter. The rock is transported by conveyors to the plant and to the loading-dock. The limestone is used for pulp rock for paper-mills, agricultural limestone. crushed limestone, and cement rock.

Limestone produced in 1959 was 302,361 tons. Twenty-six men were employed.

Ideal Cement Company Ltd."

Vananda (49° 124° N.W.). British Columbia office, 115.5 West Georgia Street, Vancouver 5; quarry office, Vananda. W. S. Beale, manager, Rock Products Division. The rock quarry is on Lot 25, Texada Island, and is about 2 miles south of Vananda. The crushing plant and loading-dock are at Marble Bay, adjacent to Vananda.

Limestone is quarried in 25-foot benches using an air track for drilling. Blasting is done with a mixture of ammonium nitrate and diesel oil. The broken

* By I. E. Merrett.

rock is loaded onto trucks by a ¾-cubic-yard Marion 372 shovel and transported to the crushing plant. At the plant the rock is crushed and screened into the following sizes: 6-inch to 14-inch, 1½-inch to 6-inch, %-inch to 1½-inch, and —¾-inch. The materials produced were stockpiled in the old Marble Bay quarry or loaded onto barges for shipment. In 1959 the production was approximately 100,000 tons. Nine men were employed.

Imperial Limestone Company Limited*

Vananda (49” 124” N.W.). Office, 7309% East Marginal Way, Seattle 9, Wash.; plant, Vananda. Don McKay, superintendent. The quarry is on the main road, 2 miles southeast of Vananda. During 1959 Imperial Limestone Company Limited purchased the quarry and preparation plant from Don McKay. Limestone is quarried in 25-foot benches by horizontal- and vertical-hole drilling using jacklegs. Blasting is done with 40 per cent forcite. The broken rock is loaded onto trucks with a %-cubic yard gasoline shovel, moved to a primary plant where it is passed through a grizzly, crusher, and screen, and then trucked to the plant at Vananda for further crushing. Select white limestone is sold as stucco dash and whiting. Grey limestone is produced for pulp rock. Six men were employed.

Limestone produced in 1959 included: White, 3,000 tons; blue-grey, 23,853 tons.

Gypsum Lime & Alabastine Limited*

Blubber Bay (49° 124” N.W.). Head office, 50 Maitland Street, Toronto 5, Ont.; British Columbia office, 1105 West Pender Street, Vancouver 1; quarry office, Blubber Bay; lime plants, Blubber Bay and Vancouver. W. M. Tully, British Columbia area manager; Arthur Pitt, Blubber Bay plant manager. In 1959 this company became a division of the Dominion Tar & Chemical Company Limited, at which time the name was changed to that indicated above. The limestone quarry is approximately 2 miles south of Blubber Bay. The quarry is worked in benches with faces 25 feet high. Horizontal and vertical blast-holes are drilled with wagon drills and Gardner-Denver rotary drills.

Broken rock is loaded by diesel shovels onto trucks and taken to the Blubber Bay plant, where the rock is crushed. sized, and stockpiled for direct sale or for use in the lime-burning plants at Blubber Bay and Vancouver.

Products are crushed stone, including sized rock, spalls, and fines or screenings, quicklime (lump, crushed, and pulverized), and hydrated lime.

Stone is supplied to such industries as pulp and paper, cement, smelting, and refining, iron and steel, agriculture, etc.; lime is supplied for building, coal-mining, pulp and paper, chemicals, agriculture, steel, and sugar industries.

The total number employed at Blubber Bay in 1959 was fifty-six, of whom thirteen work in the quarry. In 1959 the production was approximately 270,000 tons.

Koeye Limestone Co. Ltd.*

Koeye River (51° 127° N.W.). P. 0. Christensen, president; A. A. Christensen, secretary-treasurer. This company operates two adjacent quarries on the north side of Koeye River, less than a mile from its mouth on Fitz Hugh Sound, 6 miles south of Namu. Limestone is quarried in 20.foot benches by vertical-hole drilling with a small portable drill. The broken rock is hand-sorted to produce white limestone, hand-loaded onto narrow-gauge cars, and hand-trammed to a scow-loading ramp. The 1959 production was 7,489 tons, which was shipped to the Crown Zellerbach pulp plant at Ocean Falls. A crew of five men was employed.

* BY J. E. Merrett.

Rayonier Canada Limited* — Jeune Landing (50° 127" SW.). Head office, 1111 West Georgia Street, Vancouver 5; quarry office, Port Alice. Lucien Godbout, quarry contractor. There are two adjacent quarries at Quarry Bay, on the east shore of Neroutsos Inlet about 1% miles north of Jeune Landing. Horizontal drilling with a wagon drill is used to mine the quarry bench, which is up to 35 feet in height. The broken rock is tracked to a scow-loading dump and barged to Port Alice, where it is used as pulp rock for the pulp-mill. In 1959 the quarry produced 16,500 tons of limestone.

British Columbia Cement Company Limited† — Head office, 540 Burrard Street, Vancouver 1. Gordon Farrell, president; B. Franklin Cox, vice-president and general manager; R. E. Haskins, general superintendent. Limestone is mined at Cobble Hill (48° 123" N.W.) on Vancouver Island. The quarry is about 80 feet high, and churn drills are used to drill vertical blast-holes which have a 26-foot spacing and burden. Broken rock is loaded by diesel-driven shovels onto 15- and 30-cubic-yard-capacity trucks and transported over 7 miles of private road to the plant at Bamberton. In 1959, 353,670 tons of raw material was mined.

MAGNESITE

Harbour Natural Resources Limited‡ — Perry Creek (49" 115" N.W.). Company office, 811A Seventeenth Avenue S.W., Calgary, Alta.; Reuben Bond, president. This company has done exploration work on a magnesite deposit on t'he Gap 1 and Gap 2 mineral claims, registered in the name of D. A. McIntosh, of Cranbrook. The claims are one-quarter mile west of Antwerp Creek and 1 mile north of the Perry Creek road. They can be reached *via* an abandoned logging-road that branches north off the Perry Creek road 0.9 mile west of the Perry Creek bridge at Old Town. A quarter-mile-long tractor-trail to the workings branches off the west side of the logging-road at a point 1.4 miles north of the Perry Creek road.

The claims are near the south end of a band of magnesite traced by Cairnes (Ref. 1) for 5 miles across the hills between Perry Creek and the St. Mary River directly south of Marysville. On the property, magnesite is exposed on small hummocks and in bulldozer trenches along the bottom of a narrow elongate depression as shown in Figure 30. The magnesite appears to form a bed lying between quartzite to the northwest and a mixture of thin-bedded quartzites and limy argillites to the southeast. The rocks have a northeast strike with an average dip of 65 degrees to the northwest. According to Cairnes (Ref. 1) they lie on the southeasterly overturned east limb of an anticline.

No continuous exposure of the magnesite from one edge to the other was seen, and neither the drill cores nor the logs of the holes drilled the previous season were available to the writer, consequently accurate dimensions of the magnesite body were not obtained, From the data observed it would appear the band of magnesite at the property is at least 8.5 feet thick stratigraphically. For 25 to 40 feet on the west side of the band the rock is coarse grained, with grains to one-quarter inch in diameter. There is then an abrupt change to interbeds of fine-grained magnesite and limy argillite, with the amount of magnesite diminishing to the east until only limy argillite with some quartzite is present. The magnesite band can be traced for 700 feet on the surface, but undoubtedly is much longer. Over-

* By J. E. Merrett.
† By R. B. Bonar.
‡ By J. W. McCammon.

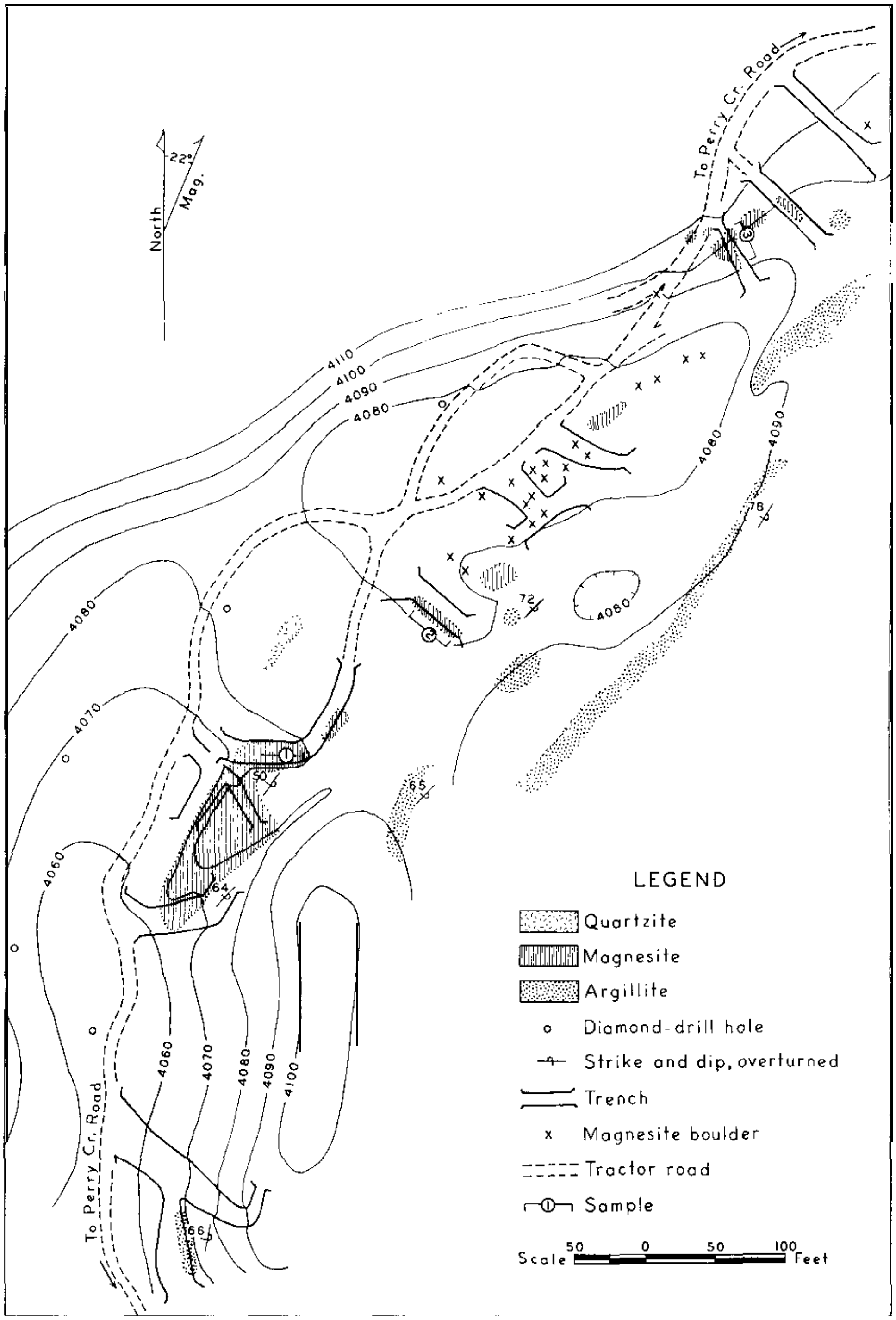


Figure 30. Magnesite at Perry Creek

burden does not appear to be deep, although all the trenches did not expose bedrock. The coarse-grained magnesite is grey to cream coloured and weathers light brown. Some small quartz veins were seen at scattered points. Where the magnesite is sheared, films of talc have formed on the shears. Calcite is scattered through the matrix.

Three channel samples were taken, as shown in Figure 30. They were cut across the cleanest parts of the magnesite exposed in the trenches. Chemical analyses of the samples follow:—

Sample No.	SiO_2	Fe (Total)	CaO	MgO	CO_2
1	5.42	0.89	0.80	45.13	45.92
2	3.52	0.66	9.27	39.03	46.92
3	4.40	0.67	0.70	45.35	48.00

[References: (1) *Geol. Surv.*, Canada, Sum. Rept., 1932, Part A II, pp. 101-104; (2) *Geol. Surv., Canada,* Mem. 207, 1937, pp. 19, 56-58; (3) *Minister of* Mines, B.C., Ann. Rept., 1958, p. 98.]

MARL

Cheam Marl Products Ltd.* Popkum (49° 121° SW.). Office, 13 South Fletcher Street, Chilliwack. A. M. Davidson, manager. This company employs a crew of eight men to excavate marl and the overlying humus from a post-Glacial deposit which has accumulated on the floor of Cheam Lake. At the north end of the lake two draglines are used to excavate the material, which is either trucked wet to the consumer or stockpiled on a large asphalt-coated draining-pad. The wet and semi-dry humus and marl are produced for agricultural purposes.

Popkum Marl Products Limited* Popkum (49° 121° SW.). Office and pit, Popkum. W. A. Munro, managing director. Marl and humus are excavated by draglines from a post-Glacial deposit on the east shore of Cheam Lake. The excavated material is sold locally for agricultural purposes. Four men were employed.

POZZOLAN†

The term " pozzolan " has been defined by the American Society for Testing Materials as " a siliceous or siliceous and aluminous material which itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties."

Various materials, both natural and manufactured, possess the required characteristics and can be used as pozzolans. These include diatomaceous earths; opaline cherts and shales; rhyolitic and dacitic tuffs, ashes, and pumicites; certain clays and shales; fly ash; ground brick and tile; burned oil shale. To develop the required properties, the shales and clays normally need calcination, as sometimes do the other materials.

Pozzolans were used originally by the early Greek and Roman engineers, who observed that their calcined limestone mortar made the best concrete when used

* By I. E. Merrett.
† By J. W. McCammon.

with volcanic ash and tuff aggregates. Later the Romans discovered that ground burned clay products would serve as pozzolans. With the development of natural and portland cement in the last two centuries, the use of pozzolanic cements dropped off. More recently it has been recognized that pozzolans can impart certain desirable properties to portland cement mixes. Among the advantages claimed for pozzolan-portland cement are generally cheaper cost; lowering of heat of hydration; earlier development of maximum rate of heat development; improved workability; increased plasticity; decrease in segregation of the concrete ingredients; decrease in bleeding of water; improved water tightness of the concrete; greater sulphate resistance; improved tensile strength; elimination or retardation of alkali-aggregate reaction.

Pozzolans can be used to replace from 10 to 40 per cent by weight of the portland cement in a concrete mix. If too much or inferior pozzolan is used, certain undesirable effects can be produced in the concrete, including serious retardation of the rate of hardening and of development of compressive strength and elasticity, increased drying shrinkage, reduced resistance to freezing and thawing, and increase in alkali-aggregate reaction.

Pozzolan is sold by itself and also pre-mixed with portland cement.

Accurate figures for pozzolan consumption in America are hard to obtain. One figure found for the United States was an estimation that the pozzolan usage over the last few years has averaged about 2.2 per cent of that for portland cement. The United States Bureau of Mines figures for 1957 show United States production of all types of cement at slightly over 56 million tons, with an average value of $16.91 per ton. If the 2.2-per-cent figure is applied, it can be seen that amount of pozzolan used would be roughly 1¼ million tons. For the same year the Bureau of Mines lists a production of nearly 1 million tons of pozzolan-portland cement valued at $17.50 per ton; this figure, however, includes portland-blast-furnace slag cement. A bid accepted for one large dam included a natural pozzolan to be supplied at two-thirds the price of portland cement. In British Columbia the cement production for 1958 was 409,319 tons, with an average value of $16.67 per ton. It is not known how much pozzolan was used. In 1959 it is reported that about 2,500 tons of Texas pozzolan was imported for use in the Seymour Creek dam.

Recently several deposits of mineral materials in British Columbia have attracted attention as possible sources of pozzolan. During the 1959 field season three of these were examined and samples were collected for testing. The deposits examined were diatomite at Quesnel (see report on p. 156), shale at Port Alberni (see report on p. 180), and volcanic ash at Deadman River (see report on p. 181). Results of tests on the materials carried out by the Provincial Department of Highways Soils Testing Laboratory according to A.S.T.M. Test Designation C402-58T are given below.

Test Results on Pozzolanic Materials

The three samples of materials from Quesnel, Port Alberni, and Deadman River were tested according to A.S.T.M. Designation C402-58T (1957, revised 1958). The chemical analyses were carried out in the Analytical Laboratory of the British Columbia Department of Mines, and the other tests were carried out in the Soils Testing Laboratory of the British Columbia Department of Highways. Sample No. 1 consisted of a composite of the diatomite from Quesnel, sample No. 2 consisted of calcined shale from Rogers Creek near Port Alberni, and sample No. 3 consisted of volcanic ash from Deadman River near Kamloops.

Chemical Analyses

	A.S.T.M. Requirement	No. 1	No. 2	No. 3
$SiO_2+Al_2O_3+Fe_2O_3$	Min. per cent, 70.0	82.60	89.80	84.80
MgO	Max. per cent, 5.0	0.99	3.01	0.49
SO_3	Max. per cent, 3.0	0.40	0.10	0.10
Ignition loss	Max. per cent, 10.0	12.03	0.66	7.25
Moisture content	Max. per cent, 3.0	6.49	0.18	3.23

Physical Tests

Test	A.S.T.M. Requirement	No. 1	No. 2	No. 3
Specific gravity		2.06	2.61	2.44
Fineness; per cent retained when wet sieved on No. 325 sieve	Max., 12	0.10	1.00	1.00
Activity index with cement per cent of control at 28 days	Min., 75	66.20	86	84
Activity index with lime at 7 days	Min., 600 p.s.i.	1,135	570	709
Water requirement per cent of control	Max., 115	124	96	97
Drying shrinkage	Max., 0.03	+.013	—.006	—.008
Autoclave expansion, per cent	Max., 0.5	0.04	0.06	0.06

[References: *A.S.T.M. Designation* C402-58T (issued 1957, revised 1958); *Econ. Geol.*, XLVI, No. 3, 1951, pp. 31 l-327, Natural Pozzolans for Concrete, by R. C. Mielenz, K. T. Greene, and N. C. Schieltz.]

SHALE

Holdfast Natural Resources Ltd.

Port Albemi (49” 124” SW.). This company has been attempting to promote the development of a local shale deposit as a source of pozzolan. The shale outcrops in the valley of Rogers Creek, chiefly on Lots 143, 19, 136, 138, and 155, approximately 2½ miles northeast of the Port Alberni station. The most accessible showings are both up and down stream, immediately adjacent to the culvert where the Port Alberni–Nanaimo Highway crosses the creek.

The shale is the upper member of a series of sedimentary rocks which form a synclinal basin as much as 4% miles wide and 30 miles long, underlying the Alberni Valley. MacKenzie (Ref. 1) correlated the rocks with part of the Upper Cretaceous Nanaimo group of the east coast of Vancouver Island. Tbe Alberni shale has not been proved a correlative of any specific member of the Nanaimo group, but lithologically it is very similar to the Haslam shale formation. No fossils have been found in the shale, but MacKenzie found marine pelecypods in the underlying sandstone, and so it is likely the shales, too, are marine. The sedimentary series was apparently formed from material eroded from the Vancouver group of predominantly volcanic rocks that bounds the sedimentary basin on the east.

The shale is fine-grained dark-grey *to* black carbonaceous rock. It occurs in ½- to 4-inch-thick beds. Material from surface outcrops is very brittle and shatters readily when struck with a hammer. The fracture is markedly conchoidal to spheroidal. Harder layers of medium-grained dark limy sandstone 2 to 6 inches thick occur at 2- to 4-foot intervals through the shale series. The beds are relatively flat lying, with maximum observed dips ranging up to 32 degrees in the area concerned. The beds are, nevertheless, warped into a series of northwest-striking folds, the anticlines apparently plunging to the northwest and the synclines to the southeast. Minor cross-folding and some faulting has also taken place. In the creek bed, outcrops are. nearly continuous through the lots mentioned earlier. In some cases the rocks form vertical cliffs 75 to 100 feet or more high. Few outcrops can be found elsewhere, although the overburden may not be very thick.

When the property was examined in early September, 1959, no evidence of any development work was found.

One sample was collected for testing. This was a channel sample across a 40-foot stratigraphic thickness of shale exposed in a steep bank 150 feet north of the highway crossing. The hard sandstone layers were omitted. The sample was submitted to Dr. B. Levelton, of the British Columbia Research Council, who had it calcined in a rotary kiln at 1,660 to 1,685 degrees Fahrenheit with a 15-minute retention time in the kiln. The sample was then pulverized and submitted for the standard A.S.T.M. tests for pozzolans. The test results are shown in the table on page 180.

This same shale. had been sampled in 1953 and tested for its bloating characteristics. Preliminary tests (Ref. 2) indicated that it bloated well and easily.

[References: (1) *Geol. Surv., Canada,* Sum. Rept., 1922, Pt. A, pp. 51-67; (2) *Minister* of *Mines, B.C.,* Ann. Rept., 1953, p. 188.1

VOLCANIC ASH

Deadman River (51° 120" S.W.). Volcanic ash outcrops for at least 4 miles along the sides of Deadman River valley in the vicinity of Snohoosh Lake. The main showing is at Sherwood (Last Chance) Creek, a tributary that flows into the lake on the east side at a point 27 miles by road north of the Trans.Canada Highway. A good dirt road that extends up Deadman Valley past the deposit to Vidette Lake branches from the highway 4.6 miles west of the Canadian Pacific Railway siding at Savona.

The occurrence has been known for many years. Sporadic attempts have been made to exploit it, the most recent in 1959, when it was investigated as a possible source of pozzolan.

The largest outcrop is at Sherwood Creek. Here ash is exposed in steep bluffs and isolated pinnacles along the north side of the creek valley for half a mile east from the road (see B in Fig. 3 1 j The ash is in flat beds lying between 2,900 and 3,200 feet elevation. The base is not exposed, but the top is overlain by medium-grained dark-green basalt. The lowest exposed ash beds are buff to grey material, a few feet higher is an 8- to lo-foot-thick bed of chalky white ash, next above are 100 feet of buff to yellow beds, overlying these is another 8-foot bed of white ash, and above this again are more mixed buff beds. The white beds consist of uniform, extremely fine-grained ash. The buff beds are variable; most are medium-grained ash, others are quite sandy and contain abundant white quartz grains one-eighth to one-quarter inch in diameter, and still others contain scattered volcanic boulders as large as 2 feet in diameter. Certain beds, more. resistant to weathering than others, project out to form horizontal ridges along the cliff faces.

Half a mile south of Sherwood Creek and about 100 yards east of the road (see A in Fig. 31), ash is exposed for 400 feet parallel to the road along a 50- to 70-foot-high cliff. A light-grey to white band is exposed at the base of the cliff. It is overlain by buff ash.

Two small showings of ash were found between Sherwood Creek and the cliffs at A. The only ash found south of A was 1¼ miles down the road, where a 15-foot-thick layer of thin-bedded pale-buff material is exposed for 200 yards along a road cut.

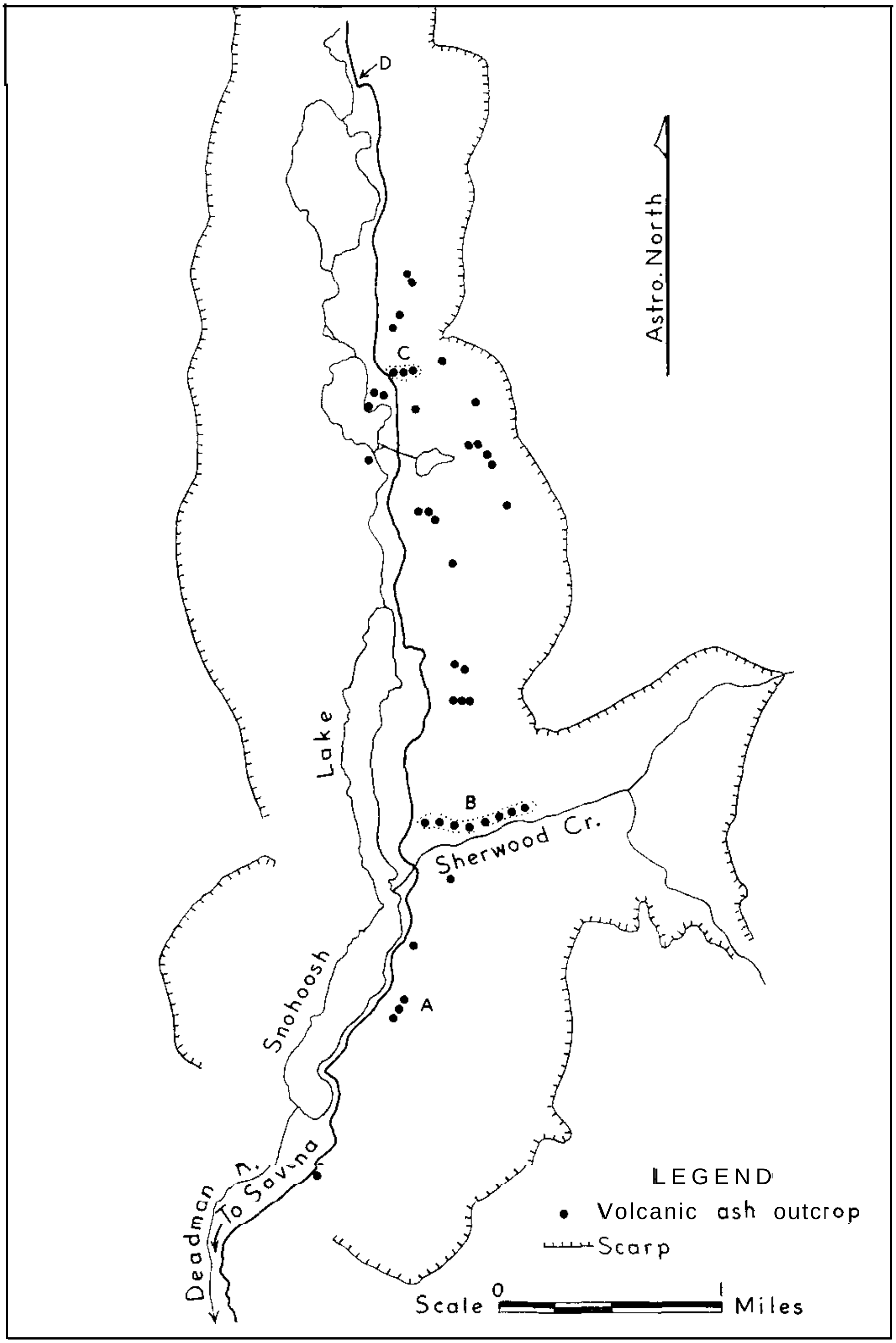


Figure 31. Volcanic ash on Deadman River.

Volcanic ash, Deadman River.

Wonah quartzite, Moberly Mountain.

At the north end of Skookum Lake, 2½ miles north of Sherwood Creek, large bare cliffs of ash can be seen just east of the road (see C in Fig. 31). The exposures arc similar to those at Sherwood Creek, but less white ash is visible. Numerous small scattered ash outcrops can be found in the area between these cliffs and Sherwood Creek.

A few showings of buff ash were found within the first half mile north of the cliffs at C. A mile and a half north of C (see D in Fig. 31) a road cut 750 feet long exposes a bank of earthy material. The lower beds are light grey, and they are overlain by brownish material. Microscopic examination showed the material is mostly diatomite with only minor amounts of ash and silt. Plant stems and leaf impressions are abundant in the beds.

The west side of Deadman Valley was not examined, but scattered light-coloured patches revealed by small slides indicate the presence of ash there.

When the deposit was examined early in June, 1959, little development work had been done. At B a rough tractor-road had been put in for 800 feet along the base of the slope below the west end of the exposure. From this road a shallow trench had been bulldozed northward up the slope *to* the crest of the ridge. It had only reached bedrock at one or two spots near the top where buff ash was exposed. About 100 yards west of the trench another cut, 150 feet long, had been dug horizontally around the end of the ridge. This cut exposed 10 feet of white ash. A third trench bad been cut for 100 feet along the slope 1,000 feet north of the last-mentioned cut. It exposed buff-coloured ash. At C a 300-foot-long bulldozed track had been cut from the road toward the base of the cliffs. No true bedrock was visible in it.

White ash was found only at points A, B, and C. It is very uniform in colour and extremely fine grained. Tests by Cole (Ref. 1) showed 83.6 per cent passed through a 200-mesh screen. Microscopically it is seen to consist essentially of angular fragments of clear volcanic glass, many showing striations and vesicles. An analysis published by Eardley-Wilmot (Ref. 2) gave the following percentage composition: $SiO_2=73.10$, $Al_2O_3=12.46$, $Fe_2O_3=1.74$, CaO=*nil,* $MgO=0.46$, $Na_2O=2.98$, $K_2O=3.46$, H_2O (+105° C.)=1.90, organic matter=3.86.

The buff ash consists mainly of devitrified glass with quartz and feldspar fragments, some moderately well rounded. An analysis (Ref. 2) of this ash showed the following percentage composition: $SiO_2=67.60$, $Al_2O_3=15.84$, $Fe_2O_3=3.16$, $CaO=2.00$, $MgO=3.9$, $Na_2O=0.36$, $K_2O=2.95$, H_2O (+105° C.)=5.00, organic matter=2.42.

To test the pozzolanic reaction of the ash, a sample was cut across 80 feet, stratigraphically above the top white bed at the main outcrop at B on Sherwood Creek. The test results are shown on page 180.

Tests have indicated that the white ash is suitable for cream glazes on ceramic-ware and as an ingredient for certain ceramic bodies.

[References: (1) Mines Branch, *Dept.* of Mines, Canada, Sum. Rept., 1918, p. 161; *(2) Mines Branch, Dept. of Mines, Canada, No. 673,* 1927, pp. 87-89; *(3) Munitions Resources Commission,* Canada, Final Report, 1920, pp. 36-38; (4) *Western Miner and Oil Review, June, 1959,* p. 52.]

PYROPHYLLITE*

Pyro Group

Coalmont (49° 120" N.W.). In 1958 T. Karop recorded four claims, the Pyro Nos. 1 to 4, on a pyrophyllite showing a few miles northwest of Princeton. The pyrophyllite is at 3,500 feet elevation on a side-hill half a mile due east of the Princeton to Coalmont

* By J. W. McCammon.

road at a point 3 miles east of Coalmont. A logging-road that branches north-eastward from the Princeton road 2.4 miles east of Coalmont passes through one of the main exposures.

The pyrophyllite is in an intensely altered zone in rocks mapped by Rice (Ref.) as Upper Triassic Nicola group volcanics. On his map Rice shows a major fault zone passing through this area, and the pyrophyllite deposit is undoubtedly related to it. The deposit consists of rock which has been altered to a mixture of quartz and pyrophyllite with scattered pyrite grains. Some of the pyrite has changed to iron oxide. Outcrops are scarce, and the only good exposures of the pyrophyllite rock are in two areas stripped during a preliminary investigation of the property. One area is 150 feet in diameter. No definite attitude of the rocks could be determined, but a north-south striking colour banding was seen. The central 80 feet of the exposure is light grey to white, and is bordered along both sides by brown-stained zones. The light-coloured rock appears to be mostly quartz, with thin films of very fine-grained powdery pyrophyllite streaked through it on shears and fracture faces. A grab sample from a stockpile in the centre of the stripping contained 80.96 per cent silica, 13.24 per cent alumina, and 0.13 per cent iron. The second stripped area is 400 feet north of the first one. A road between the two areas cuts through pyrophyllite for most of its length. The second area is about 150 feet long and 80 feet wide. A brown zone 30 feet wide borders the west side of the area and the remainder of the exposed rock is fairly light coloured. The pyrophyllite zone could be traced for 300 feet south of the south stripping, but no showings of it could be found north of the north stripping nor east or west of the strippings. Apparently one small trial shipment of pyrophyllite was made from the deposit.

[Reference: *Geol. Surv.*, Canada, Map 888.4, Princeton, 1947.1

SAND AND GRAVEL*

PRINCE GEORGE

Northwest Paving Company Limited† Office, 201 Victoria Street, Prince George. This pit is situated in Central Fort George in Parcel Y, Lot 2507, Plan 833. Gravel is excavated from a 20-foot bank with a Bucyrus-Erie ¾-yard shovel and fed into a portable crushing and screening plant. Three men were employed.

Central Sand and Gravel Company Limited† Office and plant, North Nechako, Prince George. Robert Kropp, manager. This company operates a sand and gravel pit on the north side of the Nechako River. Gravel is mined from a 25-foot face by a Scoopmobile mobile loader with a 1 ¼-yard bucket. This machine loads the gravel into a screening and washing plant. A read-mix plant is operated in conjunction with the pit. Gravel products and ready-mix is sold locally. A crew of twelve was employed, including truck-drivers (four men were employed in the pit and plant).

CRESTON

Louis Salvador and Son.*—This company operates a gravel crushing, screening, and washing plant on Goat River, south of Creston. Material is taken from the gravel bars along the river bank and hauled to the plant. The sand and gravel is used mainly in the local construction industry.

* BY J. E. Merrett, except as noted.
† By A. R. C. James.

WYNNDEL

Merriam and Peskor.*—F. Merriam, owner and operator. This pit is alongside Creston–Kootenay Bay Highway, 4% miles north of Wynndel. There is a crushing and screening unit at the pit. A tar-mixing plant uses some of the production.

Scaman's Gravel Pit.*-George Scaman, Creston, owner and operator. This pit is 1 mile north of Wynndel on the Duck Creek road. A small yardage of road gravel was excavated by a front-end loader.

NELSON

Premier Sand and Gravel Company Limited.*-Albert Shrieves, president and manager; D. Norcross, superintendent. This property is located above the Fairview district of the City of Nelson, in the vicinity of Anderson Creek. Gravel is excavated by dragline and hauled to a crushing and screening unit. The sized material is stockpiled and used mainly by Nelson Ready-Mix Concrete Ltd. concrete plant. Production in 1959 was 30,786 cubic yards. Five men were employed.

SALMO

Feeney Pit.* -Associated Enterprises Limited, of Salmo, have a portable screening plant at this pit, 5 miles south of Salmo on the Salmo-Nelway Highway. Sized material was trucked to the cement-tile manufacturing plant of Valley Concrete Limited, located 1 mile west of Salmo on the main highway to Trail.

TRAIL

Ferraro Gravel Pit.*-This pit, owned by Korpack Cement Products Limited, of Trail, is located between Casino Road and the Columbia River, 2 miles south of Trail. Gravel excavated from low benches is loaded directly into a portable crushing and screening plant. A crew of three men was employed.

McGauley Gravel Pit.*-This pit is owned and operated by McGauley Ready-Mix Concrete Company: J. McGauley, manager. The pit is located on the bank of the Columbia River, 1 mile south of Trail on the Casino Road. The gravel is scraped directly to the crushing unit. where it is screened, washed, and sized. An interesting feature of the plant is the secondary crushing unit-a cable-suspended overhead-driven gyratory crusher. Fines from the washing circuit are collected and will be checked for gold content. All production is hauled to the ready-mix plant.

NORTH AND WEST VANCOUVER

Capilano Crushing Co. Ltd.—C. W. Bridge, general manager. This company operates two crushing and washing plants-plant No. 1 at 606 Marine Drive, West Vancouver, and plant No. 2 at 33 East First Avenue, Vancouver. Gravel is mined by dragline dredging of the foreshore near the mouth of the Capilano River. Two diesel-driven draglines are used to excavate the gravel. One dragline, being self-mobile, loads into trucks on the spit at the river mouth. The gravel is then trucked to plant No. 1. The other dragline, being on a barge, loads onto barges for plant No. 2. In 1959 the production from No. 1 plant was 104,100 tons and from No. 2 plant, 554,486 tons.

* By J. D. McDonald.

Routledge Gravel Ltd.

Office, Capilano Post Office. T. C. Routledge, president. This company has two foreshore gravel-recovery plants on the north shore of Burrard Inlet. Plant No. 1 is on the Indian reservation at the lower end of Lower Capilano Road in the Municipality of West Vancouver. Plant No. 2 is at the mouth of Lynn Creek at the lower end of Brooksbank Avenue, North Vancouver. In both operations, gravel is scraped by 7-cubic-yard scrapers from underwater deposits, then washed, crushed, and screened. The production in 1959 was 80,000 cubic yards of run-of-pit and 170,000 cubic yards of screened and crushed material. Thirty-two persons were employed.

Highland Sand and Gravel Company Limited

Company office, Lynnmour. W. J. Barrett-Leonard, president and general manager; D. F. Spankie, director; plant, East Keith Road, west of Seymour Creek. Gravel is excavated from low faces by a %-cubic-yard diesel-driven shovel and is trucked to the adjacent plant for crushing, washing, and screening. Locally purchased gravel was also processed at the plant. Some of the processed products were used in the adjacent cement-tile and black-top plants. A crew of ten men was employed. Another plant was operated at Langley.

During 1959, 104,146 cubic yards of material was handled by this plant, which involved the following products: Crushed rock, 18,979 cubic yards; sand and gravel, 13,220 cubic yards; crushed road mulch, 61,962 cubic yards; bank-run till, 9,985 cubic yards.

Deeks-McBride Ltd.

Company office, 1051 Main Street, Vancouver 4. George B. McKeen, president; H. W. Rhodes, vice-president, production and development: J. C. Mills, vice-president, sales and administrator. This company operated a pit near the mouth of Seymour Creek, where gravel is scraped from the harbour or obtained from a pit immediately north of the plant. The gravel is washed, crushed, and screened, then sold directly or used in the ready-mix concrete plant erected at the site. In 1959, 297,000 cubic yards of gravel was produced. A crew of twelve men was employed. (See also under Coquitlam District Municipality.)

E. R. Taylor Construction Co. Ltd.—This company, using a diesel shovel and trucks, removed 71,000 cubic yards of gravel from a pit east of Seymour Creek pipe-line road, 1 mile north of the Deep Cove Highway.

Burnaby District Municipality

Corporation of the Municipality of Burnaby.—A. Evans, works and yard engineer. The Stride Avenue pit at the southeast corner of Fourteenth Avenue and Twentieth Street was operated by G.M. and H. Construction Company Limited for the Municipality of Burnaby. Gravel is excavated from pit faces 100 feet high using a diesel shovel and trucks. Prior to the end of the year this pit closed.

City of Port Moody

City of Port Moody.—W. Fast, city engineer. The City of Port Moody operated a small sand pit one block south of the junction of Barnet Road and St. John Street. A shovel-loader and trucks were used to remove sand for fill purposes.

Coquitlam District Municipality

Corporation of the District of Coquitlam.—The Corporation of the District of Coquitlam operated a high-walled pit on the west side of the south end of

Schoolhouse Road. The material extracted was used for fill purposes. A second pit has been established recently near the junction of Laurentian and Austin Roads. A screening plant and a black-top plant were installed in this pit.

Burquitlam Sand & Gravel Co. Ltd.—A. J. Percy, manager. Fill and unscreened gravel are being removed by front-end loader and trucks from a pit at the southeast corner of North Road and the Lougheed Highway. Approximately 37,000 cubic yards of gravel was produced from this pit. An additional 10,000 cubic yards of crushed ungraded gravel was obtained from a pit immediately east of McLellan farm on the north municipal boundary and adjacent to Pitt River.

T. B. Allard and Son.-T. B. Allard, manager. Fill gravel was removed by gas shovel and trucks from a pit on Schoolhouse Road, Maillardville, immediately opposite a municipal pit.

Scott Bros. Gravel Co. Ltd.—Office, Port Coquitlam. George Scott, manager. This company, employing a crew of nine men, worked three gravel pits and two screening plants. The Lucas pit, one-half mile west of the Deeks-McBride pit on Pipe-line Road, produced 95,410 cubic yards of gravel fill material, the major portion of which was used for road fill on the north approach to the proposed Port Mann bridge. The Jacob pit and washing and screening plant on the east side of Coquitlam River produced 101,259 cubic yards of screened gravel. Part of this gravel was obtained from the bed of the river and the remainder from the Jacob pit, adjacent to the screening plant. This company acquired the Burquitlam Sand & Gravel company pit west of the McLellan farm on Pitt River Road. A crushing and screening plant was established on Widgeon Slough, the barge shipping point. A total of 20,500, cubic yards of gravel was produced by Scott Bros. from this pit.

Deekr-McBride Ltd.—Company office, 1051 Main Street, Vancouver 4. George B. McKeen, president; H. W. Rhodes, vice-president, production and development; J. C. Mills, vice-president, sales and administration. This company operated a gravel pit and washing, screening, and ready-mix concrete plant on Pipe-line Road, 1 mile north of the Lougheed Highway. Gravel is excavated with a l-cubic-yard-capacity electrically operated dragline and transported by conveyor-belt to a jaw crusher and to the washing and screening plant. In 1959, 247,155 cubic yards of gravel was produced for direct sale or for use in the adjoining concrete ready-mix plant. A crew of twenty-seven men was employed. Columbia Bitulithic Limited, operating a paving-producing plant within this pit, produced 45,000 tons of asphalt paving and employed a crew of five men. (See also under North and West Vancouver.)

Independent Ventures Limited—2065 Coquitlam Avenue, Port Coquitlam. E. Warren, superintendent. G. H. Phillips Contracting Co. Ltd., contractor. An intermittent production of fill material was excavated by a crew of four men working in a pit one-half mile northwest of the Deeks-McBride washing plant. A diesel-driven shovel and trucks were used to remove the gravel.

Riverside Sand &Gravel Co. Ltd.-R.R. 1, Hockaday Street, Port Coquitlam. Harold Curle, manager. C. D. Slack, North Bumaby, contractor. A crew of four men was employed clearing timber and preparing a new gravel pit on Pipe-line Road, 2% miles north of the Lougheed Highway.

Pipe Line Sand & Gravel Ltd.

E. R. Taylor Construction Company, Deep Cove Highway, operated on a royalty basis the Pipe Line Sand & Gravel Ltd. pit on Pipe-line Road, approximately 2% miles north of the Lougheed Highway. A crushing and screening plant was used to process the gravel. A crew of twelve men was employed and 72,834 cubic yards of gravel was produced.

S. & S. Sand & Gravel Limited

Company office, 1101 Eighth Avenue, New Westminster. N. P. Stromgren and C. B. Scott, owners. This pit and washing and screening plant are on Pipe-line Road, 3¼ miles north of Lougheed Highway. Gravel is caved from high banks, loaded by diesel shovel or overhead loader, sold as run-of-pit material, or taken to the processing plant. A crew of five men produced 75,049 cubic yards of processed materials in 1959.

Jack Cewe Blacktop Ltd.

Company office, 309 Cedar Street, New Westminster. Jack Cewe, manager. This pit and asphalt-mixing plant are on Pipe-line Road 3% miles north of Lougheed Highway. Gravel is excavated by a l-cubic-yard-capacity diesel-driven shovel and trucked to the adjacent mixing plant. A crew of eight men was employed. In 1959, 100,000 tons of asphalt mix was produced.

PORT COQUITLAM

Gilley Bros. Limited (Maryhill Division)

Company office, 902 Columbia Street, New Westminster. J. H. Gilley, general manager; James C. Gilley, production supervisor; E. Johnston, superintendent. This company is a subsidiary of Evans, Coleman & Evans Limited. Two pits and a processing plant are adjacent to the Fraser River at Mary Hill, 2 miles south of Port Coquitlam. Sand and gravel are mined from 30-foot faces by a 2½-cubic-yard diesel-driven shovel and trucked by 12-cubic-yard trucks to a crushing plant. The gravel is washed, screened, and transported by scows to markets. Thirty-five men were employed. Production for 1959 was 550,000 cubic yards.

PITT MEADOWS DISTRICT MUNICIPALITY

Haney Brick and Tile Ltd.--Company office, 846 Howe Street, Vancouver 1; plant, Haney. E. G. Baynes, president; J. Hadgkiss, managing director. This company owns a sand pit approximately 1 mile northwest of Port Hammond. An overhead loader is used to excavate the sand for fill purposes.

MAPLE RIDGE DISTRICT MUNICIPALITY

Corporation of the District of Maple Ridge.-A municipal gravel pit is operated on the southwest slope of Grant Hill, 1 mile east of Albion. Fill material is produced. Columbia Bitulithic Limited produced 7,000 tons of asphalt mix from a plant established in the pit.

McIntosh Sand and Gravel.-A. McIntosh, manager, P.O. Box 245, Haney. Approximately one-quarter mile north of the municipal pit is a pit operated by A. McIntosh. Three men were employed producing screened or run-of-pit gravel.

Van Boyen Pit.-Henry Van Boyen, of Haney, using a bulldozer, excavated a small amount of fill material from a pit immediately north of the McIntosh pit.

Hammond Pioneer Sand and Gravel Company.-Fred Worfolk, Westfield Street, Port Hammond, manager. A small pit, 1 mile north of the municipal pit, was operated intermittently to produce fill gravel. The gravel was excavated by a ½ -cubic-yard shovel and a bulldozer.

Kirkpatrick Sand and Gravel Co. Ltd.

Wm. Kirkpatrick, P.O. Box 188, Haney, manager. A large gravel pit and crushing and washing plant were operated by a crew of three men at the east end of No. 27 Road and adjacent to the Alouette River. Gravel is excavated with a front-end loader and ½-cubic-yard gasoline-driven shovel, loaded onto trucks and sold as run-of-pit fill material or delivered to the washing plant.

R. E. George.-R. E. George, of Whonock, using a front-end loader, removed a small amount of clean gravel from a pit on the north side of Lougheed Highway 1 mile east of the Whonock water-tank.

Mission District Municipality

Corporation of the District of Mission.-This municipality operated a large pit and screening plant 1 mile east of the Stave River power-house and a smaller pit and screening plant on Shaw Road. 3½ miles east of Stave River power-house.

Department of Highways.-This Department operated a small pit having a 15-foot face of sandy gravel on the west side of Dewdney Road. I .8 miles south of Steelhead.

Indian Mission.—Lassier Trucking and Contracting Co. Ltd., of Pitt Meadows, employing a crew of two men, stripped and removed a small amount of gravel from a pit on the Roman Catholic Indian Mission School property, 2 miles east of Mission City.

Dewdney

Catermole Construction Co.-Gravel was removed at low water from a Fraser River bar south of the west end of Nicomen Island. The gravel was transported by scow to the company ready-mix plant at the east end of Hjorth Road in surrey.

Department of Highways.-A large gravel pit was operated intermittently by the Department of Highways at the west side of Indian Reserve No. 8, 2 miles west of Squakum on the Mission-Agassiz Highway.

Kent District Municipality

Corporation of the District of Kent.-This municipality operated a rock quarry and large gravel pit at the west end of Cemetery Road, immediately south of Mount Agassiz, 4 miles by road from the village of Agassiz. Columbia Bitulithic Limited produced 13,000 tons of asphalt mix at this pit.

Yale

Yale Pit.-R. J. G. Richards, of West Vancouver, owns a large pit of fill-grade gravel on the Schoolhouse Road, one-quarter mile north of the village of Yale. Production in 1959 was small.

Department of Highways.-This Department operated two pits on the west side of the Hope-Yale Highway at points half a mile and 3% miles south of Yale.

Highway Construction Co. Ltd.-Angular gravel was obtained from a large pit on No. 1 Highway, 2.2 miles south of Yale.

Canadian National Railway.-Gravel was excavated by diesel shovel from a large pit on the railway right-of-way on the east side of the Fraser River 3 miles south of Yale.

HOPE

Hope Cement Works.-A small amount of sand was removed from a pit adjacent to the Hope Cement Works plant, on the south side of the Hope-Princeton Highway one-half mile east of its junction with Highway No. 1. The sand was used to manufacture cement blocks, tiles, and ornamental pieces.

Corporation of the Village of Hope.-The Village of Hope operated a sand pit on the south side of the Hope–Princeton Highway one-half mile east of its junction with Highway No. 1. Gravel fill was excavated by a front-end loader. Columbia Bitulithic Limited produced 3,500 tons of asphalt mix in this pit.

Department of Highways.-This Department operated a small pit with a 20-foot face in angular gravel on the west side of Highway No. 1, 12 miles north of Hope. A sand pit was operated on the east side of Highway No. 1 on Indian Reserve No. 2 at Haig station on the Canadian Pacific Railway.

A large pit for fill material was operated on the east side of Highway No. 1, 2 miles northeast of Laidlaw.

CHILLIWHACK DISTRICT MUNICIPALITY

W. C. **Arnot &** Company Limited.-A large pit to supply highway fill and a screening plant were operated at the south end of the Rosedale-Agassiz Bridge on Indian Reserve No. 1 adjacent to Chilliwhack Municipality by this company during 1959.

Greyell Slough.—J. Janzen, of Chilliwack, installed a screening plant at and excavated gravel from Greyell Slough on the north side of Windermere Island, 3% miles north of Rosedale.

Minto Landing

At low-water-level period, gravel was excavated from Fraser River bars at Minto Landing, 2 miles north of Chilliwack. The gravel was stockpiled on higher ground. Among those Chilliwack suppliers who worked this area were W. Ballam, employing one man using a front-end loader and truck; J. Emms, employing a front-end loader and truck; P. Marks, employing a bulldozer and truck; W. J. Quinlan, employing a man using a diesel shovel and truck.

The Corporation of the Township of Chilliwhack.-This municipality operated a large pit and screening plant one-half mile west of the R.C.E. School of Military Engineering at Vedder Crossing. Another pit producing washed gravel was operated on Chilliwack Creek half a mile north of the Trans.Canada Highway and 2 miles southwest of the City of Chilliwack. Gravel was recovered from the creek-bed by using a dragline.

B. and **G. Sand and Gravel Ltd.**-A. K. Gregory, 8641 Elm Drive, **Chilliwack,** manager. Gravel was removed by dragline from the bed of Chilliwack Creek, at a point 1% miles north of the Tram-Canada Highway, 2 miles southwest of Chilliwack. The gravel was processed in a **screening** plant and sold for construction purposes. A crew of three men was employed.

CULTUS LAKE

Columbia Bitulithic Limited.—Company office, Granville Island, Vancouver. This company reported having manufactured 20,000 tons of asphalt mix at a gravel pit at Cultus Lake.

SUMAS DISTRICT MUNICIPALITY AND SUMAS MOUNTAIN

Department of Highways.—The Department of Highways operated a large fill pit on the northeast slope of Sumas Peak. The material excavated was a mixture of clay and coarse angular granite fragments. It was used for dyke and road-construction fill.

Quadling Pit.—A large fill pit from which a mixture of clay and granite fragments is obtained for dyke and road-fill purposes is on the farm of H. Quadling, at the foot of and immediately east of Taggart Peak on Sumas Mountain. In 1959 some fill material was removed by diesel shovel and trucks.

Huntingdon Pit (Blackham's Construction Limited).—Company office, Abbotsford. A. Blackham, manager. This pit and screening plant is immediately west of the village of Huntingdon. Gravel was scraped from a high-walled pit to a screening plant to produce screened material for concrete or fill purposes. Production: 23,675 cubic yards.

The Corporation of the District of Sumas.—Gravel fill was obtained from a large high-walled pit one-half mile east of Abbotsford. A larger pit was operated on Vye Road (Eighth Avenue) 1 mile north of Huntingdon. Columbia Bitulithic Limited produced 25,000 tons of asphalt mix from a plant in this pit.

MATSQUI DISTRICT MUNICIPALITY

Blackham's Construction Limited.—Company office, Abbotsford. A. Blackham, manager. A new pit was commenced and a screening plant installed south of the microwave tower road, 1 mile east of Abbotsford. A crew of two men was employed. Production: 9,974 cubic yards.

Corporation of the District of Matsqui.—This municipality operated three gravel pits at various locations in the district. The largest operation was on Lefevre Road, 1½ miles north of the Canadian boundary. A screening plant was established in this pit. Another pit where only a small amount of gravel was removed is on Ross Road, three-quarters of a mile south of the Tram-Canada Highway. A third pit where only a small amount of gravel was removed is in Clearbrook, adjacent to the Municipal Works Yard at the corner of Tretheway Road (Three Hundred and Twenty-fourth Street) and the Tram-Canada Highway.

Department of Highways.—This Department operated three gravel pits at various locations in the district. One small pit on Immel Road, 1 mile east of Abbotsford, produced fill material. Approximately three-quarters of a mile north of the Trans-Canada Highway at Clearbrook, two adjoining pits in good-quality gravel were operated on the extension of Tretheway Road.

Dueck Ready Mix Ltd.—Company office, 12811 Eightieth Avenue, R.R. 6, North Surrey. This company, a subsidiary of Deeks-McBride Ltd., operated a portable screening plant and a ready-mix concrete plant on Tretheway Road one-half mile north of the Trans-Canada Highway. A crew of seven me" was employed and 9,566 cubic yards of ready-mix concrete was produced.

Valley Ready-Mix Ltd.-R. M. Vosburgh, Haney, manager. This company opened a small pit and screening and bulk concrete-mixing plant on the west side of the Mission Road immediately north of Abbotsford. Production: 1,681 cubic yards of concrete.

Abbotsford Gravel Sales

Box 836, Abbotsford. Trevor Charles, manager. This company operated a gravel pit and screening plant on the east side of Clearbrook Road, one-half mile north of the Canadian border. A gasoline shovel, front-end loader, and truck were used to remove the gravel for run-of-pit fill or for concrete mixing. A crew of three me" was employed. Production: 36,696 cubic yards. Totem Trucking Ltd., of Abbotsford, operated a" adjoining concrete-mixing plant which produced 13,170 cubic yards of concrete.

Nicholson Gravel Sales Ltd.-D. G. Nicholson, Mount Lehman, manager. A small amount of gravel was removed from a pit immediately east of the junction of Forty-eighth Avenue and Mount Lehman Road. A front-end loader was used to excavate the gravel.

LANGLEY DISTRICT MUNICIPALITY

corporation of the Township of Langley

This municipality operated several gravel pits at various locations. These operations included a pit of good-quality gravel with a lo-foot face above the water-table at the northwest corner of Eighth Avenue and Jackman (Two Hundred and Seventy-second) Road; a shallow pit in conjunction with a Department of Highways pit at the south end of Sturmer (Two Hundred and Fifty-second) Road, one-half mile south of the Trans-Canada Highway; a pit in conjunction with another Department of Highways pit at the northeast corner of Dogwood (Fiftieth) Avenue and Brown (Two hundred and Forty-eighth) Road; a shallow pit of 6-foot depth above the water-table in good-quality gravel on Gray Road (Eighty-fourth Avenue) a quarter mile west of County Lie (Two Hundred and Sixty-fourth) Road; a large pit on Campbell River northwest of the junction of Wix (Twenty-fourth) and Carvolth Roads; and a large pit and screening plant at the north end of Kinch (Two Hundred and Fifth) Street, north of Bell (Thirty-sixth) Avenue.

Department of Highways

This Department operated three pits in the Langley Municipality. A shallow pit was operated adjoining a municipal pit at the south end of Sturmer (Two Hundred and Fifty-second) Road, one-half mile south of the Trans-Canada Highway. At the northwest corner of Dogwood (Fiftieth) Avenue and Brow" (Two Hundred and Forty-eighth) Road, a pit was operated adjacent to a municipal pit. A large shallow pit was operated astride Anderson Creek, one-half mile east of Carvolth Road at Thirty-fifth Avenue.

Foster's Gravel Pit.—C. N. Foster, 782 Jackman Road, owner. This pit is on the south side of Eighth Avenue adjacent to the Matsqui District boundary, about 3 miles south of Aldergrove. Gravel is mined from low faces by a front-end loader and sold locally as pit-run gravel. Production: 3,800 cubic yards.

Dupont Bros.—L. Dupont, Eighth Avenue, Aldergrove. A screening plant was installed at this pit on the north side of Eighth Avenue immediately west of the Matsqui District boundary. A front-end loader was used to remove gravel from low pit faces.

Craig's Pit.-J. Craig, Jackman Road, Aldergrove, owner. A small production of good-grade gravel was made, using a front-end loader in a small pit on the east side of Jackman Road one-quarter mile north of Eighth Avenue.

O'Malenick's Pit. — S. O'Malenick, Jackman Road, Aldergrove, owner. A small production of good-grade gravel was made, using a front-end loader in a small pit having two IO-foot benches above ground water-level, northeast of the junction of Eighth Avenue and Jackman Road.

Kitsul Bros.—Company office, 24306 Trans.Canada Highway, R.R. 3, Langley. This pit adjoins on the east the municipal and Department of Highways pits on Dogwood (Fiftieth) Avenue and Brown Road. A band of fine gravel, 12 to 20 feet in thickness, overlies a sand bed. Gravel was removed by front-end loader. Production: 17,448 cubic yards.

Millers Trucking.-Company office, 22383 Wilson Townline Road, R.R. 5, Langley. A front-end loader was used to remove gravel from the McLellan pit at the southeast corner of River Road (Eighty-eighth Avenue) and (Two Hundred and Sixtieth Street and from a small new pit 100 yards northwest of the corner of Gray (Eighty-fourth Avenue) and Coghlan (Two Hundred and Fifty-sixth) Roads.

Clark Sand and Gravel.-H. G. Clark, 9785 Two Hundred and First Street, R.R. 4, Langley, owner. Pit, Hudson Bay Avenue, Fort Langley. Approximately 5,000 cubic yards of run-of-pit and screened gravel was produced.

Hornby General Machinery Company.-Office, Cloverdale; pit, southeast corner of Bradshaw and Berry Roads. Harry Hornby, owner. Run-of-pit and screened gravel was produced from the Langley Rod and Gun Club pit by a crew of three men. In excess of 10,000 cubic yards of gravel was produced.

Fox Pit.-D. H. Fox, 3520 Carvolth Road, owner. A small amount of gravel was produced from this pit east of Carvolth Road at Thirty-fifth Avenue.

Sleep Pit.-J. W. Sleep, owner. A small amount of gravel was produced from a newly opened pit 100 yards east of the junction of Thirty-second Avenue and Berry Road.

Highland Sand and Gravel Company Limited

Company office, Lynnmour; plant, 2962 Lambert Road, Langley. W. J. Barrett-Leonard. president and general manager; J. C. Rees, plant manager. Another pit and plant is operated at Lynnmour. Gravel is excavated from low gravel faces by shovel and trucked to a plant where it is crushed, washed, and screened. Six men were employed. During 1959, 66,289 cubic yards of processed materials was produced. This included 2,865 cubic yards of crushed rock, 44,942 cubic yards of sand and gravel, 2,798 cubic yards of crushed road mulch, and 15,538 cubic yards of bank-run fill.

Border Sand and Gravel Company.-Office and plant, Boundary Road, R.R. 4, White Rock. T. Lapierre, manager. Gravel is dug from low faces by an overhead loader and transported to a washing and screening plant. A new washing and screening plant was being erected at the pit at the southwest corner of the municipality. Three men were employed.

SURREY DISTRICT MUNICIPALITY

Corporation of the District of Surrey.—Several pits are operated at various locations in this municipality. Among these is a large pit with a crushing, screening, and paving-mix plant at the west end of Fifty-fifth Avenue, adjacent to the Delta municipal boundary. Another large pit, from which fill material was obtained, is immediately east of S.U.B. Quarries pit 1 mile south of Port Mann. Fill material is obtained also from a shallow pit on Twenty-second Avenue one-quarter mile west of Coast Meridian Road.

Department of Highways.-This Department operated a small pit on One Hundred and Forty-eighth Street one-quarter mile south of McLellan Road.

Elderkin's Excavating Ltd.-Office, 1591 Stride Avenue, Burnaby; pit, north end of One Hundred and Forty-fourth Street, 1 mile south of Port Mann. Lawrence Elderkin, manager. Run-of-pit gravel was excavated by gasoline shovel from high pit faces, and 89,579 cubic yards of gravel was produced.

S.U.B. Quarries Ltd.-Office, 611 No. 3 Road, Brighouse; pit and plant adjoining to the east the pit of Elderkin's Excavating Ltd. Ivan Eivenmark, pit superintendent. This pit was operated by Whalley Construction Co. Ltd.

Mutual Sand and Gravel Ltd.-Office and pit, 15945 One Hundred and Twelfth Avenue, North Surrey. R. H. Cripps, manager. A crushing, washing, and screening plant was installed at this recently opened pit at the northwest corner of Pike Road and One Hundred and Twelfth Avenue. Seven men were employed. The adjacent Anglo Canadian Cement ready-mix plant used the major portion of the sand and gravel produced.

Anglo Canadian Cement Ltd.—Office, 1865 Stewart Street, Vancouver 6; plant 15945 One Hundred and Twelfth Avenue, North Surrey. William Ralston, manager. The major portion of the sand and gravel produced by Mutual Sand and Gravel Ltd. was used to manufacture 2,684 cubic yards of ready-mix concrete. A crew of eight men was employed.

United Sand & Gravel Ltd.-This property is operated by Steeves and Mann Equipment Ltd., 990 Wildwood Lane, West Vancouver; pit, east of Pike (One Hundred and Sixtieth) Street at One Hundred and Twelfth Avenue. Two men, a gasoline shovel, and a front-end loader were employed to excavate 14,111 cubic yards of run-of-pit gravel.

C&brook Sand & Gravel Company Limited.-Office and plant, 12311 Fifty-third Avenue, R.R. 1, Cloverdale. F. Bray, president and general manager. Two men, using an overhead loader and trucks, produced 21,000 cubic yards of run-of-pit and sized gravel from a semi-portable washing plant in a pit off Fifty-third Avenue adjacent to the Delta municipal boundary and the Surrey municipal pit, at the west end of Fifty-fifth Avenue.

Armstrong Pit.-Owner, W. Armstrong, 16594 Sunnyside Road, White Rock. A small production was made from a shallow pit on the owner's property.

Dueck Ready Mix Ltd.—Company office, 12811 Eightieth Avenue, R.R. 6, North Surrey. This company, a subsidiary of Decks-McBride Ltd., operated two screening and concrete-mixing plants in Surrey. The plant at the above address produced 13,481 cubic yards of ready-mix concrete while 5,557 cubic yards of concrete was produced from gravel obtained from a pit southeast of the corner of Larsen and Latimer Roads, 4% miles southwest of Langley.

Delta District Municipality

Abbey and Knight Pit.-Messrs. Abbey and Knight, of Whalley, using a front-end loader, produced a small amount of gravel from shallow workings on the north side of Seventy-second Avenue 1¼ miles west of Scott Road, the eastern boundary of this municipal district.

Industrial Peat Products Pit.-L. Holmes, of Whalley, produced a small amount of sandy gravel from a pit one-quarter mile south of the west end of Seventy-second Avenue. The pit is owned by Industrial Peat Products Ltd.

Sunshine Properties Ltd.—Linton's Construction Co. Ltd., 13124 Seventy-second Avenue, R.R. 6, North Surrey. Thomas A, Linton, managing director. This pit is one-half mile west of Scott Road at Sixty-eighth Avenue. Gravel is mined from low faces by three diesel-driven shovels. It is either crushed and screened in a portable crusher or is sold as run-of-pit. Production in 1959 was 1,190,000 cubic yards.

Western Paving Ltd.-This company produced 21,000 tons of asphalt mix in a plant installed in the pit of Sunshine Properties Ltd. west of Scott Road at Sixty-eighth Avenue.

Peter Kiewit Sons Company of Canada Ltd.-D. Liscum, General Delivery, Ladner, superintendent. This company acquired the old Delta municipal pit, one-half mile west of the junction of Fifty-eighth Avenue and Scott Road. The pit was cleaned of a mudslide, and an equipment repair building and yard were completed. Some drill testing was done on the gravel deposit.

Patrick Harrison and Company Limited—Office and plant, R.R. 2, Boundary Road, Ladner. Walter Grieve, manager. A crew of fourteen men was employed at this plant at the corner of Fifty-sixth Street and First Avenue. Gravel is excavated from high banks by diesel-driven shovel and front-end loader to be sold as run-of-pit material or further processed in the screening and washing plant. A concrete mixing plant is operated in conjunction with the pit operation. In 1959, 182,338 cubic yards of gravel was produced and the ready-mix concrete plant produced 4,293 cubic yards of concrete. Midway Asphalt Company produced 6,172 cubic yards of asphalt mix within this pit.

Corporation of the District of Delta.-Adjoining the Patrick Harrison pit on its north side is a municipal pit which was operated for the municipality by Patrick Harrison and Company Limited.

Howe Sound

Construction Aggregates Ltd.—Company office, 628 Carnarvon Street, New Westminster; pit and plant, Britannia Beach. Eric D. Scholefield, manager; V. Schurer, foreman. This gravel pit is on the Vancouver–Squamish Highway immediately south of Britannia Beach. Gravel is drawn from the pit with a 3-cubic-yard-capacity Sauerman bucket-scraper powered by a 150-horsepower electric motor. The bucket discharges through a rail grizzly into a feed-pocket, beneath which is a plate feeder. The feeder discharges onto a 30-inch conveyor-belt which carries the feed to the plant by way of an overhead highway crossing. All material passes a Z-inch scalping screen, with the undersize going successively to 1⅜-inch, ⅜-inch, %-inch, and $^{3}/_{16}$-inch screens. The sized fractions arc then washed and stockpiled. Gravel +2-inch in size is conducted to a 10- by 24-inch Kue-Ken jaw crusher and to a %-inch scalping-screen. The oversized fraction is conveyed to a Simons 3-inch standard cone crusher and in turn to the ¾-inch screen. The undersized fraction is washed and stockpiled. In addition to completing the construction of this all-steel plant and installing the equipment, the crew of ten men processed 205,000 cubic yards of gravel. The finished products were transported by barge to the Lower Mainland market, used locally for road construction or for backfill in the adjoining Britannia mine.

Hillside Sand & Gravel Limited. Company office, 1075 Main Street, Vancouver 4; plant, Hillside. J. E. Buerk, manager; Ray Kehoe, superintendent. This pit and plant were operated by Champion and White Limited, a subsidiary of Evans, Coleman & Evans Limited. Access is by way of the Gibsons-Port Mellon Highway. Three separate pits were. operated on Hastings Creek, 1 mile south of Port Mellon on the west shore of Howe Sound. Gravel is mined by ground-sluicing with a constant flow of water cascading over the high pit faces. Diesel-driven shovels are used to load the gravel into 15-cubic-yard Euclid trucks for transporting to the crushing, washing, and screening plant at tidewater. Although the plant was being reconstructed during 1959, a crew of twenty-seven men processed 414,875 cubic yards of gravel for barge shipment to the Lower Mainland market.

POWELL RIVER

G. & H. Sand and Gravel Company Ltd.-Edward Gresley, owner. This company operated a gravel pit, screening plant, and ready-mix concrete plant on the south side of Haslam Lake Road, approximately 3 miles northeast of Westview.

Pete's Transfer Pit.-P. Massichuk operated a large sand pit off Allen Road, approximately 3 miles northeast of Westview. Run-of-pit gravel was excavated by a front-end loader and trucked to the consumer.

Parsons Tractor Service Ltd.-E. Parsons, manager. This company operated a portable crushing and screening plant, producing gravel for municipal use from a pit midway between Powell River and Westview.

VANCOUVER ISLAND*

Butler Brothers Supplies Ltd.-Of&e and plant, Keating Crossroad. Gravel is blasted or is dug from gravel faces by diesel-driven shovels and an overhead loader. It is transported to a washing and sizing plant or sold as pit-run. A ready-mix plant furnishes concrete for local sales. In 1959, 174,557 cubic yards of gravel was mined. Six men were employed.

McIntyre & Harding Grovel Company Limited.-Company office and plant, Royal Oak Post Office, Saanich. Gravel is dug by %-cubic-yard diesel-driven shovels and is transported by trucks to a chute and grizzly. It is then conveyed to a washing and cleaning plant, where sand, gravel, and washed and sized products are produced. A concrete plant for making concrete bricks, building-blocks, and drain-tile is also operated. In 1959, 44,007 cubic yards of gravel was produced. Sixteen men were employed.

* By R. B. Bonar.

Evans, Coleman & Evans Limited.—Company office, 900 Wharf Street, Victoria; plant, Royal Bay. D. E. Smith, manager; B. W. Parker, plant superintendent. Two plants are operated by this company, both of which are in the vicinity of Royal Bay. At plant No. 1, sand and gravel are mined by using a scraper on a slack-line cableway to loosen packed gravel from the high face. Gravel is loaded by a 1¼-cubic-yard shovel into a hopper, where it discharges onto a conveyor-belt and is conveyed to the plant. Gravel is crushed, screened, washed, and classified, and the products are shipped by scow to markets.

At plant No. 2, gravel is dug by a diesel-driven shovel from a low face, loaded onto trucks, and transported to a washing and cleaning plant.

Sand, gravel, and crushed products are sold locally. The production from both pits was 375,444 cubic yards in 1959. Twenty-two men were employed.

McRae Bros. Ltd.—Office, 1445 Ocean View, Victoria. McRae Bros., operators; John McRae, manager. This pit is near Langford Lake. Gravel is mined from low gravel faces by an overhead loader and sold locally as pit-run. Two men were employed.

Midland Pit.—Office, 1325 Rudlin Street, Victoria. George F. Fox, operator and manager. This pit is in the vicinity of Langford Lake. Gravel is mined from low gravel faces by an overhead loader and hauled to a small cleaning and sizing plant by trucks. The pit works intermittently. In 1959, 24,213 cubic yards of gravel was produced.

Mutter Gravel Pit.—Office. Preini Pacific, Patricia Bay Airport; Preini Pacific Limited, operators. H. Blair, manager. This pit is near Whiskey Point, Vancouver Island. Gravel is bulldozed to a hopper, whence it is conveyed by belt conveyor to a mobile crusher and cleaner. It is then transported by trucks to the head of a multiple belt-conveyor system, whereby it is conveyed to the loading-wharf on tidewater. Eight men were employed.

Butler Brothers Supplier (Duncan) Ltd. (A. V. Richardson Ltd.).—Company office, Duncan. This property is owned and operated by Butler Brothers Supplies Ltd. The pit is 4 miles from Duncan on the Lake Cowichan road. Pit-run gravel and washed and screened sand, gravel, and rock are produced. Gravel is mined by an overhead loading-machine and also by scraping. Pit-run gravel that is not used directly as fill or road dressing is washed and sized in an adjoining plant. A ready-mix plant uses the washed products as aggregate in concrete for local sales. Three men were employed. In 1959 total production was 14,165 cubic yards of gravel.

Cassidy Sand and Gravel Ltd.—Company office, Cassidy Post Office. R. Manko and L. Passetti, operators; R. Manko, manager. This property is adjacent to the Island Highway at Cassidy. There were two pits operating. The gravel is mined by overhead loaders and hauled to a washing and sizing plant by trucks. Six men were employed.

S. H. Marriott Sand and Gravel.—Office, Courtenay. S. H. Marriott, manager and operator. This pit is beside the Courtenay–Cumberland Road, 2% miles from Courtenay, and is operated on a lease from Canadian Collieries Resources Limited. Gravel is mined from a high face with a %-cubic-yard gasoline-driven mobile loader. The gravel is fed to a small rotary screening plant, where it is sized into two products-under 2 inches and over 2 inches. Three men are normally employed at the quarry.

SILICA

Mountain Minerals Limited* Golden (51° 116° SW.). Company office, Meech Building, P.O. Box 273, Lethbridge, Alta. R. A. Thrall, managing director; William MacPherson, superintendent. This company holds leases covering a silica deposit on the southwest shoulder of Mount Moberly, 5 miles northeast of Golden. The workings and main showings are at 5,000 feet elevation near the centre of Section 1, Township 28, Range 22, west of the 5th meridian. The property can be reached by a road, 6 miles long, that branches north off the Golden-Banff Highway 1 mile east of Golden.

The silica is in the Wonah quartzite, a well-known Ordovician formation that is found over a considerable area south and east of Mount Moberly. In most places the Wonah is a hard, compact, medium-grained, white to pinkish quartzite, but in a few scattered locations the rock consists of buff friable sandstone. The Mountain Minerals company property is located on one of the largest showings of the friable material, and the only one known that is readily accessible. The workings are on the southwest limb, near the closed end of a southwesterly overturned syncline that plunges rather steeply to the southeast. The bedding ranges in strike between north 45 and 65 degrees west and in dip between vertical and 74 degrees northeast. To the southwest the quartzite is in what must be fault contact with the younger Beaverfoot-Brisco dolomite formation; to the northeast the quartzite grades gradually into conformably overlying Beaverfoot-Brisco dolomite. The quartzite band is over 1,000 feet thick at the property. Near the southwest contact the rock is hard quartrite; about 100 feet northeast of the contact a sharp gully, parallel to the bedding, marks the beginning of the friable sandy material; the sandy material continues for the next 100 to 200 feet northeast; beyond this again for the next 200 to 300 feet the quartzite is more massive with only patches of friable sand; still farther to the northwest the rock is compact hard quartzite. The sandy zone can be traced nearly 1,000 feet northwest along the strike. Beyond this the quartzite becomes more massive, and about 1,500 feet farther on, at an elevation 700 feet below the lowest workings, the trough of the quartzite bed in the syncline is exposed in a cliff. To the southeast the sandy zone can be followed for nearly a mile, almost to the north fork of Hospital Creek.

In the sandy zone the proportion of friable material is quite variable. Much of the rock is such that upon being rubbed between the fingers it breaks down into individual grains of quartz. Scattered through the friable sand are streaks and patches, a fraction of an inch to 2 feet wide, of firm quartzite lying parallel to the bedding. Toward the edges of the sandy zone the rock is mainly hard quartzite with streaks and round spots of friable sand. The sand is pale buff to almost white with scattered brown spots. Microscopic examination reveals that the compact quartzite consists of well-rounded quartz grains with quartz outgrowths which have completely filled the spaces between individual grains and have cemented them firmly together. The friable material consists of rounded grains which have some quartz outgrowths, but apparently insufficient silica was available for these outgrowths to grow enough to fill the interstices, as in the compact quartzite, with the result that the rock is highly porous and only loosely cemented. Quartz makes up almost 100 per cent of the rock. In the thin sections examined the grains were in two distinct sizes, one group averaging 0.5 millimetre in diameter and the other group averaging 0.15 to 0.25 millimetre in diameter, with minor amounts outside these ranges.

---
* By J. W. McCammon.

When the property was examined in July, 1959, the workings consisted of seven trenches and two pits as shown in Figure 32. The most northerly trench was 45 feet long with a 25-foot-high face at the inner end. Most of the rack exposed was highly friable and light coloured, but that in the end of the trench was quite yellow. Sample No. 1 consisted of a channel sample cut along the entire east wall. The next trench to the southeast was 21 feet long with a 19-foot-high face. The rock here had a peculiar pitted appearance due to there being round sandy spots scattered abundantly through hard quartzite. Sample No. 2 was cut completely around the walls of the trench. In the next two small cuts to the southeast the rock was mostly sandy, with some hard streaks. In the two cuts farthest to the southeast the rock was quite white, with a few small rust spots scattered on the face. Sample ***No. 3*** was taken along a 25-foot face in the most easterly trench (see Fig. 32).

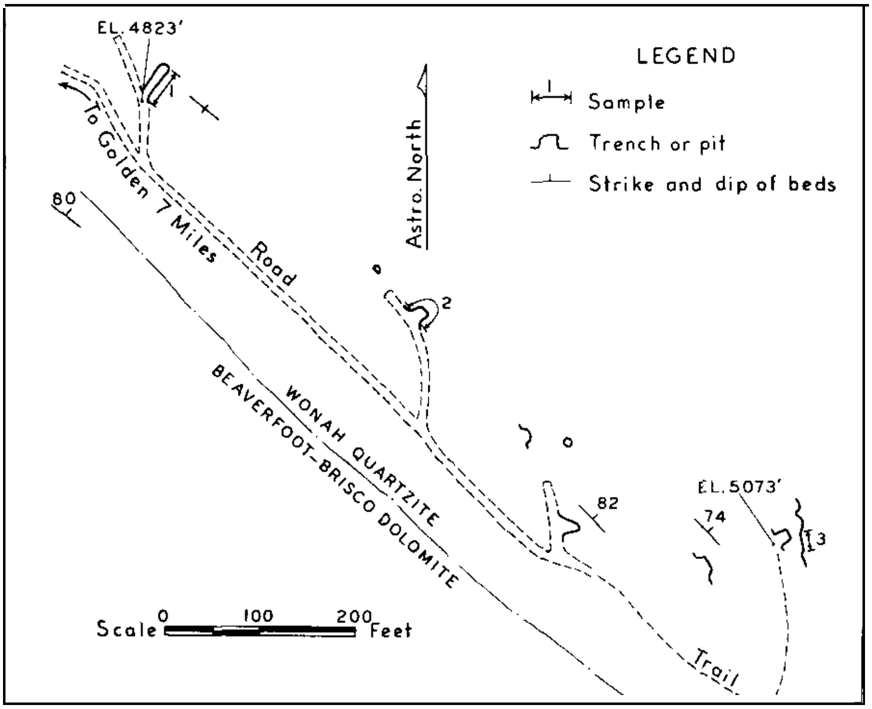


Figure 32. Silica sand on Mount Moberly.

Analyses of Mount Moberly Silica

Sample No.	SiO_2	Al_2O_3	Total Fe	Ti
1	98.63	0.54	0.04	Trace
2	98.85	0.63	0.02	Trace
3	98.65	0.58	0.02	Trace

A sieve analysis was made of the samples after they had been crushed enough to free individual grains from any consolidated rock fragments. United States standard sieves were used. All single grains passed through the No. 20 sieve. The results, in percentages, were as follows:-

Sample No.	On 40	On 60	On 100	Pan
1	19.5	32.4	21.5	26.6
2	22.7	34.6	22.3	20.4
3	7.2	45.0	32.2	15.6

The pan fraction contained a considerable volume of grain fragments broken by the crushing.

Sheep Creek*

(49° 117" SE.) The Consolidated Mining and Smelting Company of Canada, Limited, is now accepting silica from the dumps of several of the old gold mines in the Sheep Creek area. During 1959 F. Rotter made shipments from dumps leased from the Sheep Creek Mines Limited. A. Endersby shipped silica from dumps at the Gold Belt mine. M. Arishenkoff made shipments from the Dixie claim of the Kootenay Belle dump.

Oliver Silica Quarry†

Oliver (49" 119" SW.). Pacific Silica Limited. Registered office, 717 West Pender Street, Vancouver 1; quarry office, Box 397, Oliver. I. A. Hunter, manager. The Oliver silica quarry is on the Gypo mineral claim, owned by The Consolidated Mining and Smelting Company of Canada, Limited, and is operated under lease by the Pacific Silica Limited. The Gypo claim is less than one-quarter of a mile west of Highway No. 97, 1 mile north of Oliver. During 1959 the average crew employed was eighteen. Estimated production for the year was 38,409 tons.

[Reference: *Minister* of Mines, ***B.C.,*** Ann. Rept., 1958, p. 104.]

* By J. D. McDonald.
† By D. Smith.

Petroleum and Natural Gas

By J. D. Lineham

CONTENTS

EXPLORATION

In northeastern British Columbia thirty seismic crews did work in 1959 for seventeen oil companies. The reflection seismic method was used chiefly, but some refraction profiles were shot. Minor gravity meter and magnetometer surveys were made. Oil companies continued photogeological and surface geological mapping of the plains, foothills, and Rocky Mountains.

In other parts of the Province several sedimentary areas were also investigated for oil and gas potential using the following exploratory methods:-

(1) Rocky Mountain Trench, Cranbrook area-seismic survey.
(2) Fernie and Flathead area--seismic, gravity, magnetic, photogeological, and geological surveys.
(3) Nass River area--seismic, aeromagnetic, photogeological, and geological surveys.
(4) Nechako and Nazko River areas-photogeological and geological surveys.
(5) Vancouver-Chilliwack area-seismic survey.
(6) Nanaimo Basin-photogeological and geological surveys of the Gulf Islands and part of Vancouver Island.
(7) Hecate Strait-marine seismic survey.
(8) Graham Island-seismic, aeromagnetic, and geological surveys.

Drilling activity in 1959 was confined to northeastern British Columbia, where, of the 140 wells operated, 138 were located on the plains and two in the foothills of the Rocky Mountains.

Most of the wells were drilled north of the Peace River, with a marked increase in exploratory drilling in the Fort Nelson area, where major gas discoveries were made in February and March. Existing fields generally were developed and enlarged.

The following discovery wells were completed in 1959:-

Oil Discoveries

Well Name	Oil Zone
Sinclair Pac Peejay d-39-E	Triassic Halfway.
Triad West Beatton River d-39-K	Lower Cretaceous Bluesky-Gething.
Union Aitken Creek b-42-L	Lower Cretaceous Bluesky-Gething.

Gas Discoveries

Well Name	Gas Zone
FPC-Richfield N Daiber c-76-D (1)	Triassic Baldonnel.
Gulf States et al. Evie Lk b-85-H (2)	Devonian Slave Point.
Gulf States Imp Clarke L c-94-L (2)	Devonian Slave Point.
Gulf States Kotcho Lake c-67-K (3)	Devonian Slave Point.
Gulf States Petitot R d-24-D (1)	Devonian Slave Point.
Imperial Calvan Altares a-83-A	Lower Cretaceous Bluesky-Gething.
Imperial Pan Am La Biche b-55-E	Mississippian Rundle.
Pacific et al. Jedney b-88-J	Triassic Charlie Lake.
Pacific et al. Siphon 11-27-86-16	Triassic Charlie Lake.
Pacific Imperial Bubbles b-33-I	Triassic Baldonnel-Charlie Lake.
Pacific Sunray Imp Sojer a-61-L	Triassic Baldonnel-Charlie Lake.
Pacific Sunray Imp E Laprise d-68-E	Triassic Baldonnel-Charlie Lake.
Sinclair et al. Lily d-12-K (XB18-1)	Mississippian Rundle.
Sun et al. E Jeans c-Al-H	Upper Palæozoic.
Sun et al. W Jeans a-22-B	Triassic Charlie Lake.
Texaco NFA Cameron River d-43-H	Triassic Schooler Creek.
Union Aitken Creek a-53-L (3)	Lower Cretaceous Bluesky-Gething.
Union Fireweed d-53-G	Lower Cretaceous Dunlevy.
Union-HB Milligan Creek d-20-H	Triassic Halfway.

DEVELOPMENT

One hundred and forty wells were drilled in 1959, an increase of 26 per cent over the number in 1958. Forty-eight different rigs drilled fifty development wells and ninety exploratory wells, with a total of 614,861 feet of hole, an increase of 27 per cent over the 1958 footage.

Successful completions numbered sixty-four, of which forty-four were gas wells and twenty were oil wells, representing increases of twenty-one and three wells respectively. Forty-six wells were abandoned, a decrease of four from 1958. At the end of 1959 two wells were classified as suspended pending deepening and twenty-eight were being drilled.

Eighty-one gas wells and thirty-seven oil wells were in production at the end of 1959. The number of gas and oil wells capable of production were 193 and fifty-nine respectively.

A complete summary of wells drilled during the year is shown in Table 1.

General statistics concerning well operation and production data are shown in Table 3.

New fields designated were the Beatton River, Beatton River West, Bubbles, Jedney, Nig Creek, and Stoddart fields. Field boundaries were revised for the Boundary Lake, Buick Creek, Buick Creek West, Gundv Creek, Jedney, Milligan Creek, Montney, and Red Creek fields. Oil and gas fields designated at December 31st, 1959, are shown in Table 2.

The names of a number of wells were changed during 1959, following adoption of a system designed to standardize well-naming. All well names, except those of wells abandoned prior to the establishment of the system, now conform to the standard procedure which divides a well name into three basic parts, as follows:-

(1) The full or abbreviated name of the company or companies responsible for the well.

(2) Reference to the general or specific area in which the well is located. This part of the name refers to a geographic area, topographic feature, or to an established position such as a triangulation station. In areas where a definite reference is not possible, some other name is designated.

(3) Reference to the survey system recognized in the area. This part of the name indicates either the legal subdivision, section, township, and range or, in areas not surveyed into townships, the quarter-unit, unit, and block as described in the publication entitled "Permit and Lease 'Grid' System." The National Topographic Series map numbers given in this publication are not included in the official well names but are recorded by the Branch for reference purposes.

Examples:—

Dome Boundary Lake 16-26-85-14.
Sinclair Pac Peejay d-39-E.

FIELD OFFICE

The field staff, with headquarters at Dawson Creek, carried out continuous inspections of all phases of drilling and producing operations in northeastern British Columbia, from the northern boundary of the Province to the Monkman Pass area and from the foothills of the Rocky Mountains to the Alberta Boundary. A distance of 86,783 miles was driven by the technical staff in the performance of inspection duties and to make or witness tests on individual wells.

In addition to enforcing the Regulation Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas, the staff investigated all complaints laid by land-owners concerning work done by exploration companies under the Geophysical Regulations.

The Branch owns a wire-line unit, also known as a bottom hole unit, which has been used by the technical field staff since October, 1958, to measure the temperature and pressure of each well completed in every natural-gas reservoir. It consists basically of a power-winch mounted in a %-ton panel truck, 10,000 feet of wire line, a depth indicator, recording temperature and pressure gauges, and other miscellaneous equipment designed to facilitate running the measuring instruments in wells under pressures as high as 5,000 pounds per square inch. During 1959 ninety-seven successful runs were made in gas wells capable of production in the Blueberry East, Blueberry West, Buick Creek West, Bubbles, Fort St. John, Fort St. John Southeast, Highway, Jedney, Kiskatinaw, Kobes-Townsend, Montney, and Stoddart fields. A number of runs were made, the results of which were inconclusive, incomplete, or unacceptable due to mechanical failures or operational difficulties.

Two fatalities occurred on January 11 th in one accident at Pan Am A-l Beaver River b-63-K well, located approximately 100 miles northwest of Fort Nelson and 3 miles south of the British Columbia-Northwest Territories Boundary. Arnold Lindberg and Helmund Adolf Hartwig, employees of the drilling contractor, were killed instantly.

A series of difficulties had been encountered during the two weeks prior to the accident, commencing on December 28th, 1958, with a flash explosion beneath the derrick floor after the drill pipe had been run approximately 4,800 feet of the total well depth of 8,519 feet. Two days before the accident, following completion of repairs which had been required after the travelliig-block and hook fell to the floor damaging the drilling line, draw-works, hook, and the top tool joint, the drill pipe was run to the bottom and the hole was being conditioned when the drilled mud suddenly became gas-cut. The well was shut down immediately to condition the mud and to mix 350 barrels to replace mud which had been lost to the formation.

The mud volume was restored within ten hours but, since the temperature was 40 degrees below zero, the swivel, hose, stand pipe, and kelly had frozen, the latter with the kelly cock open. As a positive float valve was installed in the drill collars, the hose was disconnected from the swivel, and for eighteen hours steam was used to supply heat for thawing. The men were working above the derrick floor when the ice plug dislodged suddenly. A flow of gas, at an estimated rate of between 8 and 10 million cubic feet per day, escaped and exploded.

An inquest was held at Fort Nelson on February 4th, and the Coroner's jury returned the following verdict:-

" We the jury find that Arnold Lindberg and Helmund Adolf Hartwig crone to their death by accidental means on January 11, 1959, at approximately 2.45 a.m. at Beaver River, British Columbia, Dallas Drilling No. 1 on Rig Floor, by concussion caused by a sudden escape of gas."

RESERVES

Proved recoverable reserves of crude oil and natural gas increased substantially during the year, the former by 39.4 per cent and the latter by 43.5 per cent. A summary of these reserves, together with explanatory notes, is given in Table 14.

The increase of oil reserves is due mainly to the extension of Boundary Lake and Milligan Creek reserve areas. New discoveries were made in the Bluesky-Gething formation at Beatton River West and in the Halfway formation at Peejay area (formerly called Doig River), but the additional reserves proved thereby are still small, pending outstep drilling to appraise the extent of the reservoirs. In addition to the Beatton River West and Peejay areas, oil was also discovered in the Bluesky-Gething formation in Aitken Creek area but, due to the thicker section and better porosity of a near-by gas well, which is probably up dip on the same structure, the accumulation may eventually be shown to be marginal, as is the case in the Buick Creek West field.

New oil discoveries are expected along the Boundary Lake-Milligan Creek-Beatton River trend, especially as drilling in these areas has been greatly accelerated as a result of the X-inch oil pipe-line which is scheduled to be in operation during the latter part of 1960.

The increase in gas reserves is due largely to the development of the Jedney and Laprise Creek reservoirs, which were discovered in 1958, the discovery and development of the Bubbles reservoir, and the further development of the Nig Creek reservoir. Large potential reserves have been discovered in the Middle Devonian east and north of Fort Nelson, at Kotcho Lake and Petitot River, while the reserves in the same formation have been increased by two additional wells during 1959 in the Clarke Lake area. Gas discoveries were also made during the year west of the Kobes Creek-Townsend trend in the general Cameron River area and also in the Jedney-Bubbles-Laprise Creek area, at Sojer and East Laprise.

Large increases in both oil and gas reserves are anticipated in 1960.

PRODUCTION

Thirty-seven oil wells produced 866,109 barrels of crude oil and eighty-one gas wells produced 69,128,700,000 cubic feet of gas during 1959. These figures represent increases in production over 1958 of 69 per cent and 8 per cent respectively. The highest monthly production was in December, when 93,338 barrels of oil and 7,128,861,000 cubic feet of gas were produced.

Propane production increased 40 per cent to 96,925 barrels, and butane production increased 154 per cent to 207,029 barrels.

Sulphur production decreased 14 per cent to 53,694 tons. The decrease can be attributed to a marked decline in gas production in the general Fort St. John area and increased production of gas with a lower hydrogen sulphide content from other fields.

Other by-products recovered were 512,951 barrels of condensate and 382,833 barrels of natural gasoline.

A general summary of oil, gas, and water production, by years, is shown in Table 4, page 215.

Monthly and annual oil production by fields and pools in 1959 and 1958 is shown in Tables 5 and 5A.

Summaries of oil and gas production by months and years are shown in Tables 6 and 8.

Monthly and annual gas production by fields and pools in 1959 and 1958 is shown in Tables 7 and 7A.

Production of condensate, natural gasoline, butane, propane, and sulphur in 1959 and 1958 is shown in Tables 9 and 9A.

Disposition of crude oil and natural gas in 1959 and 1958 is shown in Tables 10 and 10A, pages 224 to 227.

The gross values, by months and years, of oil, gas, and by-products marketed are shown in Tables 11, 12, and 13.

Some of the figures shown in these tables do not agree with data published previously in the Monthly Oil and Gas Reports. but all revisions are based on amended reports submitted by operating companies.

Westcoast Transmission Company Limited purchased all gas produced. Of the 64,525,633,000 cubic feet of British Columbia gas and 25,252,876,000 cubic feet of Alberta gas delivered to the main gas transmission pipe-line, less a total line loss of 1,194,698,000 cubic feet, British Columbia Electric Company Limited, Inland Natural Gas Co. Ltd., and Plains Western Gas and Electric Co. Ltd. distributed 13,873,244,000, 4,140,395,000, and 255,518,000 cubic feet respectively. The remaining 70,314,654,000 cubic feet, representing approximately 80 per cent of the gas transported by the 30-inch main gas transmission pipe-line, was sold to Pacific Northwest Pipeline Corporation for export to the United States.

Gas produced in Alberta was distributed to the communities of Dawson Creek and Pouce Coupe by Northland Utilities Limited. A total of 1,221,468,000 cubic feet was consumed during the year.

Crude oil produced was sold chiefly to the refinery at Dawson Creek, owned by X-L Refineries Limited. This company purchased 778,360 barrels. The remaining 83,576 barrels was marketed chiefly in Alberta.

GAS-GATHERING SYSTEM

The Westcoast Transmission Company's gas-gathering system, which previously had terminated to the north in a 12-inch western branch to the Highway field and a 20-inch eastern branch to the West Buick Creek field, was extended during 1959. The western branch was continued for 18.7 miles to the north to a common metering station, from which two lo-inch laterals now serve the Bubbles and Jedney fields. This extension represents an additional capacity to the system of some 50 million cubic feet per day. The eastern branch is now connected by a 4-inch lateral with the Buick Creek field, approximately 4 miles to the east.

CRUDE-OIL PIPE-LINE

A board was appointed by the Minister of Commercial Transport pursuant to the provisions of section 6 of the Pipe-lines Act, being chapter 60 of the Statutes of British Columbia, 1955, to hear evidence in support of applications for certification to construct an oil pipe-line from the Beatton River-Milligan Creek and Boundary Lake areas of northeastern British Columbia to Dawson Creek, via Taylor. Public hearings were held in the Parliament Buildings at Victoria for eleven days between June 15th and July 15th, 1959, and on August 28th, 1959, the board submitted a report, on the basis of which the right to construct and operate the first oil-gathering system in British Columbia was given to Peace River Oil Pipe Line (B.C.) Ltd. This company has undertaken to construct 135 miles of 8-inch transmission-line from the Beatton River-Milligan Creek area via the Boundary Lake field, Taylor, and Dawson Creek to within one-half mile of the British Columbia-Alberta border and, from one-half mile on the other side of the border, 120.3 miles of S-inch transmission-line via Grande Prairie to connect with the 12-inch line from Valley View to Edson, on the Trans.Mountain trunk pipe-line from Edmonton to Vancouver. The British Columbia and Alberta sections of the 8-inch line will be connected across the common boundary by 1 mile of X-inch line which will be owned by British American Pipeline Company and will be constructed and operated under Federal jurisdiction. In addition, 13 miles of 4-inch line will connect the Beatton River, Milligan Creek, Peejay, and Boundary Lake wells into the system.

Not only will the refinery at Dawson Creek and the refinery under construction at Taylor be assured of an uninterrupted supply of crude oil for their operations, but British Columbia crude oil will also be available for the North Star Refinery at Grande Prairie in Alberta and for the larger refineries in the Vancouver area.

WELL RECORDS, WELL INFORMATION, AND STATISTICS

WELL RECORDS AND INFORMATION

Complete records are maintained of all wells drilled and produced within the Province. All information collected is compiled and classified for release. in accordance with the regulation. Non-confidential data are made available to interested persons at a nominal charge for examination, or by reproduction of records, or by publication.

A Schedule of Wells listing pertinent data on all wells drilled within the Province is published periodically. A revised edition, including all wells drilled to January lst, 1960, and which consolidates all previously published schedules and supplements thereto, was issued in 1960.

STATISTICS

Two reports, issued at the end of each month, are available by subscription or by purchase of single copies.

The Monthly Drilling and Land Report is prepared jointly by the Petroleum and Natural Gas and the Administration Branches. It outlines current drilling activity and disposition of Crown petroleum and natural-gas rights.

The Monthly Oil and Gas Report is a monthly summary of the number of producing and productive wells by field; production and disposition of crude oil, natural gas, and water by field; gross value of crude-oil and natural-gas production to the producer; and the production and disposition of propane, butane, condensate, natural gasoline, and sulphur. The cumulative annual figures are included.

WELL SAMPLES

Unless otherwise directed, any operator who drills a well for petroleum or natural gas is required to take a sample of bit-cuttings at least every 10 feet of depth.

All material from core samples must be preserved in labelled boxes not more than 30 inches long and must be delivered to the Department when required. The Department of Mines core-storage depot at Pouce Coupe became filled in September, 1957, and since then each operator has been required to provide temporary core storage.

Samples of all well-cuttings are forwarded by the operator to the stratigraphic laboratory in Victoria. A part of each IO-foot sample is washed, dried, and filed in a labelled glass bottle in sequence with other samples from the same well. A complete set of samples from each well is available for examination at Victoria. Two additional sets of samples are bottled and shipped-one to the laboratory of the Geological Survey of Canada at Calgary and one, since January, 1958, to the Petroleum and Natural Gas Branch field office at 1805 One Hundred and Eighth Avenue, Dawson Creek. During 1959, 49,254 bit-cutting samples were washed and bottled in Victoria.

Statistics

Table 1.—Wells Drilled or Operated, 1959

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1959 Footage	Status at Dec. 31, 1959
	Northeastern British Columbia					
413	Calvan Trutch Creek c-46-K (1)[1]	Dec. 19, 1958	Feb. 16, 1959	5,891	2,481	Dry and abandoned.
459	Champlin Boundary Lake 8-33-84-14	May 27, 1959	June 15, 1959	4,391	4,391	Dry and abandoned.
465	Dome Boundary Lake 16-26-85-14	July 12, 1959	July 31, 1959	4,811	4,811	Triassic Boundary Lake oil well.
488	Dome Boundary Lake 8-35-85-14	Sept. 2, 1959	Sept. 15, 1959	4,410	4,410	Triassic Boundary Lake oil well.
528	Dome Boundary Lake 14-35-85-14	Dec. 6, 1959	Dec. 23, 1959	4,439	4,439	Triassic Boundary Lake oil well.
464	Dome Basco Bubbles b-19-A	July 19, 1959	Sept. 9, 1959	5,056	5,056	Triassic Baldonnel-Charlie Lake gas well.
506	Dome Basco Bubbles b-50-A	Oct. 25, 1959	Nov. 28, 1959	4,592	4,592	Triassic Baldonnel-Charlie Lake gas well.
482	Dome Basco Laprise Creek b-79-A	Sept. 14, 1959	Oct. 20, 1959	5,075	5,075	Dry and abandoned.
490	Dome Basco Laprise Creek a-81-A	Sept. 27, 1959	Nov. 4, 1959	4,330	4,330	Triassic Baldonnel-Charlie Lake gas well.
474	Dome Basco Laprise Creek d-13-H	Aug. 1, 1959	Sept. 14, 1959	5,045	5,045	Triassic Baldonnel-Charlie Lake gas well.
443	Dome Pan American Trutch Creek c-84-I	Feb. 16, 1959	Mar. 4, 1959	3,552	3,552	Dry and abandoned.
448	Fargo et al. Highway d-47-L (2)	Mar. 8, 1959	Apr. 12, 1959	4,676	4,676	Dry and abandoned.
500	FPC Buick Creek a-85-J	Oct. 20, 1959	Nov. 15, 1959	4,110	4,110	Dry and abandoned.
432	FPC Richfield Daiber c-56-D	Jan. 24, 1959	Mar. 19, 1959	4,899	4,899	Triassic Baldonnel gas well.
386	FPC Richfield N Daiber c-76-D (1)[1]	Oct. 14, 1958	Jan. 6, 1959	5,700	30	Triassic Baldonnel gas well.
405	Gulf States Bonnie Creek c-94-C (1)[1]	Dec. 9, 1958	Feb. 8, 1959	6,076	1,716	Dry and abandoned.
503	Gulf States Imp Clarke L c-8-D (5x)	Sept. 19, 1959	Dec. 3, 1959	6,850	3,733	Devonian Slave Point gas well.
471	Gulf States Imp Clarke L b-18-D (5)	Aug. 2, 1959	Sept. 19, 1959	7,405	7,405	Dry and abandoned.
458	Gulf States Imp Clarke L c-64-I (4)	May 27, 1959	July 25, 1959	7,316	7,316	Dry and abandoned.
422	Gulf States Imp Clarke L c-75-K (3)	Feb. 9, 1959	Apr. 1, 1959	7,400	7,400	Dry and abandoned.
397	Gulf States Imp Clarke L c-94-L (2)[1]	Nov. 8, 1958	Feb. 5, 1959	8,039	1,474	Devonian Slave Point gas well.
476	Gulf States et al. Evie Lk b-85-H (2)	Sept. 23, 1959	Dec. 18, 1959	7,720	7,720	Dry and abandoned.
505	Gulf States Fort Nelson c-78-I (3)	Dec. 11, 1959			2,240	Drilling.
532	Gulf States Kotcho Lake d-39-J (4)	Dec. 29, 1959			412	Drilling.
404	Gulf States Kotcho Lake c-67-K (3)[1]	Dec. 16, 1958	Feb. 27, 1959	6,702	4,237	Devonian Slave Point gas well.
403	Gulf States Petitot R d-24-D (1)[1]	Dec. 30, 1958	Mar. 13, 1959	6,680	6,422	Devonian Slave Point gas well.
533	Gulf States Petitot Rvr b-1-D (2)	Dec. 18, 1959			4,000	Drilling.
415	HB Union Imp Paddy c-14-C	Jan. 7, 1959	Mar. 15, 1959	8,130	8,130	Dry and abandoned.
410	Imperial Calvan Altares a-83-A[1]	Dec. 15, 1958	Apr. 21, 1959	6,848	3,669	Lower Cretaceous Bluesky-Gething gas well.
537	Imp Calvan Altares c-14-H	Dec. 17, 1959			3,095	Drilling.
523	Imp Pac Boundary 8-18-85-13	Dec. 2, 1959	Dec. 21, 1959	4,325	4,325	Triassic Boundary Lake oil well.
524	Imp Pac Boundary 6-20-85-13	Dec. 2, 1959	Dec. 18, 1959	4,350	4,350	Triassic Boundary Lake oil well.
521	Imp et al. Boundary 14-1-85-14	Dec. 5, 1959	Dec. 29, 1959	4,270	4,270	Triassic Boundary Lake oil well.
501	Imp Pac Boundary 6-2-85-14	Oct. 4, 1959	Oct. 16, 1959	4,159	4,159	Triassic Boundary Lake oil well.
493	Imp Pac Boundary 14-2-85-14	Sept. 20, 1959	Oct. 3, 1959	4,187	4,187	Triassic Boundary Lake oil well.
442	Imperial Pan Am La Biche b-55-E	Mar. 7, 1959	Sept. 2, 1959	10,007	10,007	Mississippian Rundle gas well.
467	Pacific Sunray Imp Bubbles b-22-I	Aug. 3, 1959	Aug. 26, 1959	4,757	4,757	Triassic Baldonnel-Charlie Lake gas well.
451	Pacific Imperial Bubbles b-33-I	Mar. 25, 1959	May 22, 1959	5,578	5,578	Triassic Baldonnel-Charlie Lake gas well.

[1] Name changed during 1959.

Table 1.—Wells Drilled or Operated, 1959—Continued

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1959 Footage	Status at Dec. 31, 1959
	Northeastern British Columbia—Continued					
466	Pacific Sunray Imp Bubbles b-44-I	July 27, 1959	Aug. 18, 1959	4,670	4,670	Triassic Baldonnel-Charlie Lake gas well.
479	Pacific Sunray Imp Bubbles d-55-I	Oct. 13, 1959	Nov. 6, 1959	4,591	4,591	Triassic Baldonnel-Charlie Lake gas well.
480	Pacific Sunray Imp Bubbles b-66-I	Sept. 10, 1959	Sept. 29, 1959	4,679	4,679	Triassic Baldonnel-Charlie Lake gas well.
478	Pacific Sunray Imp Bubbles d-77-I	Sept. 8, 1959	Sept. 29, 1959	4,504	4,504	Triassic Baldonnel-Charlie Lake gas well.
462	Pacific Sunray Imp Bubbles d-88-I	July 10, 1959	Aug. 20, 1959	5,300	5,300	Triassic Baldonnel-Charlie Lake gas well.
517	Pacific Sunray Imp W Bubbles c-16-I	Nov. 13, 1959	Dec. 10, 1959	5,110	5,110	Dry and abandoned.
457	Pacific Buick Creek b-4-B	May 17, 1959	June 9, 1959	4,158	4,158	Lower Cretaceous Buick Creek gas well.
463	Pacific Buick Creek c-12-B	June 13, 1959	July 3, 1959	4,102	4,102	Dry and abandoned.
469	Pacific Buick Creek c-14-B	July 11, 1959	Aug. 3, 1959	4,163	4,163	Lower Cretaceous Buick Creek gas well.
392	Pacific Fort Nelson a-44-G (3)[1]	Nov. 5, 1958	Jan. 25, 1959	7,595	1,110	Dry and abandoned.
43	Pacific Fort St John 2-18-84-19 (16)	July 27, 1952	Dec. 31, 1952	8,437	....	Dry and abandoned.
43	Pacific Fort St John 2-18-84-19 (16)	Mar. 31, 1959	Oct. 11, 1959	12,475	4,038	Dry and abandoned.
473	Pacific Sunray Imp Jedney b-10-B	Aug. 5, 1959	Sept. 8, 1959	5,384	5,384	Triassic Baldonnel-Charlie Lake gas well.
460	Pacific Sunray Imp Jedney b-30-B	June 14, 1959	July 21, 1959	5,045	5,045	Triassic Baldonnel-Charlie Lake gas well.
491	Pacific Sunray Imp Jedney c-12-C	Nov. 8, 1959	Dec. 21, 1959	5,163	5,163	Dry and abandoned.
453	Pacific Sunray Imp Jedney d-42-C	Apr. 8, 1959	May 24, 1959	5,349	5,349	Triassic Halfway gas well.
492	Pacific Sunray Imp Jedney b-44-J	Sept. 23, 1959	Nov. 7, 1959	5,409	5,409	Triassic Baldonnel-Charlie Lake gas well.
461	Pacific Sunray Imp Jedney a-65-J	June 13, 1959	July 28, 1959	5,531	5,531	Triassic Halfway gas well.
475	Pacific Sunray Imp Jedney b-66-J	Aug. 7, 1959	Sept. 23, 1959	5,497	5,497	Triassic Baldonnel-Charlie Lake and Halfway multi-zone gas well.
484	Pacific Sunray Imp Jedney d-77-J	Sept. 15, 1959	Oct. 14, 1959	5,476	5,476	Triassic Baldonnel-Charlie Lake and Halfway multi-zone gas well.
427	Pacific et al. Jedney b-88-J	Jan. 23, 1959	Mar. 30, 1959	5,539	5,539	Triassic Charlie Lake gas well.
516	Pacific Sunray Imp E Laprise d-68-E	Nov. 19, 1959	Dec. 18, 1959	4,800	4,800	Triassic Baldonnel-Charlie Lake gas well.
551	Pacific Sunray Imp E Laprise c-78-E	Dec. 29, 1959	....	....	716	Drilling.
389	Pacific Imperial Medana 47-G[1]	Nov. 30, 1958	Jan. 11, 1959	5,215	187	Dry and abandoned.
468	Pacific HB Pocketknife c-37-L	Aug. 30, 1959	....	....	5,655	Drilling.
444	Pacific et al. Siphon 11-27-86-16	Feb. 17, 1959	Mar. 23, 1959	4,680	4,680	Triassic Charlie Lake gas well.
487	Pacific Sunray Imp Sojer b-47-D	Sept. 29, 1959	Oct. 29, 1959	5,111	5,111	Dry and abandoned.
472	Pacific Sunray Imp Sojer a-61-L	July 17, 1959	Aug. 20, 1959	5,227	5,227	Triassic Baldonnel-Charlie Lake gas well.
438	Pacific et al. Stoddart 10-1-86-20	Feb. 26, 1959	May 5, 1959	6,536	6,536	Dry and abandoned.
529	Pacific Utahn b-83-C	Dec. 15, 1959	....	....	4,115	Drilling.
325	Pan Am A-1 Beaver River b-63-K[1]	Jan. 21, 1958	....	....	3,400	Drilling at 10,498 ft., whipstocked at 7,098 ft.
531	Pan Am A-1 Deer Lake a-90-I	Dec. 15, 1959	....	....	1,600	Drilling.
434	Pan Am A-1 East Poplar a-37-F	Jan. 30, 1959	....	....	6,962	Suspended.
527	Pan Am A-1 Komie a-51-A	Dec. 27, 1959	....	....	617	Drilling.
414	Pan Am et al. A-1 Snake River c-28-D	Jan. 1, 1959	Apr. 8, 1959	7,614	7,614	Dry and abandoned.
445	Phillips Beatton d-59-F	Feb. 23, 1959	Mar. 20, 1959	4,010	4,010	Dry and abandoned.

416	Phillips Beatton a-65-J (A-2)	Jan. 4, 1959	Feb. 12, 1959	3,928	3,928	Dry and abandoned.
499	Phillips SR West Cdn Kledo c-14-G	Dec. 10, 1959			3,760	Drilling.
489	Phillips Kobes b-24-A	Nov. 23, 1959			3,182	Drilling.
496	Phillips Kobes b-82-I	Oct. 6, 1959	Nov. 11, 1959	3,015	3,015	Lower Cretaceous Dunlevy gas well.
450	Phillips Milligan c-72-J	Mar. 4, 1959	Mar. 22, 1959	3,800	3,800	Dry and abandoned.
494	Phillips Minaker a-25-D	Oct. 10, 1959			5,270	Drilling.
340	Phillips Puggins c-40-L (1)[1]	Jan. 28, 1958	Mar. 3, 1959	14,753	51	Dry and abandoned.
407	(Phillips) Umbach No. 2	Dec. 10, 1958	Jan. 8, 1959	4,488	42	Dry and abandoned.
520	Richfield Prespatou Creek d-57-A	Nov. 27, 1959	Dec. 17, 1959	4,160	4,160	Dry and abandoned.
420	Sinclair Pac Chinchaga a-34-L (B9-1)	Jan. 24, 1959			9,096	Drilling.
539	Sinclair et al. Dogrib b-17-K	Dec. 27, 1959			1,275	Drilling.
498	Sinclair et al. Jedney b-68-J	Oct. 2, 1959	Dec. 6, 1959	5,706	5,706	Triassic Baldonnel-Charlie Lake gas well.
421	Sinclair Pac Klua Creek a-55-L (B11-1)	Jan. 30, 1959			5,940	Drilling.
385	Sinclair et al. Lily d-12-K (XB18-1)[1]	Oct. 17, 1958	Apr. 19, 1959	8,691	2,643	Mississippian Rundle gas well.
419	Sinclair Pac Milligan d-71-B (B8-2)	Jan. 20, 1959	Feb. 15, 1959	3,717	3,717	Dry and abandoned.
426	Sinclair Minaker b-34-H (XB20-1)	Jan. 25, 1959			1,322	Suspended.
543	Sinclair et al. Peejay d-29-E	Dec. 30, 1959			549	Drilling.
418	Sinclair Pac Peejay d-39-E (B8-3)	Feb. 21, 1959	Mar. 15, 1959	3,910	3,910	Triassic Halfway oil well.
454	Sohio Un. Prod. et al. Tupper Creek c-70-B	Apr. 20, 1959	Oct. 30, 1959	12,130	12,130	Dry and abandoned.
510	Sun et al. Blueberry c-29-K	Nov. 21, 1959	Dec. 13, 1959	3,366	3,366	Dry and abandoned.
549	Sun et al. Blueberry c-A29-K	Dec. 14, 1959			4,310	Drilling.
504	Sun et al. Blueberry d-99-D	Oct. 22, 1959			6,759	Drilling.
525	Sun et al. Blueberry a-61-L	Dec. 6, 1959			4,903	Drilling.
495	Sun et al. Halfway 10-2-87-25	Sept. 29, 1959			6,697	Drilling.
481	Sun Indian Creek 9-11-85-19	Aug. 24, 1959	Sept. 6, 1959	3,527	3,527	Dry and abandoned.
470	Sun et al. W Jeans b-10-A	Aug. 1, 1959	Oct. 28, 1959	7,070	7,070	Upper Palæozoic gas well.
507	Sun et al. Jeans a-57-A	Nov. 3, 1959			6,688	Drilling.
412	Sun et al. W Jeans a-22-B[1]	Dec. 22, 1958	Feb. 20, 1959	4,773	2,919	Triassic Charlie Lake gas well.
411	Sun et al. E Jeans c-1-H[1]	Dec. 12, 1958	Mar. 29, 1959	6,231	2,149	Dry and abandoned.
455	Sun et al. E Jeans c-A1-H	May 8, 1959	July 25, 1959	6,800	6,800	Upper Palæozoic gas well.
518	Sun Stoddart 7-23-86-20	Nov. 22, 1959			6,060	Drilling.
433	Texaco NFA Cameron River d-43-H	Feb. 20, 1959	Dec. 28, 1959	9,472	9,472	Triassic Schooler Creek gas well.
456	Texaco NFA Nig Creek a-1-G	May 15, 1959	June 3, 1959	4,385	4,385	Triassic Baldonnel-Charlie Lake gas well.
447	Texaco NFA Nig Creek b-2-G	Mar. 2, 1959	Mar. 22, 1959	4,422	4,422	Triassic Charlie Lake gas well.
439	Triad Beatton River d-61-A	Feb. 3, 1959	Feb. 19, 1959	4,253	4,253	Dry and abandoned.
430	Triad Beatton River d-51-D	Jan. 12, 1959	Feb. 12, 1959	3,922	3,922	Lower Cretaceous Bluesky-Gething oil well.
425	Triad Beatton River d-17-J	Jan. 2, 1959	Jan. 22, 1959	3,783	3,783	Dry and abandoned.
396	Triad Beatton River d-28-J	Dec. 19, 1959			3,810	Drilling.
513	Triad Beatton River d-40-J	Nov. 25, 1959	Dec. 16, 1959	3,775	3,775	Dry and abandoned.
424	Triad Beatton River d-63-K	Jan. 1, 1959	Jan. 29, 1959	4,724	4,724	Dry and abandoned.
446	Triad Beatton River d-86-K	Feb. 23, 1959	Mar. 9, 1959	3,945	3,945	Dry and abandoned.
538	Triad West Beatton River d-38-K	Dec. 29, 1959			510	Drilling.
408	Triad West Beatton River d-39-K[1]	Dec. 19, 1958	Jan. 9, 1959	3,791	199	Lower Cretaceous Bluesky-Gething oil well.
441	Triad West Beatton River d-48-K	Feb. 15, 1959	Mar. 4, 1959	3,835	3,835	Lower Cretaceous Bluesky-Gething oil well.
515	Triad West Beatton River d-57-K	Nov. 25, 1959	Dec. 12, 1959	3,830	3,830	Lower Cretaceous Bluesky-Gething oil well.
512	Triad West Beatton River d-59-K	Dec. 14, 1959	Dec. 26, 1959	3,500	3,500	Lower Cretaceous Bluesky-Gething oil well.

[1] Name changed during 1959.

Table 1.—Wells Drilled or Operated, 1959—Continued

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1959 Footage	Status at Dec. 31, 1959
	Northeastern British Columbia—Continued					
522	Triad Birley Creek d-13-G	Nov. 21, 1959	Dec. 8, 1959	4,170	4,170	Dry and abandoned.
452	Triad BP Bush Mountain a-15-A	Apr. 1, 1959	Nov. 19, 1959	10,967	10,967	Dry and abandoned.
364	Triad Bush Mountain b-23-A (1)[1]	July 16, 1958	Feb. 15, 1959	10,614	2,080	Dry and abandoned.
535	Triad Conroy Creek d-44-B	Dec. 14, 1959	Dec. 29, 1959	4,067	4,067	Dry and abandoned.
477	Triad Conroy Creek d-62-C	Nov. 23, 1959	Dec. 12, 1959	4,203	4,203	Dry and abandoned.
552	Triad N Laprise Creek b-57-L	Dec. 31, 1959			258	Drilling.
390	Triad Prairie Creek a-24-H (1A)[1]	Nov. 18, 1958	Dec. 1, 1959	11,322	9,482	Dry and abandoned.
502	Union Aitken Creek d-48-J	Dec. 4, 1959			4,867	Drilling.
485	Union Aitken Creek b-42-L	Sept. 30, 1959	Nov. 2, 1959	4,860	4,860	Lower Cretaceous Bluesky-Gething oil well.
400	Union Aitken Creek a-53-L (3)[1]	Nov. 27, 1958	Apr. 11, 1959	7,297	3,049	Lower Cretaceous Bluesky-Gething gas well, whipstocked at 6,295 ft.
497	Union Fireweed d-53-G	Oct. 2, 1959	Nov. 29, 1959	5,177	5,177	Lower Cretaceous Dunlevy gas well.
437	Union-HB Milligan Creek d-96-A	Jan. 25, 1959	Feb. 9, 1959	3,742	3,742	Dry and abandoned.
423	Union-HB Milligan Creek d-41-G	Jan. 8, 1959	Jan. 21, 1959	3,724	3,724	Dry and abandoned.
409	Union-HB Milligan Creek d-42-G[1]	Dec. 21, 1958	Jan. 3, 1959	3,760		Triassic Halfway oil well.
435	Union-HB Milligan Creek d-43-G	Feb. 21, 1959	Mar. 5, 1959	3,750	3,750	Triassic Halfway oil well.
401	Union-HB Milligan Creek d-52-G	Jan. 24, 1959	Mar. 1, 1959	3,750	6,325	Triassic Halfway oil well. Original hole T.D., 4,202 ft., whipstocked at 1,745 ft., and redrilled to 3,750 ft.
440	Union-HB Milligan Creek d-63-G	Feb. 12, 1959	Feb. 27, 1959	3,729	3,729	Triassic Halfway oil well.
436	Union-HB Milligan Creek d-74-G	Jan. 31, 1959	Feb. 14, 1959	3,786	3,786	Triassic Halfway oil well.
449	Union-HB Milligan Creek d-20-H	Mar. 1, 1959	Mar. 14, 1959	3,700	3,700	Triassic Halfway gas well.
417	Union Richfield Scot Point d-85-I	Jan. 7, 1959	Jan. 19, 1959	3,752	3,752	Dry and abandoned.
530	Union-HB Wildmint 4-46-A	Dec. 14, 1959			3,728	Drilling.
429	West Can et al. Bissette 7-10-77-15	Jan. 17, 1959	Feb. 1, 1959	3,789	3,789	Dry and abandoned.

[1] Name changed during 1959.

NOTE.—Drilling data are compiled on the basis of a drilling day extending from 8 a.m. to the following 8 a.m.

Table 2.—Oil and Gas Fields Designated at December 31st, 1959

Field	Date Designated	Date(s) Revised	Pools[1]	Field Location	Number of Wells	Discovery Well
Beatton River	Aug. 7, 1959	....	9	N.T.S. 94-H-2	3	Triad Beatton River b-38-J, oil.
Beatton River West	Aug. 7, 1959	....	2	N.T.S. 94-H-2	4	Triad West Beatton River d-39-K, oil.
Blueberry	Feb. 7, 1958	Dec. 22, 1958	4, 6, 11	N.T.S. 94-A-12	11	Sun et al. Blueberry c-82-L (11), oil. Sun et al. Blueberry d-87-D (1), gas.
Blueberry East	Dec. 22, 1958	....	6, 9, 11	N.T.S. 94-A-13	2	Sun et al. E Blueberry b-36-C (17), gas. Sun et al. E Blueberry b-38-C (7), gas.
Blueberry West	Feb. 7, 1958	....	4, 6	N.T.S. 94-A-12	3	Sun et al. W Blueberry d-19-L (12), gas.
Boundary Lake	Oct. 30, 1956	Feb. 7, 1958 Aug. 7, 1959	7, 9	Tp. 85, R. 14, W. of 6th M.	30	Texaco NFA Boundary L 6-6-86-13 (1), oil. Pacific Boundary 8-15-85-14, gas.
Bubbles	Nov. 24, 1959	....	6, 7	N.T.S. 94-G-1, 94-G-8	8	Pacific Imperial Bubbles b-33-I, gas.
Buick Creek	Feb. 7, 1958	Aug. 7, 1959	5, 7	N.T.S. 94-A-11	6	Texaco NFA Buick Creek d-98-I (1), gas.
Buick Creek West	Feb. 7, 1958	Jan. 6, 1959	5, 6, 9	N.T.S. 94-A-14	14	Pacific W Buick Creek c-83-K (13A), oil. Pacific West Buick Creek b-23-E (1), gas.
Dawson Creek	Feb. 7, 1958	....	1	Tp. 79, R. 15, W. of 6th M.	4	Pacific Sc Dawson Creek 1-15-79-15 (1), gas.
Fort St. John	Aug. 22, 1955	Feb. 7, 1958	2, 3, 6, 7, 9, 10	Tp. 83, R. 18, W. of 6th M.	33	Pacific Ft St John 3-14-83-18 (9), oil. Pacific Ft St John 14-21-83-18 (4), gas.
Fort St. John Airport	Feb. 7, 1958	....	3, 6, 9	Tp. 83, R. 17, W. of 6th M.	3	Pacific Airport 8-32-83-17 (3), gas.
Fort St. John Southeast	Feb. 7, 1958	....	3, 6, 9, 10	Tp. 83, R. 17, W. of 6th M.	15	Pac Ft St John SE 4-10-83-17 (12), gas.
Gundy Creek	Feb. 7, 1958	Jan. 6, 1959	4, 6, 7	N.T.S. 94-B-16	4	Gulf States Gundy Creek c-80-A (2), gas.
Halfway	Dec. 22, 1958	....	6, 9	Tp. 87, R. 25, W. of 6th M.	3	Sun et al. Halfway 5-1-87-25, gas.
Highway	Feb. 7, 1958	....	4, 6, 11	N.T.S. 94-B-16	5	Phillips Highway b-25-I (1), gas.
Jedney	Aug. 7, 1959	Nov. 24, 1959	6, 7, 9	N.T.S. 94-G-1, 94-G-8	10	Pacific Imp Jedney d-99-J, gas.
Kiskatinaw	Feb. 7, 1958	....	12	Tp. 81, R. 15, W. of 6th M.	1	Pacific Imp Parkland 6-29-81-15, gas.
Kiskatinaw West	Feb. 7, 1958	....	7	Tp. 81, R. 17, W. of 6th M.	1	Pacific et al. Pingel 13-17-81-17 (1), gas.
Kobes-Townsend	Dec. 22, 1958	....	3, 7, 9, 11	N.T.S. 94-B-9	8	Phillips Kobes d-94-I (1), gas.
Milligan Creek	Feb. 7, 1958	Aug. 7, 1959	9	N.T.S. 94-H-2	9	Union-HB Milligan Creek d-73-G, oil.
Montney	Feb. 7, 1958	Jan. 6, 1959	2, 7, 9	Tp. 86, R. 19, 20, W. of 6th M.	3	Pac Sunray Montney 14-36-86-19 (2), gas.
Nig Creek	Aug. 7, 1959	....	7	N.T.S. 94-H-4	6	Texaco NFA Nig Creek a-79-B (1), gas.
Pouce Coupe	Aug. 22, 1955	Feb. 7, 1958	1	Tp. 80, R. 13, W. of 6th M.	2	Westcoast Pouce Coupe 6-30-80-13 (1), gas.
Red Creek	Feb. 7, 1958	Aug. 7, 1959	9, 10	Tp. 85, R. 21, W. of 6th M.	2	Pacific Red Creek 5-27-85-21 (36), gas.
Stoddart	Jan. 6, 1959	....	10	Tp. 86, R. 20, W. of 6th M.	2	Pacific Stoddart 4-24-86-20 (85), gas.
Sunrise	Feb. 7, 1958	....	1	Tp. 79, R. 16, W. of 6th M.	3	Pacific Sunrise 10-7-79-16 (3), gas.

[1] Pools listed numerically:—

1. Lower Cretaceous Cadotte sandstone.
2. Lower Cretaceous Bluesky-Gething sandstone.
3. Lower Cretaceous Cadomin sandstone.
4. Lower Cretaceous Nikanassin sandstone.
5. Lower Cretaceous Buick Creek sandstone.
6. Triassic Baldonnel dolomite and limestone.
7. Triassic Charlie Lake sandstone and carbonate.
8. Triassic Boundary Lake dolomite.
9. Triassic Halfway sandstone.
10. Permo-Pennsylvanian dolomite and limestone.
11. Mississippian Rundle limestone and dolomite.
12. Devonian Wabamun dolomite.

Table 3.—Well Operation and Production Statistics, 1959

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Well Data													
Drilling Authorities issued	13	12	1	4	4	5	10	12	12	18	10	26	127
Wells spudded	19	12	6	3	5	3	8	6	13	9	12	24	120
Rigs operated during month	31	33	32	15	14	13	15	18	21	24	27	37	———
Rigs operating at end of month	29	27	11	9	11	10	13	14	17	18	22	28	———
Development footage[1]	11,571	22,374	6,123	———	8,284	8,914	6,641	30,627	31,480	40,059	25,417	31,718	223,208
Exploratory outpost footage	20,067	11,695	15,483	6,514	7,349	8,996	10,029	6,005	9,052	7,474	12,845	33,317	148,826
Exploratory wildcat footage	43,487	44,516	26,995	11,722	11,055	10,625	16,016	9,962	8,249	17,332	15,227	27,641	242,827
Footage drilled, total	75,125	78,585	48,601	18,236	26,688	28,535	32,686	46,594	48,781	64,865	53,489	92,676	614,861
Wells abandoned	7	7	8	3	1	1	2	———	2	3	2	10	46
Oil Wells													
Completed	2	3	4	———	———	———	1	———	1	2	1	6	20
Capable of production	41	44	48	48	48	48	49	49	50	52	53	59	59
Operated	30	31	32	22	23	25	24	24	25	28	34	37	———
Production (bbl.)	84,640	69,399	73,864	40,296	64,767	72,738	66,138	54,534	81,924	71,666	92,805	93,338	866,109
Average daily production (bbl.)	2,821	2,313	2,462	1,343	2,159	2,425	2,205	1,814	2,731	2,389	3,094	3,111	———
Gas Wells													
Completed	1	3	6	3	2	2	3	5	7	2	6	4	44
Capable of production	150[2]	153	159	162	164	166	169	174	181	183	189	193	193
Operated	65	67	66	68	68	65	63	66	68	71	76	81	———
Production (M s.c.f.)[3]	6,489,841	5,642,760	6,134,493	6,006,812	5,724,000	4,914,911	4,870,333	5,190,542	4,888,352	5,877,815	6,259,988	7,128,861	69,128,708
Average daily production (M s.c.f.)	216,328	188,092	204,483	200,227	190,800	163,830	162,344	173,018	162,945	195,927	208,666	237,628	———
Gas-plant By-products													
Condensate (bbl.)	59,237	41,268	37,590	40,658	42,028	41,575	39,061	31,813	40,044	43,885	48,972	46,820	512,951
Natural gasoline (bbl.)	38,212	35,378	38,669	36,314	33,240	28,024	25,808	22,136	22,306	32,001	41,548	29,197	382,833
Butane (bbl.)	17,304	19,676	15,755	13,810	14,635	15,104	15,122	16,196	17,165	17,455	17,574	27,233	207,029
Propane (bbl.)	10,753	10,045	8,742	7,123	6,136	5,429	5,122	6,112	7,244	8,750	10,735	10,734	96,925
Sulphur (short tons)	5,127	4,281	4,847	4,639	4,326	3,475	3,772	4,275	3,806	4,892	4,806	5,448	53,694

[1] Includes deep pool test.
[2] Revised total at December 31st, 1958, 149.
[3] Excluding solution gas.

Table 4.—Crude-oil, Natural-gas, and Water Production, 1954–59

Year	Crude Oil (Bbl.)			Natural Gas (M s.c.f.)			Water (Bbl.)		
	Annual	Cumulative Total	Annual Daily Average	Annual	Cumulative Total	Annual Daily Average	Annual	Cumulative Total	Annual Daily Average
1954	......	......	......	60,883	60,883	166.3	......	......	......
1955	......	......	......	168,651	229,534	462.0	......	......	......
	582	582	1.6	(297)	(297)	(0.8)	......	......	......
1956	......	......	......	187,846	417,380	514.6	......	......	......
	148,454	149,036	406.7	(89,890)	(90,187)	(246.3)	354	354	0.97
1957	......	......	......	8,274,942	8,692,322	22,671.0	......	......	......
	345,320	494,356	946.1	(272,158)	(362,345)	(745.6)	400	754	1.1
1958	......	......	......	63,638,297	72,330,619	174,351.4	2,699	3,453	7.4
	512,359	1,006,715	1,403.7	(413,488)	(775,833)	(1,132.8)	759	4,212	2.1
1959	......	......	......	69,128,708	141,459,327	189,393.7	60,293	64,505	165.2
	866,109	1,872,824	2,372.9	(830,858)	(1,606,691)	(2,276.3)	79	64,584	0.2

( ) Oil-well solution gas flared.

Table 5.—Crude-oil Production by Fields and Pools, 1959

(Quantities in barrels.)

Field	Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1959	Total, 1958
Beatton River	Triassic Halfway	892	3,437	234	—	—	—	—	—	—	—	—	884	5,447	—
Beatton River West	Lower Cretaceous Bluesky-Gething	—	—	382	—	—	—	—	—	—	—	—	687	1,069	—
Blueberry	Mississippian Rundle	—	—	—	—	—	—	—	—	2,160	108	861	1,080	4,209	1,605
Boundary Lake	Triassic Boundary Lake	60,094	40,080	57,890	31,731	55,628	61,193	56,046	46,211	67,647	61,055	76,054	75,192	688,821	354,388
Buick Creek West	Lower Cretaceous Buick Creek	—	—	—	—	—	—	—	—	—	—	—	—	—	4,762
Fort St. John	Lower Cretaceous Bluesky-Gething	775	620	748	263	414	731	585	450	393	752	658	621	7,010	10,441
	Triassic Charlie Lake	9,574	7,687	8,660	8,302	8,725	8,743	7,801	6,464	9,534	8,951	7,838	8,322	100,601	119,977
	Permo-Pennsylvanian	—	—	—	—	—	2,071	1,706	1,409	2,190	800	966	92	9,234	6,705
Milligan Creek	Triassic Halfway	13,305	17,575	4,905	—	—	—	—	—	—	—	4,423	4,069	44,277	12,880
Other areas	Lower Cretaceous Bluesky-Gething	—	—	—	—	—	—	—	—	—	—	2,005	2,391	4,396	—
	Triassic Halfway	—	—	1,045	—	—	—	—	—	—	—	—	—	1,045	1,601
Totals		84,640	69,399	73,864	40,296	64,767	72,738	66,138	54,534	81,924	71,666	92,805	93,338	866,109	512,359

Table 5A.—Crude-oil Production by Fields and Pools, 1958

(Quantities in barrels.)

Field	Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1958	Total, 1957
Blueberry	Mississippian Rundle	1,605	—	—	—	—	—	—	—	—	—	—	—	1,605	4,375
Boundary Lake	Triassic Boundary Lake	21,559	18,443	36,304	1,443	23,010	24,952	30,846	28,913	38,963	48,730	30,213	51,012	354,388	199,220
Buick Creek West	Lower Cretaceous Buick Creek	—	—	—	—	641	2,419	1,132	373	197	—	—	—	4,762	3,086
Fort St. John	Lower Cretaceous Bluesky-Gething	1,599	1,069	1,468	216	738	811	810	757	777	789	701	706	10,441	3,997
	Triassic Charlie Lake	11,320	9,285	9,875	10,245	10,297	9,983	10,097	9,982	9,745	10,130	9,560	9,458	119,977	126,776
	Permo-Pennsylvanian	—	164	5,480	—	637	424	—	—	—	—	—	—	6,705	7,866
Milligan Creek	Triassic Halfway	1,882	3,754	941	—	—	—	—	—	—	—	—	6,303	12,880	—
Other areas	Triassic Halfway	—	—	—	—	—	—	—	—	—	—	900	701	1,601	—
Totals		37,965	32,715	54,068	11,904	35,323	38,589	42,885	40,025	49,682	59,649	41,374	68,180	512,359	345,320

Table 6.—Crude-oil Production by Months, 1955–59

(Quantities in barrels.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Cumulative Total
1955	....	582	....	....	....	....	....	....		....	....	....	582	582
1956	160	....	101	....	....	3,842	9,799	19,605	19,517	34,444	28,853	32,133	148,454	149,036
1957	34,556	35,426	34,015	16,309	32,549	29,896	28,359	16,501	35,689	31,959	28,419	21,642	345,320	494,356
1958	37,965	32,715	54,068	11,904	35,323	38,589	42,885	40,025	49,682	59,649	41,374	68,180	512,359	1,006,715
1959	84,640	69,399	73,864	40,296	64,767	72,738	66,138	54,534	81,924	71,666	92,805	93,338	866,109	1,872,824

Table 7.—Natural-gas Production by Fields and Pools, 1959

(Quantities in M s.c.f.)

Field	Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1959	Total, 1958
Beatton River	Triassic Halfway	(368)	(3,517)	(550)									(757)	(5,192)	(2,701)
Beatton River West	Lower Cretaceous Bluesky-Gething			(134)									(264)	(398)	
Blueberry	Lower Cretaceous Nikanassin	32,050	40,726	46,813	42,863	40,686	43,766	41,613	41,683	48,867	54,634	62,800	70,451	566,952	71,672
	Triassic Baldonnel	143,164	101,727	81,537	87,315	147,574	135,649	133,180	118,830	125,416	137,096	131,111	135,250	1,477,849	262,152
	Mississippian Rundle									(981)	(75)	(714)	(1,247)	(3,017)	(3,663)
Blueberry East	Triassic Baldonnel	68,191	73,034	78,903	69,852	68,197	32,932							391,109	153,713
	Triassic Halfway	42,018	34,157	40,143	44,085	44,120	12,934							217,457	87,963
	Mississippian Rundle	37,672	24,067	17,516	14,282	10,745	1,214	9,578	6,513	4,439	3,340	2,222	406	131,994	143,071
Blueberry West	Lower Cretaceous Nikanassin	19,639	19,079	18,834	17,270	15,231	14,873	15,642	14,099	14,441	11,297	13,465	10,765	184,635	45,558
	Triassic Baldonnel	56,135	49,163	52,289	49,629	50,393	39,597	25,547	21,224	22,599	28,368	23,450	41,358	459,752	115,148
Boundary Lake	Triassic Boundary Lake	(29,828)	(26,141)	(35,225)	(21,676)	(34,539)	(42,545)	(42,134)	(37,893)	(49,894)	(41,991)	(58,193)	(68,020)	(488,079)	(219,558)
Bubbles	Triassic Baldonnel										18,309	469,567	664,623	1,152,499	
Buick Creek	Lower Cretaceous Buick Creek												22,278	22,278	
Buick Creek West	Lower Cretaceous Buick Creek	1,269,677	978,003	1,088,308	1,077,765	1,125,329	827,665	889,047	857,698	924,395	1,087,181	1,005,413	1,186,188	12,316,669	7,475,506
	Lower Cretaceous Buick Creek														(1,412)
	Triassic Baldonnel														16,590
	Triassic Halfway	176,946	103,780	135,104	125,571	150,208	98,791	105,118	137,239	118,604	139,988	120,115	135,596	1,547,060	2,085,810
Dawson Creek	Lower Cretaceous Cadotte	2,067			91,730	84,860	86,896	99,777	92,801	90,951	91,106	82,758	97,758	820,704	879,224
Fort St. John	Lower Cretaceous Bluesky-Gething	(892)	(1,070)	(1,051)	(491)	(582)	(893)	(962)	(593)	(584)	(1,060)	(953)	(990)	(10,121)	(8,130)
	Lower Cretaceous Cadomin									14.047	2,646			16,693	
	Triassic Baldonnel "A" Zone	192,944	166,999	176,317	169,471	150,678	163,242	173,207	155,221	160,023	172,611	160,151	169,205	2,010,069	3,021,202
	Triassic Baldonnel "A" and "B" Zones	523,256	449,043	517,387	508,361	397,499	379,368	418,324	399,032	367,511	523,540	484,344	492,184	5,459,849	7,761,641
	Triassic Charlie Lake	(13,724)	(10,870)	(13,893)	(13,400)	(13,774)	(14,851)	(14,118)	(13,626)	(18,343)	(18,748)	(18,646)	(18,522)	(182,515)	(134,255)
	Triassic Halfway	763,804	675,007	731,620	738,379	632,439	535,740	534,669	633,706	546,412	676,524	630,980	648,194	7,747,474	12,203,733
	Permo-Pennsylvanian	160,288	129,577	135,922	129,090	107,318	95,106	81,016	105,178	92.802	124,721	104,434	100,678	1,366,130	2,987,885
	Permo-Pennsylvanian						(6,370)	(12,734)	(19,245)	(35.960)	(30,346)	(21,689)	(3,430)	(129,774)	(41,943)
Fort St. John S.E.	Lower Cretaceous Cadomin	12,306	36,953	41,443	40,443	33,797	10,841		228	13.816	49,123	45,636	39,129	323,715	172,095
	Triassic Baldonnel	92,072	76,137	82,387	77,707	55,208	65,725	67,938	65,168	59,716	74,115	75,925	61,920	854,018	1,269,930
	Triassic Halfway	116,652	128,157	102,186	117,409	123,043	28,073	50,053	197,115	162,402	326,288	383,669	348,342	2,083,389	2,750,928
	Permo-Pennsylvanian	695,953	648,771	711,437	674,279	655,760	665,962	549,388	631,570	598.642	631,254	672,956	623,120	7,759,092	9,521,470
Gundy Creek	Triassic Baldonnel	18,011	8,981	6,400		3,500				5.019	25,303	29,529	3,746	100,489	14,920
	Triassic Baldonnel-Charlie Lake	94,116	53,354	106,685	97,192	107,322	85,008	86,276	79,983	66,043	70,143	59,777	88,761	994,660	164,966
Halfway	Triassic Baldonnel	288,600	255,319	237,816	216,496	225,976	193,797	177,088	163,220	122.818	115,526	126,653	63,418	2,186,727	696,185
	Triassic Halfway	48,747	43,311	50,084	47,679	50,627	46,403	45,118	43,099	49.316	42,547	48,464	13,606	529,001	172,622
Highway	Lower Cretaceous Nikanassin	3,631	4,859	7,353	7,178	9,512	9,883	11,113	11,883	10.596	10,450	11,597	14,920	112,975	
	Triassic Baldonnel	48,752	102,459	124,503	98,422	113,988	108,528	97,605	57,357	39.427	38,866	25,096	26,649	881,652	153,431
	Mississippian Rundle	172,265	154,440	165,340	155,719	138,163	135,369	129,386	130,842	125.699	121,526	113,690	110,613	1,653,052	543,787
Jedney	Triassic Baldonnel											76,922	447,772	524,694	
	Triassic Halfway											46,538	136,380	182,918	

Kiskatinaw	Devonian Wabamun	81,310	97,914	98,072	145,323	140,119	123,644	112,874	163,223	175,088	177,433	189,878	308,646	1,813,524	1,679,539
Kobes-Townsend	Lower Cretaceous Cadomin		7,585	43,552	51,261	42,334	49,457	38,781	14,726	52,982	57,541	64,533	51,450	474,202	
	Triassic Charlie Lake	94,485	108,067	109,479	107,377	73,572	98,088	78,682	68,252	68,378	77,418	73,486	67,822	1,025,106	237,735
	Triassic Halfway	129,865	154,550	171,205	168,731	159,793	163,032	175,447	165,299	142,596	136,124	107,022	163,524	1,837,188	347,656
	Mississippian Rundle	530,188	417,455	413,601	324,120	263,249	185,424	235,512	298,364	244,234	280,142	248,465	235,906	3,676,660	1,364,204
Milligan Creek	Triassic Halfway	(2,393)	(3,016)	(980)								(1,135)	(1,100)	(8,624)	(1,826)
Montney	Lower Cretaceous Bluesky-Gething					76,363	72,237	70,236	55.820	61,924	73,062	75,468	68,542	833,773	1.284,892
	Triassic Charlie Lake														271,356
	Triassic Halfway	65,652	64,515	76,846	73,108										87,084
Red Creek	Triassic Halfway							25,829	47,734	43,539	49,314	40,403	47,326	254,145	377,371
Stoddart	Permo-Pennsylvanian	509,385	435,571	465,411	438,705	426,397	405,667	392,289	413,435	315,610	450,279	453,471	432,335	5,138,555	5,217,258
Other areas	Lower Cretaceous Bluesky-Gething											(947)	(1,889)	(2,836)	
	Triassic Halfway			(302)										(302)	
										Total natural gas produced (gas wells)				69,128,708	63,638,297
										Total solution gas flared (oil wells)				(830,858)	(413,488)
										Total natural-gas production				69,959,566	64,051,785

( ) Oil well solution gas flared.

Table 7A.—Natural-gas Production by Fields and Pools, 1958

(Quantities in M s.c.f.)

Field	Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1958	Total, 1957
Beatton River	Triassic Halfway	—	—	—	—	—	—	—	—	—	—	(458)	(2,243)	(2,701)	—
Blueberry	Lower Cretaceous Nikanassin	—	—	—	—	—	—	—	—	—	24,294	23,320	24,058	71,672	—
	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	19,682	91,666	150,804	262,152	—
	Mississippian Rundle	(3,663)	—	—	—	—	—	—	—	—	—	—	—	(3,663)	(8,614)
Blueberry East	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	45,945	70,114	37,654	153,713	—
	Triassic Halfway	—	—	—	—	—	—	—	—	—	—	30,487	57,476	87,963	—
	Mississippian Rundle	—	—	—	—	—	—	—	—	—	35,283	58,788	49,000	143,071	—
Blueberry West	Lower Cretaceous Nikanassin	—	—	—	—	—	—	—	—	—	1,341	26,085	18,132	45,558	—
	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	2,222	59,853	53,073	115,148	—
Boundary Lake	Triassic Boundary Lake	(17,578)	(15,795)	(27,445)	(4,370)	(12,866)	(13,103)	(19,730)	(19,397)	(21,874)	(28,280)	(17,926)	(21,194)	(219,558)	(124,445)
Buick Creek West	Lower Cretaceous Buick Creek	583,431	711,395	784,131	797,638	795,476	—	—	—	439,911	907,335	1,224,668	1,231,521	7,475,506	629,522
	Lower Cretaceous Buick Creek	—	—	—	—	(109)	(861)	(309)	(111)	(22)	—	—	—	(1,412)	(2,123)
	Triassic Baldonnel	—	—	4,565	4,081	7,944	—	—	—	—	—	—	—	16,590	—
	Triassic Halfway	101,161	103,813	207,208	213,239	237,506	212,735	182,996	172,505	132,772	178,673	178,008	165,194	2,085,810	1,234
Dawson Creek	Lower Cretaceous Cadotte	—	—	131,818	107,563	78,280	93,835	92,362	113,234	98,102	91,871	45,726	26,433	879,224	—
Fort St. John	Lower Cretaceous Bluesky-Gething	(1,362)	(677)	(1,047)	(191)	(460)	(347)	(597)	(651)	(695)	(800)	(540)	(763)	(8,130)	(2,355)
	Lower Cretaceous Cadomin	—	—	—	—	—	—	—	—	—	—	—	—	—	69,493
	Triassic Baldonnel "A" Zone	298,833	249,757	276,435	270,409	240,204	234,436	264,503	295,845	272,089	216,767	185,970	215,954	3,021,202	543,850
	Triassic Baldonnel "A" and "B" Zones	829,947	698,111	732,758	656,538	678,638	683,787	670,041	656,691	618,154	494,772	524,760	517,444	7,761,641	1,142,154
	Triassic Charlie Lake	(9,260)	(8,215)	(9,246)	(10,427)	(11,291)	(10,985)	(12,043)	(11,500)	(11,807)	(12,954)	(13,983)	(12,544)	(134,255)	(93,285)
	Triassic Halfway	1,300,706	1,118,000	1,222,739	1,085,959	1,077,850	1,025,528	997,987	996,625	924,008	845,000	804,033	805,298	12,203,733	1,931,032
	Permo-Pennsylvanian	450,151	349,939	333,726	246,781	267,772	226,244	226,133	211,521	181,088	158,880	168,540	167,110	2,987,885	713,327
	Permo-Pennsylvanian	—	(204)	(32,957)	—	(5,499)	(3,283)	—	—	—	—	—	—	(41,943)	(41,336)
Fort St. John S.E.	Lower Cretaceous Cadomin	22,951	19,066	20,243	20,887	18,661	15,575	14,164	15,649	16,528	8,372	—	—	172,095	13,046
	Triassic Baldonnel	123,487	111,718	161,074	133,525	112,874	93,945	92,331	84,087	103,887	102,546	59,530	90,926	1,269,930	185,208
	Triassic Halfway	236,007	300,081	310,200	295,090	291,343	259,859	216,205	176,001	182,803	196,840	150,793	135,706	2,750,928	351,101
	Permo-Pennsylvanian	978,886	802,362	836,823	815,923	842,230	783,413	801,500	827,381	739,891	756,027	639,458	697,576	9,521,470	1,361,374
Gundy Creek	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	—	—	14,920	14,920	—
	Triassic Baldonnel-Charlie Lake	—	—	—	—	—	—	—	—	—	—	39,791	125,175	164,966	—
Halfway	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	215,738	229,980	250,467	696,185	—
	Triassic Halfway	—	—	—	—	—	—	—	—	—	53,729	59,109	59,784	172,622	—
Highway	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	18,085	74,520	60,826	153,431	—
	Mississippian Rundle	—	—	—	—	—	—	—	—	—	96,979	243,901	202,907	543,787	—
Kiskatinaw	Devonian Wabamun	256,315	214,088	158,533	109,254	118,279	119,764	119,721	102,768	98,718	155,816	121,173	105,110	1,679,539	623,544
Kiskatinaw West	Triassic Baldonnel	—	—	—	—	—	—	—	—	—	—	—	—	—	167,089
Kobes-Townsend	Triassic Charlie Lake	—	—	—	—	—	—	—	—	—	16,268	109,711	111,756	237,735	—
	Triassic Halfway	—	—	—	—	—	—	—	—	—	39,509	151,436	156,711	347,656	—
	Mississippian Rundle	—	—	—	—	—	—	—	—	46,039	255,471	521,430	541,264	1,364,204	—
Milligan Creek	Triassic Halfway	(377)	(849)	(123)	—	—	—	—	—	—	—	—	(477)	(1,826)	—

Montney	Lower Cretaceous Bluesky-Gething	4,797	9,740	11,299	11,826	9,134	7,798	5,631	7,841	9,593	8,509	916	.....	87,084	.....
	Triassic Charlie Lake	.....	*23,263*	*39,535*	*41,584*	*41,604*	*39,765*	*17,943*	*34,276*	*26,509*	*6,877*	.....	.....	*271,356*	.....
	Triassic Halfway	114,449	112,779	107,673	98,107	149,609	139,331	116,785	111,971	103,285	75,770	78,044	77,089	1,284,892	94,117
Red Creek	Triassic Halfway	25,392	45,760	46,795	41,503	42,682	36,829	41,125	33,468	32,694	29,323	1,770	.....	377,371	.....
Stoddart	Permo-Pennsylvanian	439,546	390,312	407,764	413,738	456,203	453,637	450,645	399,315	420,818	475,523	453,703	456,054	5,217,258	448,851
											Total natural gas produced (gas wells)			63,638,297	8,274,942
											Total solution gas flared (oil wells)			(413,488)	(272,158)
											Total natural-gas production			64,051,785	8,547,100

( ) Oil-well solution gas flared.

Table 8.—Natural-gas Production by Months, 1954–59

(Quantities in M s.c.f.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Cumulative Total
1954	—	—	—	—	—	4,868	5,374	6,550	8,505	9,407	12,502	13,677	60,883	60,883
1955	17,287	16,071	20,555	15,187	10,940	6,581	9,533	6,653	10,786	13,861	20,833	20,364	168,651	229,534
	—	(297)	—	—	—	—	—	—	—	—	—	—	(297)	(297)
1956	21,049	17,941	17,020	13,965	11,021	8,693	7,239	8,023	12,737	16,985	20,247	32,926	187,846	417,380
	(72)	—	(45)	—	—	(2,028)	(5,068)	(10,277)	(9,885)	(18,292)	(19,313)	(16,910)	(81,890)	(90,187)
1957	30,023	54,500	112,447	86,358	64,521	10,922	33,624	30,667	21,794	264,060	2,258,717	5,307,309	8,274,942	8,692,322
	(21,676)	(25,515)	(27,125)	(16,791)	(20,093)	(19,269)	(22,426)	(16,658)	(23,735)	(28,981)	(25,244)	(24,645)	(272,158)	(362,345)
1958	5,766,059	5,260,184	5,793,319	5,363,645	5,466,289	4,426,481	4,310,102	4,239,177	4,446,889	5,533,447	6,427,283	6,605,422	63,638,297	72,330,619
	(32,240)	(25,740)	(70,818)	(14,988)	(30,225)	(28,579)	(32,679)	(31,659)	(34,398)	(42,034)	(32,907)	(37,221)	(413,488)	(775,833)
1959	6,489,841	5,642,760	6,134,493	6,006,812	5,724,000	4,914,911	4,870,333	5,190,542	4,888,352	5,877,815	6,259,988	7,128,861	69,128,708	141,459,327
	(47,205)	(44,614)	(52,135)	(35,567)	(48,895)	(64,659)	(69,948)	(71,357)	(105,762)	(92,220)	(102,277)	(96,219)	(830,858)	(1.606.691)

( ) Oil-well solution gas flared.

Table 9.-Condensate, Natural-gasoline, Butane, Propane, and Sulphur Production, 1959

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1959	Total, 1958
Condensate (bbl.)	59,237	41,268	37,590	40,658	42,028	41,575	39,061	31,813	40,044	43,885	48,972	46,820	512,951	251,055
Natural gasoline (bbl.)	38,212	35,378	38,669	36,314	33,240	28,024	25,808	22,136	22,306	32,001	41,548	29,197	382,833	339,024
Butane (bbl.)	17,304	19,676	15,755	13,810	14,635	15,104	15,122	16,196	17,165	17,455	17,574	27,233	207,029	81,609
Propane (bbl.)	10,753	10,045	8,742	7,123	6,136	5,429	5,122	6,112	7,244	8,750	10,735	10,734	96,925	69,095
Sulphur (short tons)	5,127	4,281	4,847	4,639	4,326	3,475	3,772	4,275	3,806	4,892	4,806	5,448	53,694	62,604

Table 9A.—Condensate, Natural-gasoline, Butane, Propane, and Sulphur Production, 1958

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1958	Total, 1957
Condensate (bbl.)	48,285	19,928	4,568	5,244	......	......	......	27,633	27,169	27,706	40,169	50,333	251,055	27,964[1]
Natural gasoline (bbl.)	3,672	18,311	34,173	22,698	36,474	45,127	24,425	28,219	26,530	25,469	38,951	34,975	339,024	......
Butane (bbl.)	2,955	1,101	498	374	11,554	6,747	10,511	9,197	10,030	4,318	5,093	19,231	81,609	......
Propane (bbl.)	4,988	5,653	6,433	237	5,297	3,551	6,058	3,678	6,445	9,276	6,200	11,279	69,095	......
Sulphur (short tons)	5,074	5,052	5,805	5,738	5,954	5,225	5,201	4,875	4,656	4,845	4,985	5,194	62,604	......

[1] Production commenced in December, 1957.

Table 10.—Disposition of Crude Oil and Natural Gas, 1959

CRUDE-OIL DISPOSITION

(Quantities in barrels.)

Sales to—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1959
X-L refinery	63,083	51,130	66,804	33,644	66,449	71,688	62,160	49,455	76,270	69,872	85,826	81,979	778,360
Other	16,852	23,324	10,275	330	154	1,723	2,045	2,140	5,187	2,113	7,957	11,476	83,576
Totals	79,935	74,454	77,079	33,974	66,603	73,411	64,205	51,595	81,457	71,985	93,783	93,455	861,936

Table 10.—Disposition of Crude Oil and Natural Gas, 1959—Continued

NATURAL-GAS DISPOSITION
(Quantities in M s.c.f.)

Month	Field						Gas-Gathering System			
	Total B.C. Production			Flared	Lease Fuel	Delivered to G.G.S.	Received from B.C. Producers	Line Loss and Metering Difference[1]	Delivered to—	
	Wet Gas	Dry Gas	Solution Gas						Westcoast Transmission (Dry Gas)	Gas Plant (Wet Gas)
January	6,406,464	83,377	47,205	47,205	24,050	6,465,791	6,465,791	−54,397	82,551	6,437,637
February	5,544,846	97,914	44,614	44,614	25,164	5,617,596	5,617,596	−141,330	96,915	5,662,011
March	6,036,421	98,072	52,135	52,135	27,677	6,106,816	6,106,816	−154,779	96,999	6,164,596
April	5,769,759	237,053	35,567	35,567	27,559	5,979,253	5,979,253	−169,210	236,142	5,912,321
May	5,499,021	224,979	48,895	48,895	27,960	5,696,040	5,696,040	−72,145	224,261	5,543,924
June	4,704,371	210,540	64,659	64,659	23,158	4,891,753	4,891,753	−4,957	210,013	4,686,697
July	4,657,682	212,651	69,948	69,948	24,022	4,846,311	4,846,311	−83,856	211,886	4,718,281
August	4,934,518	256,024	71,357	71,357	25,569	5,164,973	5,164,973	−100,130	255,246	5,009,857
September	4,622,313	266,039	105,762	105,762	24,916	4,863,436	4,863,436	−87,904	265,237	4,686,103
October	5,609,276	268,539	92,220	92,220	31,737	5,846,078	5,846,078	−23,665	267,060	5,602,683
November	5,987,352	272,636	102,277	102,277	43,792	6,216,196	6,216,196	−23,185	271,726	5,967,655
December	6,722,457	406,404	96,219	96,219	67,183	7,061,678	7,061,678	−122,306	404,209	6,779,775
Totals	66,494,480	2,634,228	830,858	830,858	372,787	68,755,921	68,755,921	−1,037,864	2,622,245	67,171,540

Month	Gas Plant					Transporters								
	B.C. Wet Gas Received from G.G.S.	Plant Fuel	Processing Shrinkage	Plant Waste and Metering Difference[1]	Marketable Residue Gas	Receipts			Line Loss and Metering Difference[1]	Sales to Purchasers and Distributors				Total Sales
						Marketable Residue Gas from Plant	B.C. Dry Gas from G.G.S.	Alberta Dry Gas Imports		British Columbia			United States	
										North-east	Interior	Lower Mainland		
January	6,437,637	189,918	324,780	22,433	5,900,506	5,900,506	82,551	3,001,787	92,448	249,925	426,202	1,427,263	6,789,006	8,892,396
February	5,662,011	174,511	286,634	83,312	5,117,554	5,117,554	96,915	2,615,049	99,250	175,150	370,395	1,284,023	5,900,700	7,730,268
March	6,164,596	186,206	296,841	−30,332	5,711,881	5,711,881	96,999	2,702,635	150,247	147,113	341,210	1,306,039	6,566,906	8,361,268
April	5,912,321	187,453	279,893	−6,135	5,451,110	5,451,110	236,142	2,612,150	178,732	114,810	253,188	1,105,646	6,647,026	8,120,670
May	5,543,924	176,507	268,347	−59,346	5,158,416	5,158,416	224,261	1,972,798	155,735	85,130	260,698	881,861	5,972,051	7,199,740
June	4,686,697	169,671	224,634	−91,589	4,383,981	4,383,981	210,013	1,375,574	30,466	63,854	210,628	741,570	4,923,050	5,939,102
July	4,718,281	162,224	231,718	−55,367	4,379,706	4,379,706	211,886	1,454,440	64,027	50,262	186,806	625,385	5,119,552	5,982,005
August	5,009,857	173,148	258,886	10,970	4,566,853	4,566,853	255,246	1,606,329	118,605	61,898	263,337	700,009	5,284,579	6,309,823
September	4,686,103	158,518	235,770	−10,482	4,302,297	4,302,297	265,237	1,857,290	51,565	85,625	356,173	867,914	5,063,547	6,373,259
October	5,602,683	182,252	292,485	−34,833	5,162,779	5,162,779	267,060	2,313,010	55,640	122,329	419,008	1,286,615	5,859,257	7,687,209
November	5,967,655	245,935	317,397	−116,290	5,520,613	5,520,613	271,726	2,254,159	146,021	157,018	523,227	1,706,589	5,513,643	7,900,477
December	6,779,775	259,375	389,782	−117,074	6,247,692	6,247,692	404,209	2,709,123	51,962	163,872	529,523	1,940,330	6,675,337	9,309,062
Totals	67,171,540	2,265,718	3,407,167	−404,733	61,903,388	61,903,388	2,622,245	26,474,344	1,194,698	1,476,985	4,140,395	13,873,244	70,314,654	89,805,279

[1] Differences in metered volumes necessitate adjustments between metering stations. The total of metering difference and line loss (or plant waste) is subtracted algebraically from the appropriate total; thus a minus figure represents an actual gain.

Table 10A.—Disposition of Crude Oil and Natural Gas, 1958

CRUDE-OIL DISPOSITION

(Quantities in barrels.)

Sales to—	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total, 1958
X-L refinery	29,683	31,639	47,970	10,278	32,494	33,219	42,994	40,206	51,375	54,085	38,863	64,316	477,122
Other	1,745	4,168	6,007	602	301	3,352	1,338	491	591	609	1,332	7,985	28,521
Totals	31,428	35,807	53,977	10,880	32,795	36,571	44,332	40,697	51,966	54.694	40,195	72,301	505,643

Table 10A.—Disposition of Crude Oil and Natural Gas, 1958—Continued

NATURAL-GAS DISPOSITION
(Quantities in M s.c.f.)

Month	Field						Gas-gathering System			
	Total B.C. Production			Flared	Lease Fuel	Delivered to G.G.S.	Received from B.C. Producers	Line Loss and Metering Difference[1]	Delivered to—	
	Wet Gas	Dry Gas	Solution Gas						Westcoast Transmission (Dry Gas)	Gas Plant (Wet Gas)
January	5,509,744	224,075	32,240	32,240	21,571	5,712,248	5,712,248	—70,645	255,168	5,559,965
February	5,046,096	188,348	25,740	25,740	20,604	5,213,840	5,213,840	—54,442	213,052	5,080,970
March	5,502,968	219,533	70,818	70,818	22,913	5,699,588	5,699,588	—54,723	294,957	5,530,172
April	5,146,828	201,829	14,988	14,988	21,800	5,326,857	5,326,857	—68,848	223,286	5,187,407
May	5,269,730	166,334	30,225	30,225	22,367	5,413,697	5,413,697	—82,687	200,938	5,325,671
June	4,212,882	185,020	28,579	28,579	19,625	4,378,277	4,378,277	—137,634	213,040	4,331,450
July	4,098,019	179,404	32,679	32,679	19,758	4,257,665	4,257,665	—114,543	211,899	4,192,988
August	4,023,175	184,343	31,659	31,659	20,224	4,187,294	4,187,294	—89,393	215,970	4,092,376
September	4,250,069	162,422	34,398	34,398	21,182	4,391,309	4,391,309	—71,760	195,383	4,302,084
October	5,285,760	205,653	42,034	42,034	23,051	5,468,362	5,468,362	—78,916	245,856	5,343,462
November	6,260,384	133,992	32,907	32,907	27,831	6,366,545	6,366,545	—26,022	162,045	6,263,402
December	6,473,879	94,322	37,221	37,221	24,750	6,543,451	6,543,451	—57,820	127,238	6,511,254
Totals	61,079,534	2,145,275	413,488	413,488	265,676	62,959,133	62,959,133	—907,433	2,558,832	61,721,201

Month	Gas Plant					Transporters								
	B.C. Wet Gas Received from G.G.S.	Plant Fuel	Processing Shrinkage	Plant Waste and Metering Difference[1]	Marketable Residue Gas	Receipts			Line Loss and Metering Difference[2]	Sales to Purchasers and Distributors				Total Sales
						Marketable Residue Gas from Plant	B.C. Dry Gas from G.G.S.	Alberta Dry Gas Imports		British Columbia			United States	
										North-east	Interior	Lower Mainland		
January	5,559,965	([2])	560,015	—6,512	5,006,462	5,006,462	255,168	3,242,996	112,920	157,119	176,858	833,123	7,224,606	8,391,706
February	5,080,970	([2])	549,360	—9,508	4,541,118	4,541,118	213,052	2,181,070	—48,754	180,806	161,294	713,818	5,928,076	6,983,994
March	5,530,172	([2])	632,822	—31,925	4,929,275	4,929,275	294,957	3,601,992	—57,242	161,198	156,176	803,991	7,762,101	8,883,466
April	5,187,407	205,665	296,458	—662	4,685,946	4,685,946	223,286	3,477,005	196,839	115,405	105,372	650,223	7,318,398	8,189,398
May	5,325,671	149,905	324,609	59,235	4,791,922	4,791,922	200,938	1,815,969	878	75,177	83,753	483,383	6,165,638	6,807,951
June	4,331,450	179,435	265,577	59,786	3,826,652	3,826,652	213,040	2,120,196	183,768	53,778	53,712	447,066	5,421,564	5,976,120
July	4,192,988	184,629	275,226	33,957	3,699,176	3,699,176	211,899	2,531,990	—142,748	57,189	76,987	416,015	6,035,622	6,585,813
August	4,092,376	153,624	260,034	31,874	3,646,844	3,646,844	215,970	3,223,943	105,671	67,611	114,568	456,644	6,342,263	6,981,086
September	4,302,084	156,167	256,545	15,459	3,873,929	3,873,929	195,383	2,948,681	132,251	98,974	118,785	576,863	6,091,120	6,885,742
October	5,343,462	228,533	297,550	22,503	4,794,876	4,794,876	245,856	2,790,292	213,712	110,276	190,856	832,121	6,484,059	7,617,312
November	6,263,402	164,059	310,419	82,070	5,706,854	5,706,854	162,045	2,600,283	91,714	158,918	298,280	1,142,096	6,778,174	8,377,468
December	6,511,254	239,726	331,866	—37,959	5,977,605	5,977,605	127,238	2,836,760	58,627	201,557	314,960	1,304,238	7,062,221	8,882,976
Totals	61,721,201	1,661,743	4,360,481	218,318	55,480,659	55,480,659	2,558,832	33,371,177	847,636	1,438,008	1,851,601	8,659,581	78,613,842	90,563,032

[1] Differences in metered volumes necessitate adjustments between metering stations. The total of metering difference and line loss (or plant waste) is subtracted algebraically from the appropriate total; thus a minus figure represents an actual gain.
[2] Included in processing shrinkage.

Table 11.—Value to Producers of Crude Oil by Months, 1955–59

(Dollars.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Cumulative Total
1955	....	....	....	....	264	72	72	....	....	72	....	....	480	480
1956	460	....	182	....	44	3,963	14,046	32,670	41,813	75,094	64,689	66,363	299,322	299,802
1957	76,089	78,839	80,090	28,737	72,336	66,726	58,702	38,786	84,202	54,120	68,014	57,109	763,751	1,063,553
1958	63,605	68,586	104,292	24,517	65,940	72,629	88,935	82,223	104,441	110,289	82,719	141,433	1,009,609	2,073,162
1959	145,667	131,560	149,864	63,899	123,904	135,748	118,374	95,578	146,676	132,800	166,372	162,786	1,573,227	3,646,390

Table 12.—Value to Producers of Marketable Gas by Months, 1954–59

(Dollars.)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Cumulative Total
1954	....	....	....	....	....	523	578	704	914	1,011	1,344	1,470	6,545	6,545
1955	1,858	1,728	2,210	1,633	1,176	707	1,025	715	1,160	1,490	2,240	2,189	18,130	24,675
1956	2,213	1,929	1,830	1,501	1,185	934	778	862	1,369	1,826	2,177	3,540	20,143	44,818
1957	3,041	3,765	6,678	5,667	4,394	1,095	2,497	2,313	1,792	15,096	116,498	270,995	433,830	478,648
1958	302,569	273,387	300,416	282,302	287,114	232,301	224,905	224,257	233,982	289,864	351,549	365,682	3,368,327	3,846,976
1959	358,387	312,348	347,953	340,737	329,678	275,183	275,037	288,844	273,596	325,238	371,419	430,418	3,928,839	7,775,815

Table 13.—Value to Producers of Natural-gas Liquid Products and Sulphur by Months, 1957–59

(Dollars.)

Year	Product	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Cumulative Total
1957	Natural-gas liquids	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	Sulphur	....	....	....	....	....	....	....	....	....	....	3,013	8,630	11,643	11,643
1958	Natural-gas liquids	586	1,154	1,787	97,016	46,036	56,611	31,496	32,662	34,011	33,486	48,930	44,520	428,297	428,297
	Sulphur	11,468	12,148	8,029	10,377	10,421	9,569	9,447	9,023	8,664	9,184	11,572	10,821	120,723	132,366
1959	Natural-gas liquids	48,049	46,288	40,920	49,330	38,900	32,847	32,109	26,304	28,572	40,096	44,259	37,389	465,062	893,359
	Sulphur	10,793	9,111	10,105	5,393	5,021	3,876	4,302	4,957	4,837	5,225	4,523	5,969	74,111	206,476

Table 14.—Proved Reserves of Recoverable Oil, Gas, and Gas By-products at December 31st, 1959

	Crude Oil[1]	Raw Gas[2]	Disposable Gas	Gas Liquids	Sulphur
	Bbl.	Million Cu. Ft.	Million Cu. Ft.	Bbl.	Short Tons
Reserves remaining at end of 1958	41,051,841	1,906,400	1,716,600	43,026,522	1,615,673
Production during 1959	866,109	69,129	64,526	1,987,566[3]	55,061[3]
Adjustments made during 1959[4]	+56,285	−187,231	−173,074	−1,071,094	+44,208
Reserves discovered during 1959	16,973,759	1,117,900	982,800	21,953,309	436,901
Reserves remaining at end of 1959	57,215,776	2,767,940	2,461,800	61,921,171	2,041,721

[1] The proved reserve of crude oil in some instances, where justified by structural conditions, may include up to 50 per cent of the probable reserve.

[2] Excludes the solution gas produced with crude oil and gas in the gas-caps of oil reservoirs while still in the stage of primary recovery.

[3] The production of gas liquids and sulphur are the quantities estimated from gas analyses to have been produced with the raw gas, both sweet and sour, and are not the quantities actually extracted; for example, the amount of sulphur actually extracted during 1959 was 53,694 short tons.

[4] Reserves are continually under revision as data are provided by additional drilling and production.

Inspection of Lode Mines, Placer Mines, and Quarries

By J. W. Peck, Chief Inspector of Mines

CONTENTS

PRODUCTION

The output of metal mines for 1959 was 6,990,985 tons. This tonnage was produced from sixty mines, of which forty-four produced 100 tons or more.

FATAL ACCIDENTS

During 1959 there were eighteen fatal accidents connected with lode mines, placer mines, and quarries. This was fourteen more than in 1958.

Tonnage mined per fatal accident during the last ten-year period was 897,250 tons.

The following table shows the mines at which fatal accidents occurred during 1959, with comparative figures for 1958:—

Mine	Mining Division	Number of Fatal Accidents	
		1959	1958
Beale Quarry	Nanaimo	1	....
Birkett Creek	Nicola	..	1
Britannia	Vancouver	1	....
Bralorne	Lillooet	2	....
Cassiar	Liard	2	....
Cariboo Gold Quartz	Cariboo	2	....
Emerald	Nelson	....	1
Empire Mining	Nanaimo	1	....
Ford Iron	Alberni	1	....
Mineral King	Golden	1	....
Pine Creek Placer	Atlin	....	1
Pioneer	Lillooet	1	....
Quarry Bay	Nanaimo	1	....
Sullivan	Fort Steele	1	....
Texada Mines	Nanaimo	....	1
Torbrit	Skeena	1	....
Vimy Exploration	Nanaimo	1	....
West Columbia Gold Placers	Revelstoke	1	....
Western Nickel (now Giant Nickel)	Vancouver	1	....
Totals		18	4

The following table classifies fatal accidents as to cause and location:—

Cause	Number	Location
Falls of ground	5	4 underground, 1 surface.
Haulage, surface	3	Surface.
Haulage, underground	3	Underground.
Hoisting	1	Underground.
Machinery	1	Surface.
Miscellaneous	5	Surface.
Total	18	

A description of all fatal accidents follows.

Karl Kronseth, aged 50, married, and employed as a power-house operator by Pioneer Gold Mines of B.C. Limited, was killed by gun shot some time between 7.45 a.m. and 7 pm. on January 20th, 1959, while patrolling the water-lines which supplied the mine and plant.

Karl Kronseth had left his home early in the morning, travelling on skis and carrying a rifle. The rifle was protection against a cougar which had been reported following him on other patrols. The carrying of a rifle had been approved by his foreman. When Kronseth did not return home by 4 p.m. a search was instituted, and the deceased was found lying on his back, one ski on and one off. A rolled cigarette was still in his mouth. The body was nearly frozen. The rifle was lying on the deceased's chest. An autopsy revealed that a bullet had entered the left side between the fifth and sixth ribs, passing through the heart and coming out the back right side below the shoulder blade. Powder bums were found on the left side. Death would have been instantaneous.

The rifle was a Swedish 30-06. It had four cartridges in the magazine and one spent cartridge in the chamber. The safety catch was in the " off " position, but it was found the rifle could still be fired with the catch in this position.

There was no evidence of homicide or suicide. Kronseth was a well-known rifle shot and a careful, conscientious man. It is surprising that he would carry a cartridge in the chamber of the rifle while travelling on the trail.

The verdict of the inquest was accidental death. A recommendation was added that when a man performs duties in isolated place, he be required to check in by telephone at definite specified times.

Adelard Bouillion, aged 39, married, and employed as a miner by Torbrit Silver Mines Limited at the Toric mine was killed in a snow and rock slide on the surface railway on April 7th. 1959, at about 1 p.m.

The surface railway, where the accident took place, extends along the side of a mountain slope for a distance of about one-half mile from mine to mill. It is of P-foot gauge and is covered with a snowshed for its entire length. On the day of the accident, the train crew was making its second trip from the mill to the mine. Adelard Bouillion was riding as switchman in the first car of a five-car train of empties when a slide of snow and rock crashed down on the snowshed, collapsing the shed around the first two cars. The motorman saw Bouillion stand up and endeavour to shield himself with his arms before he was buried by debris. The motorman tried without success to reverse the train. Help was then obtained, and in about twenty minutes Bouillion's body was uncovered, but there was no evidence of life.

About 40 feet of snowshed was carried away by the slide. A slide had occurred in this area about eight years previously and one in March, 1959, but the main problem has been the removal of heavy snow from the snowshed rather than slides.

In March a reported 12 feet of snow had fallen, accompanied by some rain. On the day of the slide it was warm and the snow was melting.

A coroner's jury made no recommendations.

Lazo Delic, employed as a mechanic's helper by Cassiar Asbestos Corporation Limited, was fatally injured while working on a tram-line tower on May 13th, 1959, at about 4 p.m.

Lazo Delic had been detailed to grease the sheave hub on No. 5 angle station of the tram-line. This sheave is 15 feet in diameter and is installed horizontally in a steel tower 82 feet above the ground. To grease the hub, the procedure is to climb the ladder to the toq of the tower., unscrew the grease CUD from the hub. and then fill and replace it. Access to the fitting is from above' the sheave and directly over the spokes via a steel channel 8 inches wide. There were no witnesses to the accident, but apparently Delic was in the process of replacing the grease cup when in some undetermined manner he fell or slipped into the spokes of the sheave wheel, which was in rotation. He was carried around and fatally crushed between the spokes and the tower components. The body was found about twenty minutes later, but death could be presumed to have been sudden.

All tram-line workers had been instructed not- to work on the towers when the tram-line was in operation. The deceased had had experience the previous year on tram-line towers and was regarded as a capable worker and a good climber.

The coroner's jury returned a verdict that Lazo Delic met his death by accident and no blame was attached to anyone.

Edward Rejman, aged 48, single, and employed as a trammer, was fatally injured at the Mineral King mine, Toby Creek, at approximately 11.20 p.m. on May 25th after being buried under a comparatively small quantity of rock.

Rejman, acting as trammer and motorman on No. 6 level, was loading two 2-ton-capacity side-tipping V-type rocker cars from the 66.4 chute at the time of the accident, assisted by a scraperman. After loading one car he had to clean a small amount of spillage of muck from between the wheels of the loaded car prior to moving. He leaned over between the car and the chute, and while so doing the hopper of the car tipped over, completely burying him with muck from the car. with the exception of a portion of his legs. His partner, who was standing at the other side of the car, tried to right the car and remove some of the muck from Rejman. He failed to do so and had to summon help. Rejman was released fifteen minutes later, but showed no sign of life on his release. He did not respond to artificial respiration, which was applied for approximately two hours until the arrival of the doctor from Invermere, who pronounced him dead.

It is suspected that the locking device on the hopper was not properly set prior to loading the car, and the deceased, in leaning over to clean the spillage from the rail, grasped the top of the hopper, and in so doing caused the hopper to tip. The locking device was checked after the accident and was found to be in working order. The checking of the locking device would be done by the deceased, as he was in charge of the loading, and his partner had only been sent to assist him.

The coroner's jury returned the verdict that Rejman had met his death as a result of suffocation and no blame was attached to anyone.

William Stanley Austin, aged 33, married, and employed as a miner by Giant Nickel Mines Limited near Hope, died in Vancouver on July 18th, 1959, as a result of severe pelvic injuries received from a fall of rock in the mine on July 9th, 1959.

The accident occurred in the Brunswick No. 5 stope, which is a shrinkage stope 30 to 40 feet wide in a nearly vertically dipping orebody, extending above the 3550 level. Austin, in company with two other miners, entered the stope on the day shift of July 9th and they commenced examining the place, scaling down loose rock, and washing down. At about 9.05 a.m. a large rock fell on Austin and one other miner, seriously injuring them and rendering them semi-conscious. The shiftboss was immediately notified, help was obtained, and the men were taken to Hope and later to Vancouver.

According to information obtained from the uninjured miner, who was washing down at the time, both injured men had begun to scale the back of the stope, but experienced great diiculty in barring down one piece of rock which appeared to be broken along a sulphide slip. They tried for some time to get it down with their 8- to 9-foot scaling-bars, but without success. It would seem that they then gave up for the time being and continued to scale other loose rock near by. While doing this, they evidently stood under the above-mentioned rock, which fell without warning a distance of about 9 feet. It broke into three or four pieces, but later measurements indicated it was approximately 5 by 2½ feet by 1 foot and weighed about 500 pounds.

The coroner's jury found that death was accidental, but made the following recommendations:-

(1) The mining regulations contain a provision stating that if loose rock cannot be brought down by a scaling-bar, blasting-powder must be used.

(2) A man be designated in charge of safety practices in a work area consisting of three or more men.

(3) Where piecework is being carried out, safety regulations be strictly enforced.

(4) In the future, all witnesses to accidents be required to make a statement as soon as possible.

Wilmot Swann, aged 34, married, and employed as a timberman at the Sullivan mine, Kimberley, died at the Kimberley hospital at 1 a.m. on August 1st as the result of pelvic and internal injuries received in a train collision in the mine on July 28th, 1959, at 8.30 a.m.

The accident occurred on the 4200 level. The ore-train was returning empty with seven ore-cars ahead of the locomotive when it was diverted into a side crosscut. Swann, who was operating a locomotive pushing an explosive-car and a flat car in the crosscut, saw the train coming and attempted to run back past his own train to a place of safety after jumping off his locomotive. The collision of the two trains, however, caused the explosive-car and flat car to derail. Swann was crushed against the side of the roadway. First aid was immediately applied and he was rushed to the hospital.

The crosscut where the accident occurred is at right angles to the main haulage track, and thus the driver of the ore-train could not observe what was happening. It is apparent that the switch to this crosscut must have been left open, contrary to the instructions which had been issued to all workmen concerned. It is thought the deceased left the switch open himself, as he had just previously operated his locomotive on the main track. Whether he had overlooked the switch or intended to bring his train back before the ore-train arrived is not known. He was accustomed to haulage, although classified as a timberman, but had only been employed on the locomotive since the previous day. He had been instructed as to procedure and was considered a conscientious worker and safety minded.

The coroner's jury recommended the following:—

(1) That warning lights be placed on all railway switches underground.

(2) That all trains have a light on the end car clearly visible to the motorman.

(3) That all precautions be taken to ensure that no employee be assigned to motor duties underground until they are thoroughly familiar with operating procedure.

(4) That all underground mobile units in operating areas carry a crew of two.

Victor E. Warren, aged 36, married, and employed as a miner at the Bralorne mine, was fatally injured during shaft-sinking procedures in the Queen shaft on August 18th at about 7.30 p.m.

The Queen shaft is an internal shaft extending, until commencement of the present sinking, from No. 26 level to No. 35 level, a distance of 1,350 feet. The shaft is now being sunk from No. 35 level to a projected 41st level, and at the time of the accident the shaft bottom was 115 feet below No. 36 level, The shaft comprises four compartments, and the dimensions outside the timbering are 18 feet 6 inches by 6 feet 4 inches. The shaft is timbered with sets at 6-foot intervals, and at the time of the accident the blasting set was 37 feet from the shaft bottom, The shaft is mucked out with a Cryderman mucker, which is in the north compartment. The muck is hoisted by sinking-bucket to No. 32 level, where it is dumped into a pocket, from whence it is hoisted up the main section of the shaft and distributed as fill in the stopes. The sinking is carried on on two shifts. On the night of the accident the crew consisted of the hoistman, the shaft leader, the deceased, and two other miners.

At the beginning of the shift on August 18th, the hoistman lowered the other four men in the bucket. Two men remained on the blasting set, while the shaft leader and Warren descended farther in the bucket to scale the shaft from the blasting set downward. Warren was standing on the lip of the bucket, steadying it, while the shaft leader was using the scaling-bar and standing on the floor of the bucket. The safety crosshead, which normally provides effective cover over the bucket, was in the chairs three sets above the blasting set. The bucket was about 12 feet below the blasting set when a quantity of rock sloughed from the side of the shaft 80 feet above. It was deflected by the crosshead and then struck the men in the bucket. Warren was knocked 25 feet to the shaft bottom, while the shaft leader suffered considerable head injuries. Good rescue work was immediately carried out, but Warren died at 9.15 p.m. in the Bralorne hospital. Subsequent medical evidence disclosed that death was due to multiple skull fractures and brain hæmorrhage, with the injuries resulting from a fall rather than from a blow on the head.

The shaft was well timbered throughout, and catch-alls had been built at intervals to catch any small pieces of loose rock. The sides of the shaft were not lagged, as the rock was diorite, which is usually sound. However, the rock fall occurred from a position where a dyke crossed the shaft. This area, as well as the rest of the shaft, had been inspected by both the shaft captain on the previous shift and the shaft leader on the shift when the fatality took place. Both were experienced men.

The coroner's jury returned a verdict that death was accidental, with the recommendations that the lining of the shaft be kept closer to the working area, and that a safety belt be used by the man on the rim of the bucket while scaling down.

Carl Ernest Weber, aged 39, married, and employed as a motorman in the Aurum mine of Cariboo Gold Quartz Mining Company Limited, was fatally injured in a haulage accident on September 3rd, 1959, between 2 and 3 a.m.

The accident occurred on the 4000 level, which is the main haulage level of the Aurum mine and is an adit level. The ore is hoisted up the internal shaft from the lower levels and is dumped into an ore-pocket above the 4000 level. The ore is drawn from the pocket and filled into cars at a chute at the 4000 level. The cars used are of the 40-cubic-feet-capacity side-dump type, and these are hauled by an Atlas battery locomotive in trains of up to twelve cars. Weber had been employed regularly on the night shift, which was from 7 p.m. to 3 a.m., and his job was to take empty cars in, load them at the chute, and bring out the full cars to the surface.

Weber was seen by the shiftboss at the beginning of the shift, and at that time he appeared to be in a normal state of health. The last person to see him alive was the cage-tender, who stated that at about 2 a.m. he saw Weber loading a car. Shortly after 3 a.m. the shiftboss noticed that Weber had not come out with the others at the end of the shift. At 3.20 a.m. he was found at the chute, still on the seat of the locomotive, but dead from severe head injuries. A doctor was on the scene by 3.50 a.m., when death was officially pronounced. Later evidence indicated death was due to extensive skull fractures and hæmorrhage into the brain.

It was evident that at the time of the accident Weber was bringing a train of empty cars into the mine, there being six cars in front of the locomotive and six behind. It is necessary for the motorman to lean forward as the locomotive passes under the chute, as the chute projects and the operator's seat on the locomotive is on the same side as the chute. In this case it was clear that for some reason Weber had failed to do this, and, as a result, when he reached the chute his head was knocked backward and was partly crushed between the chute lip and the battery box of the locomtive. After the accident, the locomotive was found just beyond the chute with the control lever in the neutral position. It seems probable that Weber's hand must have pulled the control lever into neutral as the accident was happening.

An inquest brought in a verdict of accidental death with no blame attached to anyone, but with the recommendation that the locomotive seat be remodelled.

Walter Maitland Cassidy, aged 50, married, and employed as a truck-driver at the Beale quarry of Lafarge Cement of North America Ltd., is presumed to have been drowned on September 1 lth at about 2 p.m.

There were no witnesses to the accident and the body has not been found. Cassidy's job was to dump waste on the edge of a flat area about 35 feet above the sea. The face of the waste varies from nearly vertical to about 50 degrees. The procedure in handling the waste is to dump a load at the lip and then dump succeeding loads back toward the pit. When the dumping area is fairly well covered by waste, a dulldozer is used to push the material over the lip into the sea. It was apparent that Cassidy was preparing to dump his load at the lip of the waste when for some reason the truck went over the lip into the sea. The reason for the truck going over the lip is open to conjecture. The ground is fairly flat, with no down-grade toward the lip. The truck was reported to be in good mechanical condition, being recently fitted with new brakes. It was located in about 100 feet of water by skin-divers, who reported the truck was still in reverse and that the driver's dwr was open and the truck empty of rock.

Cassidy was reported to be a most careful driver, who always inspected the lip of the dump before proceeding to unload his truck. He might have been leaning out the door while backing up the truck and his foot slipped or touched the gas pedal when he attempted to apply the brakes. Several men were working near by in the quarry, but none saw the accident. Cassidy was not missed until after quitting time. No inquest will be held until the body is found.

Iver I. Sallows, aged 26, widower, and employed as a miner at the Britannia mine, was killed by a fall of rock in the 45.030 stope of the No. 8 mine on September 22nd between 9 and 10 a.m.

The 45-030 is a square-set stope in a pillar recovery zone on a chalcopyrite-bearing vein with a general east-west strike and steep southerly dip. The stope was mined up from below the 4500 level and extended to the second set above it. On the 4500 level it was eleven sets or 66 feet long, and three and a half sets or 21 feet wide. The timber had been fully installed to the back and walls of the stope. Two old finger-raises extended upward at the centre and on the east end of the stope, toward an area that had been previously mined. As the grade of the ore had fallen below profitable mining practice, the stope was shortened on the first bench by dropping off the five most westerly sets and was, therefore, only 36 feet long above the second set.

Sallow was drilling off a third bench and was working on the west end when the footwall section between the two raises dropped. This section is estimated to have been approximately 30 feet long, 8 feet wide, and 6 feet high. Because it was the footwall section that dropped, the half-set timbers were dislodged and pushed both inward and downward in the stope. Sallows, while drilling, apparently heard no warning and was crushed by the falling rock. Sallows' partner was about 25 feet away and two sets below. Rescue work was started, but it was six hours before the body was recovered. It was believed Sallows had died almost instantly from multiple fractures and severe internal injuries.

Sallow and his partner had daily checked the timbering, and had done so the morning prior to the accident. The shiftboss and the foreman had also checked the timbering each time they entered the stope, and it appeared satisfactory to all concerned. No sloughing was noted at any time. After the accident, it was evident that a crack had existed behind the large slab (about 150 tons), but this crack could not be seen previous to the accident. Timber or rock cribs, in conjunction with normal square sets, might have prevented the cave, but it would have been difficult to foresee this.

An inquest was held on September 29th and a verdict was brought in of accidental death with the following two recommendations:-

(1) Any stope similar to this should have false sets supported by cribbing.

(2) In future in fatal accidents at least three members of the coroner's jury should be familiar with the working conditions of the area in which the accident occurred.

Peter Matiowsky, aged 27, single, and employed as a truck-driver by Mannix Company Ltd. at the Empire Development operation, Port McNeill, met his death by asphyxiation about 12.30 a.m., on October 3rd, when pinned in a cab of an overturned Euclid truck.

The operation is an open-pit iron mine. The ore is trucked from the various pit sections to a crushing and up-grading plant. At the end of the previous shift, the driver of this Euclid truck had turned the loaded truck around and had parked it at the fuelling station because a loaded truck was parked at the dump above the crushing plant. In the position it was in the Euclid truck could be backed easily onto the dump as soon as the other truck had left.

It is apparent that Matiowsky, when coming on shift, believed that the truck had been dumped and, after fuelling up, proceeded to go to the Kingfisher Pit for a load of ore. Approximately ten minutes later, or at 12.40 a.m., the driver of the following truck took the same route and saw Matiowsky's overturned Euclid below the second sharp corner of the road. Help was obtained right away, but it was found impossible to remove Matiowsky as he was pinned in the driver's seat by the steering-wheel, left door, and fire-guard. No pulse could be felt at this time. The truck was pulled back to the road and the cab polled away from Matiowsky, whose body was then removed and delivered by ambulance to the

R.C.M.P. at Port McNeill. The report of the autopsy was that there were a few superficial injuries, but that death was due to asphyxiation. This was as a result of the very confined position into which Matiowsky was forced by the fire-guard, door, and steering-wheel.

In order to drive from the fuelling point to where the truck overturned, it is first necessary to go up a slight grade for 400 feet, make a slight left turn, travel about 300 feet along a relatively flat or very slight down-grade below the powder magazine, make a sharp left turn and go down a IS-degree grade for a distance of 300 feet, then make a sharp right turn. The road is at least 24 feet wide throughout this distance and has three safety bays between the two corners. The truck made the first corner without difficulty, but at the second corner it went straight ahead, where it was found upside down approximately 20 feet below the road.

Evidence produced indicated that the truck was in fully serviceable condition, both as to steering and braking, at the time of the accident, but that it would not be possible to stop or to turn the corner on this steep grade with such a load (total weight approximately 34 tons) when the truck was in third gear, as it was found to be. It was believed that in third gear the engine would not be able to develop a sufficiently high number of revolutions per minute to produce the required oil pressure and volume to enable the hydraulic steering to operate properly under so heavy a load on a steep down-grade.

An inquest held at Alert Bay on October 7th, 1959, returned a verdict of accidental death with no blame attached to anyone. The jury recommended that drivers be instructed to check their trucks prior to taking over the shift.

Willi Walter Bruno Greiser, aged 43, married, and employed as a motorman at the Bralorne mine, was fatally injured on October 14th, 1959, about 4 p.m. in a fall from the cage in the Crown shaft when it was hoisted unexpectedly.

The Crown shaft is an interior three-compartment shaft, which extends 2,700 feet vertically from No. 8 level to No. 26 level. Greiser, with three other men, had been lowered from No. 8 level to No. 26 level. After the cage had stopped at No. 26 level, Greiser, who stood in the cage nearest the gate and the signal switch, reached out and gave the signal of "three." This is an unofficial signal which was intended to " hold " the cage. Greiser opened the gate and lifted the station safety bar. He then started to step out of the cage, but just as he did so the cage began to ascend. Greiser had one foot out of the cage and was unable to get back in. He fell out when the cage was about 5 feet above the station and then fell into the open shaft under the cage. He fell a further 125 feet to the spill door near the bottom of the shaft. Meanwhile the cage was brought to a stop 16 feet above No. 26 level. After waiting five minutes, one of the other men climbed out into the manway and obtained help. There was no sign of life when the body of Greiser was found, and a later autopsy indicated that death was due to multiple skull fractures and numerous internal injuries.

The hoistman involved is considered reliable and experienced. He insisted he received the release signal of five bells. The signal system was checked after the accident and found to be in order. However, it was demonstrated that if the signal rope at the level is snatched or is pulled from an angle rather than straight down, it is possible to give an indistinct signal which might be interpreted by the hoistman as two rings rather than one. None of the four men on the cage had been given authority to act as cage-tender. A return signal system, which might prevent misinterpretation of signals, had not been installed in this shaft.

The inquest was held at Bralorne on October 16th and the jury returned a verdict of accidental death with the following recommendations:-

(1) The cage should be attended by a cage-tender at all times.
(2) Monthly checks of the signal system should be made by a qualified electrician and recorded in the hoistman's log book.
(3) All present and future employees should be warned not to use the signal system.
(4) Periodic meetings of all hoistmen and cage-tenders should be held to discuss safety measures and operations of hoisting.

A prosecution was instituted against one of the workmen, who was with Greiser, for earlier operating the shaft signals without authorization. He pleaded guilty and was fined $20. A prosecution against the manager for permitting the offence was dismissed.

Antonio Di Meo, married, and employed as a driller in the Quarry Bay limestone quarry of Rayonier of Canada near Jeune Landing, was decapitated by a fall of rock on October 13th, 1959, at about 5 p.m.

Di Meo and the contractor, Lucien Godbout, were making a new set-up for a wagon drill on the east face of the west quarry. The bedding planes on this face strike north and south and dip approximately 45 degrees west. The fracturing of the ground has tended to develop large fragments of limestone. At the point where the accident occurred, the toe had been mined back so that the immediate face was approximately 30 feet high and formed a re-entrant angle overhanging part of the drill steel, but not the machine. The wagon drill was on top of the toe of broken limerock. Previous to the accident, Di Meo and Godbout spent approximately two hours scaling loose rock from the face in the vicinity of the position of the wagon drill. The face had not been mined for at least six months. On completion of the scaling, the drill was set up on a pile of broken limestone at the face.

Godbout and another workman assisted Di Meo in setting up the drill, but went about other duties when Di Meo started to drill about 4.45 pm. When one of them returned about 5 pm. Di Meo's decapitated body was found under a large slab of limestone at the side of the wagon drill, which was still running. Apparently the drilling had dislodged a slab, approximately 4 feet long, 2 feet wide, and 1% feet thick, from a joint plane at the toe of the overhang. This slab. weighing approximately 1,800 pounds_ rolled down the broken rock slope and caught Di Meo against the wagon drill.

An inquest held at Port Alice on October 16th. 1959, returned a verdict of no blame attached to any individual.

The quarry face consisted of layers of limestone dipping toward the quarry floor, and thus the safest way to mine would have been by drilling vertical holes from the top, or by breasting down along the joint planes. Both the contractor and the driller were, however, considered to be experienced quarry men.

Maxwell Godkin, aged about 23, sin& and employed as a prospector by Vimy Exploration Ltd., was killed by a falling tree while working on road construction near the Adams River mineral claims near Sayward about 10.30 a.m. on October 27th, 1959.

Godkin was engaged in clearing right-of-way preparatory to road construction to the mineral claims. Apparently he had commenced to put an undercut in a 12-inch-diameter green tree when something went wrong with the power-saw he was using. He was repairing the saw when a snag (dead tree), 40 feet long and about 10 inches in diameter, fell and struck him. Two bulldozer operators and one other man were near by at the time of the accident but did not see it happen. However, it is estimated that only a short time elapsed before Godkin was found. He was still breathing, but died shortly afterward. Death was later found to be due to a fracture dislocation of the neck. The face bones were also fractured and the left femur broken.

An inquest was held on October 27th, 1959, at Campbell River. The jury returned a verdict of accidental death with blame attached to no one, but added the recommendation that hard hats be worn by all employees.

Nelson Shiosaki, single, a logging contractor under contract to West Columbia Gold Placers Ltd., was presumed to have met his death by drowning in the Columbia River near Mile 57, Big Bend Highway, on Wednesday, November llth, 1959, at approximately 11.30 a.m.

Shiosaki and his two employees had been engaged to raft a. small tractor across the Columbia River near Mile 57, Big Bend Highway. A high-line, previously installed across the river, was to be used to guide the raft across the river. The line consisted of a 1⅛-inch steel cable, equipped with a bridle or A-frame for attaching the raft. In the high water of the previous spring the raft which had been in use was swept away and the A-frame damaged. This left most of the cable in the water, allowing brush, roots, and other debris to collect on it. The bridle was in the centre of the cable, covered with debris. This was the situation with which Shiosaki had to contend before taking the raft across the river.

On Wednesday morning, November 1 lth, all logs necessary for the raft had been skidded to the east bank of the river. The intention was to clean and tighten the cable and use the bridle in building the raft. The cable was tightened with the use of the tractor, with about 30 feet slack taken in. The cable was above the water, but had a considerable amount of debris on it. To clean the cable it was decided to lower the cable to the water and clean it by using a boat. At about 11 a.m., Shiosaki and one man proceeded out on the river in a 16-foot boat and commenced clearing the cable. A 30-foot river boat equipped with life-jackets was available at the time. At a point near the centre, about 100 feet from the shore, they worked on a large root from the downstream side of the cable. When they freed the root, the cable whipped and capsized the boat. Both men grabbed hold of the cable and the boat went down stream. S. High, the man with Shiosaki, climbed along the top of the cable until he reached shallow water. He dropped into the water and reached the shore with the help of the third man of the party, Howard Crowe. Meanwhile, Shiosaki had made no attempt to move. After being in the same position for about twenty-five minutes, he started along the cable and reached a point about 30 feet from where the cable came out of the water. At this point he let go of the cable and swam about 30 feet, then went under and was not seen again.

No inquest has been held as the body has not been found.

Thomas Bahrynowski, aged 26, and employed as a tractor operator at the Cassiar Asbestos Corporation mine, was fatally injured when the tractor he was driving went off the mine road and rolled and slid about 280 feet to a switchback below at about 5.30 a.m. on November 19th, 1959.

Bahrynowski had been ordered by his foreman to drive the tractor from the No. 1 switchback on the Cassiar mine road up to the mine to refuel it, and then leave it at No. 6 switchback for the use of the following shift. About one and a half hours later the foreman, returning up the mine road, noticed the tractor between Nos. 1 and 2 switchbacks. On continuing up the road, he found the body of the deceased about 85 feet below a point on No. 2 switchback where the tractor tracks indicated that the tractor had gone over the bank. Death was due to multiple internal and external injuries.

It was brought out at the inquest that Bahrynowski had reported five hours late for work after driving from Watson Lake. He had had only four hours sleep during the fifty hours prior to his death, and probably about twenty minutes sleep during the thirty hours prior to the accident. It was also brought out that while driving to Cassiar from Watson Lake during the early morning of November 19th, Bahrynowski fell asleep at the wheel of his car, thus causing it to leave the road, but causing no material damage.

The coroner's jury returned a verdict of accidental death.

Colin L. Faircrest, aged about 45, married, and owner and manager of Rupert Drilling and Exploration Company, was fatally injured by a fall while moving a diamond-drill machine on December 9th on the Ford Iron claims on Blacksand Creek, a tributary of Zeballos River. Mr. Faircrest's company was engaged to do diamond-drill exploration for International Iron Mines Ltd.

At the time of the accident, the portable diamond-drill machine, weighing approximately 1,700 pounds, was being moved to a new setup. In making the move, it was necessary to let the drill down a steep hillside, varying in slope from 45 to 60 degrees. The drill had been let down with the ⅜-inch winch cable on the machine and with a %-inch cable as a safety line. The drill was approximately 40 feet above a narrow trail, along which it was intended to move the drill to its new location, when Faircrest instructed his crew to remove the %-inch cable and substitute for it a ¼-inch nylon rope. At the same time, he inquired how much cable remained on the %-inch cable drum. He was advised there was one turn remaining on the drum. He instructed his crew to continue letting out the ⅜-inch cable, but, as it was being let out, the cable polled out of the cappel. At the same time, the nylon rope broke and the machine commenced sliding down the hill. Faircrest was behind the machine endeavouring to hold it back. On reaching the trail, the machine capsized and rolled end-over-end down the hill and finally, about 200 feet below, dropped into a canyon. Faircrest rolled down the slope after the machine and then fell over a waterfall about 15 feet high, landing on some boulders at the foot of the waterfall. His crew, on reaching him, noted that his head was crushed. The doctor performing the autopsy stated that death had been instantaneous as a result of a crushed skull.

The coroner's jury returned a verdict of accidental death with no blame attached to anyone. A rider recommended that the use of nylon rope was not satisfactory for the purpose for which it was being used.

Peter Vraa, aged 51, single, and employed as a miner at the Aurum mine of The Cariboo Gold Quartz Mining Company Limited, was fatally injured by a fall of rock on December 30th at 11.05 a.m. in the 2850-24A stope.

The 2850-24A stope is a cut-and-fill stope developed on a steeply dipping 2-foot-wide quartz vein. The stope at the time of the accident was approximately 200 feet long and the width varied from 3 to 10 feet. Vraa and his helper arrived at this working place shortly after 8 a.m. on December 30th. They had drilled off and blasted the previous day (there was no cross-shift), and thus Vraa spent some time scaling down the back and the hangingwall. He then started loading ore into a wheelbarrow and wheeling it to a chute. At 10.20 a.m. the working place was visited by the manager and shiftboss and all was found in order. The stope was systematically timbered with posts and stulls, but the place where Vraa was working had not yet been timbered. No loose rock was evident.

By 11 a.m. Vraa had drilled five short holes. His helper was returning from dumping the wheelbarrow when he heard a groan. He found Vraa lying semi-conscious with a slab of rock across his leg. Help was immediately obtained, but at no time did Vraa speak, and he apparently died very quickly from what later was determined as extensive internal injuries.

Investigation disclosed that directly above where Vraa was working a slip crosses the stope, making an angle of about 30 degrees with the vein. This slip would not presumably have been visible prior to the accident. It seems probable that the vibration of the drilling loosened a large slab on the hangingwall, which fell from this concealed slip. When the slab fell, it broke into five or six pieces, each weighing about 100 pounds. Vraa was evidently struck, but fell clear of the rock, as only one piece was on one of his legs when he was found.

FATAL ACCIDENTS AND ACCIDENTS INVOLVING LOSS OF TIME

Eighteen fatal accidents and 141 accidents involving a loss of time of seven days or more were reported to the Department. These were investigated and reported on by the Inspectors of Mines.

The following three tables classify these accidents as to cause, occupation, and as to the parts of the body injured. The fourth table lists all fatal and compensable accidents which occurred in lode mines over a ten-year period and relates these accidents to the number of persons employed and tons mined.

ACCIDENTS CAUSING DEATH OR INJURY CLASSIFIED AS TO CAUSE

Cause	Number of Accidents	Percentag of Total
Falls of ground	37	23.2
Breaking of staging, ladders, etc.	2	1.3
Falls of material and flying material	5	3.1
Falls from ladders, stagings, etc.	3	1.9
Slipping and falling	30	18.9
Lifting and handling material, etc.	31	19.5
Machinery and tools	32	20.1
Run of ore or waste	3	I.9
Bums and shock	3	1.9
Miscellaneous	13	8.2
Totals	159	100.0

Accidents Causing Death or Injury Classified as to the Occupation of Those Injured

Occupation	Number of Accidents	Percentage of Total
Underground—		
Chutemen	4	2.5
Haulagemen	15	9.4
Miners	68	42.7
Muckers	10	6.3
Timbermen	10	6.3
Repairmen	3	1.9
Trackmen and pipe-fitters	1	0.6
Skip-tenders	5	3.1
Supervisors and staff	1	0.6
Miscellaneous	6	3.8
Surface—		
Shops	7	4.4
Mill	7	4.4
Quarries	11	6.9
Surface, general	11	6.9
Totals	159	100.0

Accidents Causing Death or Injury Classified as to Parts of the Body Injured

Location	Number of Accidents	Percentage of Total
Head and neck	21	13.2
Eyes	6	3.8
Trunk	23	14.5
Back (including shoulders)	24	15.1
Arms (including wrists)	6	3.8
Hands and fingers	25	15.7
Legs and ankles	32	20.1
Feet	18	11.3
Asphyxia	4	2.5
Totals	159	100.0

Compensable Non-fatal Accidents Related to Tons Mined and Men Employed

Year	Number of Accidents	Number of Persons Employed	Frequency per 1,000 Persons	Tons Mined	Tons Mined per Accident
1950	953	7,073	135	6,802,482	7,130
1951	1,131	8,787	129	6,972,400	6,170
1952	1,327	9,610	139	9,174,617	6,910
1953	899	7,105	125	9,660,281	10,750
1954	718	6,293	114	8,513,865	11,850
1955	679	6,208	109	9,126,902	13,450
1956	615	6,507	94	8,827,037	14,350
1957	535	5,678	94	7,282,436	13,600
1958	396	4,353	91	6,402,198	16,200
1959	310	4,316	72	6,990,985	22,550

Note.—This table differs from a similar table published in the Annual Report for 1958 in that the previous table included accidents which occurred at the Trail smelter.

DANGEROUS OCCURRENCES

Eighteen dangerous occurrences were reported as required by section 9 of the *Metalliferous* Mines Regulation Act and were investigated by the Inspectors of Mines. This compares with the twenty-two reported for 1958.

Of these occurrences, eight were connected with hoisting; five with explosives; one with haulage; one with run of ore; and three, miscellaneous.

During January, 1959, hydrogen sulphide gas was detected by smell in the north end of the 1900 level of the Yale mine. The source was in recently drilled diamond-drill holes which had encountered a large flow of slightly warmed water. The lead-acetate test indicated the amount of gas was quite small.

On January 31st, 1959, two workmen returned to the scene of a blast at the Britannia mine before the charge detonated. Apparently the workman responsible had assumed that the sound of another blast was his own. One of the workmen was slightly injured.

On March Sth, 1959, one of the cages at the Victoria shaft of the Britannia mine was hoisted unexpectedly, apparently on signal from the other hoisting compartment. The warning bells and lights in the hoistroom were working properly. The hoistman was relieved of his duties. No one was injured.

On March 12th, 1959, the east side cage in the Victoria shaft of the Britannia mine hung up while being lowered. The location was a point 90 feet below the 2900 level. About 1,000 feet of rope was run out and was badly kinked on rewinding. It was replaced. Men were being transported at the time of the incident, but fortunately the safety dogs functioned satisfactorily.

On March 16th, 1959, a snowslide took place on the narrow-gauge surface railway of the Torbrit Silver mine. Heavy rain, preceded by 1 foot of fresh snow, appears to have precipitated the slide. A 50-foot length of snowshed which covered the railway was destroyed. No equipment or men were involved.

On April 1st, 1959, the west side cage in the Victoria shaft of the Britannia mine hung up while being lowered, at a point in the shaft 30 feet below the 2800 level. Some rope was run out and a kink occurred on rewinding. A length of 34 feet was cut off the rope to remove the kink.

On June Ist, 1959, a workman received injuries to the head and chest when he walked into an improperly guarded blast underground at the Torbrit Silver mine.

On June 5th, 1959, the Crown hoist at the Bralorne mine overspeeded while the north side cage was being lowered empty on a trip which was to move the cage from the 800 level to the 2500 level. At about the 1700 level, the power tripped off, reportedly from overspeed, but the brakes did not apply automatically. The hoist continued to gain speed under the combined weight of the cage and rope until the air resistance in the shaft prevented further acceleration. This allowed the dogs to come into action and stop the cage just above the 2600 level. The rope continued to pay out and. as the last turn came off the drum, it sheared off at its point of connection. The hoist coasted to a stop, the number of revolutions being equal to about eighteen levels measured on the depth indicator. Four guides, the motor windings on both the stator and rotor, and the rope were damaged.

The hoistman claimed that he saw the brake start to apply and, while waiting for the hoist to stop, automatically pressed the reset button to close the breaker in readiness to put the hoist in motion again. At about this time the windings started to fly apart. The hoistman did not make any attempt to use the manual brakes. Examination of the hoist after the event revealed that the weight which trips the north side brake had not fallen. On being touched, it dropped. The brake latch was tripped. How the brake. latch would be tripped without the weight falling on it could not be explained.

The motor windings on both the stator and rotor were damaged, as was the hoisting-rope and four guides in the shaft.

It is evident that the hoistman should not take his attention from the hoist while it is in motion. It is thought that manual operation of the brakes should always be attempted when a hoist commences to overspeed. Also, no hoist should be run single drum unless it is equipped with an auxiliary brake which is applied automatically, and also by application of the master switch.

On June 20th, 1959, the south side skip in the No. 5 inclined shaft of the Pioneer mine became stuck in the shaft. The hoistman was not immediately aware of this, and slack rope accumulated on the drum of the hoist. The skip then dislodged itself, pulling some of the slack cable off the drum. No men were being handled. Damage was slight.

On July 26th, 1959, an explosion occurred while a miner was drilling at the face of the Merry Widow pit of Empire Mining. Five 35-foot horizontal holes had previously been drilled, and three of these had been loaded with explosives. The miner was drilling the sixth hole several feet away, and the hole had reached a depth of 34 feet when one of the loaded holes exploded. The miner's injuries were superficial scratches, but 20 tons of rock was caved by the blast. It is thought a fissure extended between the holes, and this allowed some explosive to fall from the loaded hole into the path of the hole which was being drilled.

On August 19th, 1959, a cage-tender at the Torbrit Silver mine received injuries on being pinned between the cage and the shaft timbering when the cage was hoisted unexpectedly. The accident was due to a misinterpretation of signals. The cage-tender had given a three-bell signal when the cage arrived at a level, but the hoistman had been anticipating a five-bell release signal. The hoistman was subsequently dismissed.

About September 6th, 1959, the large spur gear on the counter-shaft of the hoist at the Giant Nickel mine broke. No one was being transported at the time and no other damage was done.

On October 10th, 1959, the floating washing plant of Kumhila Exploration Co. Ltd. capsized and sank in 35 feet of water. The dragline was feeding the washing plant at one end with a 5-cubic-yard bucket when the hopper became blocked and was rapidly filled. The discharge conveyor at the other end of the plant became empty at the same time, and this allowed the plant to sink at the hopper end. The covers on the front-end pontoons were off for cleaning purposes, and thus the pontoons rapidly filled with water so that the plant then capsized and sank. All personnel had time to leave the plant before it sank.

On October 15th, 1959, a detonator exploded in a working place at the Pioneer mine while two men were on site. They had returned to the scene after reblasting three missed holes when the incident occurred. They had relighted the old fuse, using thermolite, and it is presumed an undiscovered capped fuse became ignited in some manner. The igniting of missed holes by relighting the old fuse is not a good practice. One of the workmen sustained minor injuries.

On October 23rd, 1959, the axle of one of the sheave wheels in the No. 3 shaft at the Pioneer mine failed while the skip was travelling empty down the shaft. The hoistman noticed a slackening in the rope and brought the hoist to a stop before any further damage was done. The failure appeared to be due to fatigue, there being three distinct periods of fracture.

On November 7th, 1959, a train collision occurred on the 4100 level of the Britannia mine. Two men were injured. The accident was caused by one of the train crews proceeding against a block light without having made the customary daily agreement with the other train crew.

On December 10th, 1959, an explosion occurred during mucking operations at the Paxton pit of Texada Mines Ltd. The bucket of the shovel apparently struck an unexploded cutoff hole or loose explosive in the broken ore, causing it to detonate. No one was injured and damage to the shovel was slight.

On November 10th, 1959, a miner was buried at the Bluebell mine when the muck pile on which he was standing to replace an eye bolt gave way under him. He was carried down a raise and covered with 18 feet of muck. He was discovered in about thirty minutes, but rescue operations took three hours.

PROSECUTIONS

A workman at Bralorne was prosecuted at Lillooet on December 5th, 1959, under General Rule 151 of the *Metalliferous* Mines Regulation Act in that, not being an authorized person, he operated shaft signals on October 14th, 1959. He pleaded guilty and was fined $20. The general manager was charged for committing the same offence under section 38 (2), but the case was dismissed when prosecuted at Lillooet on March 11th, 1960.

BLASTING CERTIFICATE SUSPENSIONS

There were violations of the provisions of *the Metalliferous Mines Regulation* Act in regard to the use of explosives and blasting procedure. One offender had his provisional certificate suspended indefinitely, and another offender received a two months' suspension of his permanent certificate.

EXPLOSIVES USED IN MINES

The table below shows the quantities of explosives and blasting accessories used in metal mines and quarries in British Columbia in 1955, 1956, 1957, 1958, and 1959:—

	1955 Total	1956 Total	1957 Total	1958 Total	1959 Total	1959	
						Mines	Quarries
High explosives (lb.)	8,420,791	8,560,000	7,103,000	5,485,000	6,319,000	6,008,000	311,000
Blasting-caps	1,982,900	2,184,000	1,676,000	1,244,000	1,587,000	1,483,000	104,000
Electric blasting-caps	151,685	52,000	64,000	84,000	46,000	32,000	14,000
Delay electric blasting-caps (short period)	283,000	205,000	160,000	129,000	157,000	148,000	9,000
Delay electric blasting-caps (sure-fire delays and X107 delays)	144,875	263,000	127,000	128,000	153,000	151,000	2,000
Primacord (ft.)	399,000	226,000	261,000	574,000	592,000	415,000	177,000
B-line detonating fuse (ft.)	....	2,436,000	2,049,000	2,197,000	1,972,000	1,738,000	234,000
Safety fuse (ft.)	17,744,900	17,218,000	13,367,000	11,272,000	11,411,000	10,941,000	470,000
Ignitercord (ft.)	418,800	498,000	639,000	469,000	775,000	775,000	....
Ignitercord connectors	371,000	563,000	750,000	610,000	865,000	859,000	6,000
Ammonium nitrate	....	....	5,000	190,000	872,000	770,000	102,000
" Hydromex "	....	....	....	....	325,000	312,000	13,000
" Amex "	....	....	....	....	20,000	20,000	....

The quantity of high explosives used increased 10 per cent over that used in 1958, when the consumption was the lowest since 1947. The use of ammonium nitrate increased fourfold over that in 1958. This compound, when sensitized with fuel-oil, constitutes a powerful explosive. As such the preparation comes under the control of the Chief Inspector of Explosives at Ottawa. Written permission must first be obtained from him before the blasting agent can be mixed or used. Permission must also be obtained from the Chief Inspector of Mines, Victoria, when the blasting agent is used in mines and quarries in British Columbia. Two permits were issued in 1959, bringing the total to eight issued to open-pit mines and quarries. The main condition of the permits was that the blending of " prilled " ammonium nitrate with fuel oil take place on site as it is being loaded into the bore-hole, or within a few hours of its use. An innovation in prepared mixtures sold by a manufacturer were the compounds "Amex " and " Hydromex." "Amex " is essentially a mixture of ammonium nitrate and carbon black, while " Hydromex " is a slurry of ammonium nitrate, sodium nitrate, TNT, and water. Sensitized ammonium nitrate mixtures are not permissible explosives for underground use.

DUST CONTROL AND VENTILATION

Problems in dust control and ventilation have continued to receive the attention of mine operators and Government departments. Dust counts and ventilation surveys were made by the staff of the Chief Inspector, Silicosis Branch of the Workmen's Compensation Board, and the results of these surveys made available to the Inspectors of Mines. The following information is taken from his report, " Summary of Dust Conditions at British Columbia Metalliferous Mines during the Year 1959 ":—

" 1. During the year 1959, sixty-seven ventilation and dust control surveys were made at the metalliferous mines of British Columbia. These were made at forty-four mining operations.

"2. The main object of this inspection work is to lower the amount of dust breathed by the workmen as much as possible. It is not known what concentration of silica dust is considered safe to breathe without producing silicosis as several other factors besides the dust concentration must be taken into consideration. The figure of 300 particles per c.c. of air has been chosen as an objective to work towards. When this figure is attained, it indicates a very great improvement over conditions existing several years ago.

" 3. Blasting operations produce dense concentrations of dust but the workmen are generally not subjected to this dust or subjected to it for short periods of time only. Most of the blasting operations can be arranged to occur at the ends of the shifts and allow sufficient time for ventilation to remove the dust from the workings before the following shift goes to work. A certain amount of blasting operations, such as in chutes, may be considered necessary so that the production of ore may not be interfered with but this should be reduced to the very minimum.

" 4. Stoper drilling operations underground consistently produce the highest concentrations of dust during the time the men are working. The dust counts used to be 2000 or more particles per c.c. of air at these operations. Eighty-eight per cent of the surveys made in 1959 gave averages of less than 1000 particles.

" 5. At leyner, jackleg and plugger drilling operations underground the dust concentrations are not as high as at stoper drilling operations. Since most of the surveys gave less than 1000 particles, it is probably better to adopt the figure of 500 particles for the purpose of comparison. Fifty-seven per cent of the surveys gave averages of less than 500 particles per c.c. of air.

" 6. The averages for 'All Other Underground Locations ' are very satisfactory. Eighty-four per cent of the surveys made during 1959 gave averages of less than 300 particles. The percentages for the past ten years have remained fairly constant, varying between 76% and 93%. This condition is particularly satisfactory when considering the fact that the great majority of the men work in this lower dust concentration.

"7. The dust concentrations in the crushing plants during 1952 were not satisfactory. During 1953 and subsequent years, a special effort was made to control the dust in these plants and satisfactory results have been obtained. Sixty per cent of the surveys made in 1959 gave averages of less than 300 particles per c.c. of air.

" 8. Sixty-four per cent of the surveys made in assay grinding rooms gave averages of less than 300 particles.

"9. The percentage of certificates of fitness held by the employers for their workmen who require a medical examination has steadily increased during the past six years. In 1959, certificates in good standing for 96.2 per cent of the workmen who require same. were held by the employers. This is a very satisfactory condition as there are numerous difficulties to overcome.

" 10. Aluminum powder prophylaxis treatments for the prevention of silicosis were given at five mines during the year. No aluminum therapy treatments were given at the Rehabilitation Clinic of the Workmen's Compensation Board in Vancouver, to men who have silicosis.

" 11. The main measures for dust prevention, suppression and elimination are receiving good attention at the mines. The more important of these are good ventilation, thorough wetting of the rock before it is handled in any manner, not subjecting the workmen to dust and fumes from blasting operations, using good exhaust systems in crushing plants and assay grinding rooms, etc. Full application of all these measures at all times has not been obtained but the results obtained have been quite satisfactory."

MINE RESCUE, SAFETY, AND FIRST AID

During 1959 the mine-rescue stations at Cumberland, Fernie, Nelson, and Princeton were fully maintained, and an instructor, qualified in mine rescue and first aid, was on duty at each station. Each station is equipped with sufficient self-contained oxygen breathing apparatus to maintain at least two mine-rescue teams of six men each should any emergency in near-by mines arise. The equipment consists of McCaa two-hour apparatus and Chemox ¾-hour apparatus, as well as all-service gas-masks, self-rescuers, methane and carbon monoxide detectors, inhalators, and a complete supply of first-aid equipment. Supplies and facilities for charging and servicing all this equipment are maintained.

The station at Cumberland is maintained to serve coal mines in the area. There were no emergency calls for the apparatus during 1959, but three requests for oxygen-two from the local hospital and one from the Cumberland fire department-were promptly complied with. A truck is kept at the station for emergency purposes.

The station at Princeton still provides assistance to the community, but a mobile unit was obtained in 1957 to give service over a wider area. Mine-rescue and first-aid training was given at Britannia, Pioneer, Bralorne, Highland-Bell, Bethlehem Copper, Phoenix Copper, and Craigmont mines. The general public in the vicinity of these mines also received first-aid instruction. Travelling amounted to approximately 10;OOO miles.

The mobile mine-rescue unit stationed at Nelson continued to be of assistance in promoting and giving instruction in mine rescue and first aid at mines in the East and West Kootenay areas. Mine-rescue courses were held at Silverton, and the H.B., Canadian Exploration, Bluebell, and Mineral King mines. Mine-rescue practices were held, when practical,, at all mines in the district. Assistance at first-aid classes was given at Salmo, Nelson, Procter, New Denver, and Toby Creek.

Fire departments at Nelson, Salmo, and New Denver were given help in apparatus training. The mobile unit gave ambulance service to an accident on a highway.

The mine-rescue station at Femie is maintained principally to serve the coal mines in the area, but assistance in mine-rescue training is also given to personnel of the Sullivan mine at Kiiberley. The training of new men for mine-rescue work in coal or metal mines continued in 1959 as well as the maintenance of monthly practices for teams. Assistance was given in the first-aid classes at Fernie. There were no emergency calls for the apparatus.

In addition to the mine-rescue equipment maintained at the Government mine-rescue stations, there are sets of McCaa or Chemox apparatus at the Sullivan, Canadian Exploration, Michel, Bridge River, Cariboo Gold Quartz, H.B., Bluebell, Reeves MacDonald, Britannia, Western Nickel, Violamac, and Mineral King mines. A district instructor makes periodic checks of this equipment.

A certificate of competency in mine-rescue work is granted to each man who takes the full training course and passes the examination set by the Department of Mines. During 1959, in addition to the regular teams in training, forty-nine men took the full course and were granted certificates, as follows:—

Certificate No.	Name	Where Trained	Certificate No.	Name	Where Trained
3094	John Mahonen	Salmo.	3119	Albert Fichten	Riondel.
3095	William W. Kinakin	Salmo.	3120	James Shaw Lemmon	Riondel.
3096	Harry Kinakin	Salmo.	3121	Thomas Burton Holmes	Riondel.
3097	George F. Mackus	Lake Cowichan.	3122	George Gruelich	Riondel.
3098	William E. Olson	Duncan.	3123	Alex P. Mill	Britannia Beach.
3099	Raymond Davison	Lake Cowichan.	3124	Bertram Arthur McConachie	Toby Creek.
3100	Andrew S. Leathwood	Lake Cowichan.	3125	John Francis McIntyre	Toby Creek.
3101	Henry K. Hawkins	Lake Cowichan.	3126	George Vooro	Bralorne.
3102	David C. Reynolds	Lake Cowichan.	3127	Rae Thomas	Ymir.
3103	Frederick Hamilton	Cumberland.	3128	Brian Buckley	Salmo.
3104	Joseph Gawryluk	Union Bay.	3129	Roy Smith	Fernie.
3105	Eugene Gonet	Silverton.	3130	Walter Norman Anderson	Toby Creek.
3106	Bernard Locke	Silverton.	3131	Boleslaw Awgulowicz	Toby Creek.
3107	Joe Schurek	Nelson.	3132	William D. Rorison	Savona.
3108	Adrian John Kesler	Silverton.	3133	Robert Stanley Reilly	Crawford Bay.
3109	Stanley Pedley	New Denver.	3134	Herbert Bischler	Kootenay Bay.
3110	Michael Fryters	Silverton.	3135	Reynold Dortman	Riondel.
3111	Roland Trevor Trenaman	Kimberley.	3136	Louis Samuel Ennis	Riondel.
3112	Harold Cecil Tapp	Kimberley.	3137	Harold Edson Sutherland	Riondel.
3113	John Robert Barrie	Kimberley.	3138	Francesco Salviulo	Riondel.
3114	Albert Dellert	Kimberley.	3139	John Paul Dortman	Riondel.
3115	Edward Flegel	Kimberley.	3140	Hugh Francis Muise	Riondel.
3116	Cecil Edward Ross	Kimberley.	3141	David Smith	Kamloops.
3117	Fred Wacheck	Riondel.	3142	William Cuthbert Robinson	Prince Rupert.
3118	Roy Gerome Crutchley	Riondel.			

The Mine Safety Associations in different centres of the Province, sponsored by the Department of Mines and aided by company officials, safety supervisors, Inspectors of Mines, and mine-rescue instructors, continued to promote mine-rescue, first-aid, and safety education in their respective districts.

The Vancouver Island Mine Safety Association held its forty-fifth annual competition in Cumberland on May 30th, 1959. Three teams competed-two from the Tsable River mine and a visiting team from the Bralorne mine. The winning team was from the Tsable River mine and was captained by J. Thomson.

The Central British Columbia Mine Safety Association held its annual competition at Kamloops on June 6th, 1959. Five teams took part in this competition. They represented Bralorne (two teams), Cariboo Gold Quartz, Bethlehem Copper, and Britannia. A Bralorne team, captained by J. Greer, took first place.

The East Kootenay Mine Safety Association held its annual competition at Femie on June 13th, 1959. Four teams took part in this competition-two from

Kimberley, one from Fernie, and one from Michel. First place was won by the Femie team, captained by A. Littler.

The West Kootenay Mine Safety Association held its annual competition at Castlegar on June 20th, 1959. Five teams took part in this competition-two from the Bluebell mine, one from Canadian Exploration Limited, one from the H.B. mine, and one from the Reeves MacDonald mine. A Bluebell team, captained by B. Ramage, took first place.

At all meets, competitions were held in first-aid as well as mine-rescue work. In these competitions, events were held for women and juniors. Representatives from other industries and organizations not necessarily directly connected with mining also participated.

Competitions were also sponsored by mining companies. Two first-aid competitions were held in the Bridge River--one in April at Bralome by Bralome Mines Limited, and one in November at Pioneer by the Bridge River Valley Mine Safety Association,. In May, The Consolidated Mining and Smelting Company of Canada, Limited, held a mine-rescue competition at Chapman Camp as an elimination contest for entry in the annual competitions of the East Kootenay Mine Safety Association.

The fourth Provincial mine-rescue competition was held at Kamloops on June 27th, 1959. The winning teams from the Cumberland, Kamloops, Castlegar, and Femie events competed for a trophy and silver trays. The event was won by the Femie team, captained by A. Littler. In conjunction with this competition, the Workmen's Compensation Board sponsored the third Provincial men's first-aid competition and St. John Ambulance sponsored the first Provincial ladies' first-aid competition. Teams competed which had won local events at Cumberland, Kamloops, Castlegar, Fernie, Victoria, and Vancouver. The men's winning team was from Warfield Engineering, The Consolidated Mining and Smelting Company of Canada, Limited, and was captained by F. E. Paul. The ladies' winning team was from Bralome mine and was captained by Mrs. R. Cameron.

JOHN T. RYAN TROPHY

The John T. Ryan Regional Safety Award for the metal mine with the lowest accident-frequency record for 1959 was won by the H.B. mine of The Consolidated Mining and Smelting Company of Canada, Limited, at Salmo. To win this trophy the H.B. mine completed the year without a single compensable accident, This record also won the Dominion Ryan Trophy the second year in a row, a record not equalled in British Columbia. The company's safety organization, officials, and employees deserve high praise for this achievement.

The 1959 regional safety award for coal mines was won by the Tsable River mine of Canadian Collieries Resources Limited, near Cumberland. This is the fifth year in succession that this mine has won the award. The company's safety programme thus continues to be quite effective.

WEST KOOTENAY MINE SAFETY ASSOCIATION TROPHY

The West Kootenay Mine Safety Association in 1951 donated a safety trophy for annual competition in order to encourage and promote safety in small mines not eligible for the John T. Ryan awards. At first the trophy was restricted to mines in the West Kootenay area, but in 1956 this restriction was removed.

The award is made to the mine having the lowest accident rate and working a total of from 2,500 to 30,000 shifts per year, one-third of these having been worked underground. An accident is taken as one which involves more than three days' loss of time.

In 1959 the award was won jointly by the Highland-Bell and Violamac mines. Both mines completed the year without a single compensable accident. This is a most commendable record, especially when It is noted that both mines have won the trophy in other years-once for Highland-Bell and three times for Violamac. The trophy was presented at a joint meeting of the West Kootenay Mine Safety Association and the Nelson branch of the Canadian Institute of Mining and Metallurgy in Nelson on March 26th, 1960.

BRITISH COLUMBIA MINING ASSOCIATION, SAFETY DIVISION

In 1955 the Mining Association of British Columbia set up a Safety Division with the object of promoting and assisting in establishing and maintaining effective safety programmes at its member mines. These programmes have been quite effective since 1955, as indicated by a steady yearly reduction in the frequency rate of accidents. The record in 1959 was marred by eighteen fatal accidents, but the frequency of compensable accidents was the lowest on record. R. B. King, a former Inspector of Mines, took over as Safety Director from I. H. Sloane, who left for a position with the Canadian Johns Manville Company. Visits were made by the Safety Director to member mines. Monthly accident statistics were compiled and issued to member mines. A safety seminar for supervisors was held in Vancouver.

Coal

By Robert B. Bonar, Deputy Chief Inspector of Mines

CONTENTS

PRODUCTION

The gross output in short tons of the coal mines of the Province for 1959 was 757,628 tons, a decrease of 125,334 tons or 14.2 per cent from 1958. A total of 110,840 tons came from strip mines at Michel and Tent Mountain.

The Vancouver Island District produced 149,668 tons, a decrease of 32,636 tons or 17.9 per cent from 1958.

The Northern District production was 8,843 tons, an increase of 516 tons or 6.2 per cent over 1958.

The Nicola-Princeton District production was 1,577 tons, an increase of 888 tons or 128.8 per cent over 1958.

The East Kootenay District production was 597,540 tons, a decrease of 94,102 tons or 13.6 per cent from 1958.

Output and per Capita Production, 1959

Colliery and Mine	Gross Output Mined during Year (Tons)	Days Worked	Total Number of Employees	Daily Output per Employee (Tons)	Yearly Output per Employee (Tons)	Number of Employees Underground	Daily Output per Underground Employee (Tons)	Yearly Output per Underground Employee (Tons)
Tsable River Colliery	146,225	183	280	2.85	522	205	3.89	713
Chambers No. 5 mine	761	145	3	1.75	254	2	2.62	380
Loudon No. 6 mine	630	159	2	1.98	315	2	1.98	315
Lewis mine (Timberlands)	801	166	3	1.61	267	3	1.61	267
Carruthers and Wakelem No. 3	308	100	2	1.54	154	2	1.54	154
Stronach mine	408	123	2	1.66	204	2	1.66	204
Undun mine	449	120	2	1.87	225	2	1.87	225
Extension mine (Brodrick)	11	20	3	—	—	3	—	—
Big Flame mine	15	14	3	—	—	3	—	—
White mine	68	59	2	—	—	3	—	—
Princeton Blue Flame No. 3	1,161	200	2	2.90	580	2	2.90	580
Coldwater mine	416	112	2	1.85	208	2	1.85	208
Bulkley Valley Collieries	5,524	115	17	2.82	325	12	4.00	460
Reschke mine	235	50	3	1.56	78	2	2.34	117
Gething No. 3 mine	3,084	162	6	3.17	514	4	4.75	771
Michel Colliery (underground)	486,700	165	694	4.24	701	516	5.75	943
Michel Colliery (strip)	82,521	165	15	33.34	5,501	—	—	—
Coleman Collieries (strip)	28,319	112	15	16.85	1,888	—	—	—

District Output and per Capita Production, Underground Mines, 1959

District	Gross Output Mined during Year (Tons)	Total Number of Employees at Producing Collieries	Yearly Output per Employee (Tons)	Number of Men Employed Underground in Producing Collieries	Yearly Output per Underground Employee (Tons)
Vancouver Island	149,668	302	496	226	662
Nicola-Princeton	1,577	4	394	4	394
Northern	8,843	26	340	19	465
East Kootenay	486,700	694	701	516	943
Whole Province	646,788	1,026	630	765	845

Output per Man-shift, Underground Mines, 1950–59

Year	Man-shifts[1]	Tonnage	Average per Man-shift (Tons)
1950	460,159	1,481,813	3.22
1951	442,170	1,434,974	3.24
1952	383,422	1,388,732	3.62
1953	333,922	1,171,932	3.51
1954	280,353	1,064,023	3.79
1955	304,139	1,157,813	3.86
1956	307,821	1,100,434	3.57
1957	226,536	945,848	4.17
1958	204,148	728,722	3.56
1959	171,608	646,788	3.77

[1] Includes both surface and underground workers.

Collieries of British Columbia, 1959—Production and Distribution, by Collieries and by Districts (in Short Tons)

Mine	Gross Output	Washery Refuse	Net Output	Used Under Companies' Boilers, etc.	Used in Making Coke	Stocks				Sales				Total Coal Sold and Used[1]
						On Hand First of Year	On Hand Last of Year	Added To	Taken From	In Canada	In U.S.A.	Else-where	Total Sales	
Vancouver Island District														
Canadian Collieries Resources Ltd.—Tsable River Colliery	146,225	15,026	131,199	361	—	25,035[2]	22,437	—	2,598	133,436	—	—	133,436	133,797
Chambers No. 5 mine	761	—	761	—	—	—	—	—	—	761	—	—	761	761
Loudon No. 6 mine	630	—	630	—	—	—	—	—	—	630	—	—	630	630
Lewis mine (Timberlands)	801	—	801	—	—	—	—	—	—	801	—	—	801	801
Carruthers and Wakelem No. 3	308	—	308	—	—	—	—	—	—	308	—	—	308	308
Stronach mine	408	—	408	—	—	—	—	—	—	408	—	—	408	408
Undun mine	449	—	449	—	—	—	—	—	—	449	—	—	449	449
Extension mine (Brodrick)	11	—	11	—	—	—	—	—	—	11	—	—	11	11
Big Flame mine	7	—	7	—	—	—	—	—	—	7	—	—	7	7
White mine	68	—	68	—	—	—	—	—	—	68	—	—	68	68
Totals, Vancouver Island District	149,668	15,026	134,642	361	—	25,035	22,437	—	2,598	136,879	—	—	136,879	137,240
Nicola-Princeton District														
Princeton Blue Flame No. 3	1,161	—	1,161	—	—	—	—	—	—	1,161	—	—	1,161	1,161
Coldwater mine	416	—	416	—	—	—	—	—	—	416	—	—	416	416
Totals, Nicola-Princeton District	1,577	—	1,577	—	—	—	—	—	—	1,577	—	—	1,577	1,577
Northern District														
Bulkley Valley Collieries	5,524	—	5,524	—	—	656	727	71	—	5,453	—	—	5,453	5,453
Reschke mine	235	—	235	—	—	—	—	—	—	235	—	—	235	235
Gething mine No. 3	3,084	—	3,084	—	—	—	—	—	—	3,084	—	—	3,084	3,084
Totals, Northern District	8,843	—	8,843	—	—	656	727	71	—	8,772	—	—	8,772	8,772
East Kootenay District														
The Crow's Nest Pass Coal Co. Ltd.—Michel Colliery (underground and strip)	569,221	51,976	517,245	10,813	172,927	3,972	4,529	557	—	230,760	40,097	62,091	332,948	516,688
Coleman Collieries (strip)	28,319	2,585[3]	25,734	—	—	—	—	—	—	25,734	—	—	25,734	25,734
Totals, East Kootenay District	597,540	54,561	542,979	10,813	172,927	3,972	4,529	557	—	256,494	40,097	62,091	358,682	542,422
Coal														
Grand totals for Province	757,628	69,587	688,041	11,174	172,927	29,663	27,693	628	2,598	403,722	40,097	62,091	505,910	690,011
Coke														
The Crow's Nest Pass Coal Co. Ltd.—Michel Colliery	134,134	—	134,134	—	—	23,754	28,726	4,972	—	69,683	59,479	—	129,162	—

[1] Includes coal used in making coke and coal used under company stationary and locomotive boilers, etc. [2] Includes inventory overrun of 653 tons. [3] Estimated.

Collieries of British Columbia, 1959—Men Employed, Distribution by Collieries and by Districts

Mine	Supervision and Clerical			Miners			Helpers			Labourers			Mechanics and Skilled Labour			Boys			Total Men Employed		
	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.
Vancouver Island District																					
Canadian Collieries Resources Ltd.—																					
Tsable River Colliery	14	9	23	115	—	115	—	—	—	54	44	98	22	22	44	—	—	—	205	75	280
Chambers No. 5 mine	1	1	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	1	3
Loudon No. 6 mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Lewis mine (Timberlands)	1	—	1	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	3	—	3
Carruthers and Wakelem No. 3	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Stronach mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Undun mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Extension mine (Brodrick)	1	—	1	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	3	—	3
Big Flame mine	1	—	1	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	3	—	3
White mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Totals, Vancouver Island District	23	10	33	127	—	127	—	—	—	54	44	98	22	22	44	—	—	—	226	76	302
Nicola-Princeton District																					
Princeton Blue Flame No. 3	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Coldwater mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Totals, Nicola-Princeton District	2	—	2	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	4	—	4
Northern District																					
Bulkley Valley Collieries	2	2	4	6	—	6	3	—	3	—	1	1	1	2	3	—	—	—	12	5	17
Reschke mine	1	1	2	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	1	3
Gething mine No. 3	1	—	1	3	—	3	1	—	1	—	1	1	—	—	—	—	—	—	5	1	6
Totals, Northern District	4	3	7	10	—	10	4	—	4	—	2	2	1	2	3	—	—	—	19	7	26
East Kootenay District																					
The Crow's Nest Pass Coal Co. Ltd.—																					
Michel Colliery (underground)	33	22	55	257	—	257	115	—	115	37	80	117	74	76	150	—	—	—	516	178	694
Michel Colliery (strip)	—	1	1	—	—	—	—	—	—	—	—	—	—	14	14	—	—	—	—	15	15
Coleman Collieries (strip)	—	1	1	—	—	—	—	—	—	—	—	—	—	14	14	—	—	—	—	15	15
Totals, East Kootenay District	33	24	57	257	—	257	115	—	115	37	80	117	74	104	178	—	—	—	516	208	724
Grand totals for Province	62	37	99	396	—	396	119	—	119	91	126	217	97	128	225	—	—	—	765	291	1,056

Note.—U.=underground; A.=above ground; T.=totals.

COAL-PREPARATION PLANTS

There were no additions or extensive alterations made to existing plants in 1959. For full details of plants see 1954 Annual Report.

COKE-MAKING

Coke is made at only one plant in the Province, that of the Michel Colliery, The Crow's Nest Pass Coal Company Limited, Fernie. In August, 1959, work was started on the construction of a new drying plant for the purpose of reducing the moisture content of the coke breeze from approximately 16 per cent to 3 per cent.

BRIQUETTING

Briquettes are made at only one plant in the Province, that of the Michel Colliery, The Crow's Nest Pass Coal Company Limited, Fernie. There were no alterations or extensions made at this plant during the year. For full details of this plant see 1954 Annual Report.

LABOUR AND EMPLOYMENT

In 1959, 1,056 persons were employed in and about the coal mines of the Province, a decrease of thirty from 1958. Because of the five-day week in force throughout the Province at the larger mines and the legal holidays, the maximum number of working-days was 241. In the Vancouver Island District the one large mine, the Tsable River mine, worked 183 days. In the East Kootenay District the Michel Colliery worked 165 days.

COMPETITION FROM COAL PRODUCED OUTSIDE OF BRITISH COLUMBIA

In 1959 the shipment of Alberta coal and briquettes to British Columbia totalled 437,118 and 14,385 tons respectively.

The following table shows the amount of Alberta coal brought into British Columbia during the past ten years:—

Year	Short Tons	Year	Short Tons
1950	873,558	1955	932,764
1951	898,533	1956	860,329
1952	1,021,484	1957	672,527
1953	859,385	1958	532,911
1954	891,194	1959	437,118

Of the 505,910 tons of British Columbia coal marketed, 181,938 tons was sold for domestic and industrial use in Alberta, Saskatchewan, Manitoba, and Ontario; 21,031 tons was sold for railroad use in Canada; 40,097 tons was exported to the United States; 62,091 tons was exported to Japan; and 1,398 tons was sold for ships' bunkers.

The amount sold for domestic and industrial use in the Province was 199,355 tons.

ACCIDENTS IN AND AROUND COAL MINES

In 1959 there were two fatal accidents, as compared with "one in 1958. The number of fatal accidents per 1,000 persons (underground and strip-mine personnel) employed was 1.89, compared with 0.00 in 1958, 1.45 in 1957, 4.39 in 1956, 3.38 in 1955, 0.69 in 1954, 3.22 in 1953, 1.78 in 1952, 3.11 in 1951, and 2.21 in 1950

The number of fatal accidents per 1,000,000 gross tons of coal (underground and strip-mine coal) produced in 1959 was 2.64, compared with 0.00 in 1958.

The following table shows comparative figures for fatal accidents for 1958 and 1959:—

Company	Colliery	1959	1958
The Crow's Nest Pass Coal Co. Ltd.	Michel	1	----
Canadian Collieries Resources Limited	Tsable River	1	----
Totals		2	----

The following two tables classify the fatal accidents in coal mines as to cause and quantity of coal per accident:—

Fatal Accidents Classified as to Cause

Cause	1959		1958	
	Number	Per Cent	Number	Per Cent
Fall of roof coal	1	50.00	----	----
Crushed between tram and motor	1	50.00	----	----
Totals	2	100.00	----	----

Fatal Accidents, Underground Mines, Classified as to Quantity of Coal Mined

Cause	1959		1958	
	Number of Fatal Accidents	Coal Mined per Fatal Accident	Number of Fatal Accidents	Coal Mined per Fatal Accident
Fall of roof coal	1	646,788	----	----
Crushed between tram and motor	1	646,788	----	----
Totals	2	323,394	----	----

NOTE.—There were no fatal accidents in strip-mining operations during 1959.

Ratio of Fatal Accidents, Underground Mines

District	Accident Death Rate			
	Per 1,000 Persons Employed		Per 1,000,000 Tons of Coal Mined	
	1959	1958	1959	1958
Vancouver Island	3.31	----	6.68	----
Nicola-Princeton	----	----	----	----
East Kootenay	1.44	----	2.06	----
Northern		----	----	----
Province, 1959	1.95	----	3.09	----
Province, 1958	----	----	----	----

In 1959 there were two fatal accidents at the mines in the Province, both of which occurred underground.

On January 15th, 1959, at about 3.45 a.m., Aldo Alexander Cassarini, aged 20, single, and employed as a supplyman in "A" North mine, Michel Colliery, was fatally injured when he was crushed between a locomotive and a car.

The accident occurred on No. 4 incline off No. 2 level while the deceased was shunting four empty flat timber-trams with a battery locomotive. The locomotive was pushing the cars at the time, when one or more of the trams were derailed. The end of the car nearest the locomotive tilted and mounted over the buffer of the locomotive, crushing the deceased in the driver's seat. He was removed to the hospital, but died at 7.30 a.m. from severe internal crushing injuries, massive hæmorrhage, and shock. The actual cause of the derailment is not known as the trams and locomotive had to be moved to release the deceased. Long rope couplings had been used between the trams, and one of these might have dropped on the track. It is customary to couple the timber-trams with a short link after the timber has been unloaded, but it is doubtful if this was done. It is difficult to see how the timber-tram could have mounted over the buffer of the locomotive if it had been coupled to the locomotive by a short link coupling. It was also the recommended procedure to use a coal-car between the locomotive and timber-trams when the locomotive was pushing.

On October 14th, 1959, at about 5.15 a.m., Albert Brown, aged 58, single, and employed as a miner in the Tsable River mine, Comox Colliery, was killed by a fall of top coal.

Brown was removing a triangular pillar of coal lying between a shaker-conveyor working place and an old roadway. This pillar had been blasted on a previous shift and was more or less shattered. A bottom bench remained. hut there was only a narrow pillar or stump 18 inches wide extending from this b&h to the roof. The roof consisted of about 18 inches of top coal, which was being left. However, in the old roadway this top coal had been removed so that its support on that side was the narrow stump of coal left after blasting. This stump suddenly collapsed, allowing the top coal to fall as Brown was loading coal onto the conveyor. Brown received fatal injuries consisting of a broken back and crushed chest. His partner was near by and aid was quickly obtained, but it is considered that he died very soon after the accident occurred.

The stump or pillar of coal, only 18 inches wide, should not have been depended upon to act as a support to the load of 18 inches of top coal. Temporary posts should have been erected from the lower bench.

Including the foregoing fatal accidents, 145 accidents involving loss of seven days or more were reported to the Department by the management of the various mines. All these accidents were investigated and reported on by the District Inspectors of Mines.

The following three tables classify the accidents in coal mines in 1959 as to occupation of the men involved, as to cause, and as to injury.

Accidents Classified as to Occupation

Occupation	Number of Accidents	Percentage of Accidents
Underground—		
Miners	71	48.96
Drillers and foremen	....	......
Haulage and conveyor men	35	24.14
Trackmen and mechanics	2	1.38
Supervisors	6	4.14
Timbermen	5	3.45
Coal-cutters	....	
Miscellaneous	4	2.76
Surface—		
Shops	5	3.45
Surface	9	6.20
Preparation and coke-ovens	6	4.14
Miscellaneous	2	1.38
Totals	145	100.00

Accidents Classified as to Cause

Cause	Number of Accidents	Percentage of Accidents
Fall of ground	26	17.93
Fall of material and flying material	18	12.41
Lifting and handling equipment and material	43	29.66
Machinery and tools	20	13.79
Slipped and tripped	29	20.00
Falling off staging and platforms	6	4.14
Miscellaneous	3	2.07
Totals	145	100.00

Accidents Classified as to Injury

Injury	Number of Accidents	Percentage of Accidents
Head and neck	11	7.59
Eyes	4	2.76
Trunk	36	24.83
Back	15	10.35
Arms	9	6.20
Hands and fingers	27	18.61
Legs	35	24.14
Feet	5	3.45
Toes	3	2.07
Totals	145	100.00

EXPLOSIVES

The following table shows the quantity of explosives used in underground coal mines in 1959, together with the number of shots fired, tons of coal produced per pound of explosives used, and the average number of pounds of explosives per shot fired (these quantities include all the explosives used for breaking coal and rock work in coal mines) :—

Vancouver Island District

Colliery	Quantity of Explosives Used (Pounds)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosive per Shot Fired
Tsable River Colliery	67,900	146,225	96,800	2.15	0.70
Chambers No. 5 mine	400	761	600	1.90	0.67
Loudon No. 6 mine	875	630	850	0.72	1.03
Lewis mine (Timberland)	400	801	700	2.00	0.57
Carruthers and Wakelem No. 3 mine	300	308	380	1.02	0.79
Stronach mine	150	408	250	2.72	0.60
Undun mine	150	449	300	2.99	0.50
Extension mine (Brodrick)	5	11	5	2.20	1.00
Big Flame mine	50	7	35	0.14	1.43
White mine	25	68	50	2.72	0.50
Totals for district	70,255	149,668	99,970	2.13	0.70

Nicola-Princeton District

Colliery	Quantity of Explosives Used (Pounds)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosive per Shot Fired
Princeton Blue Flame No. 3	3	1,161	6	387.00	0.50
Coldwater mine	300	416	300	1.38	1.00
Totals for district	303	1,577	306	5.20	0.99

Northern District

Colliery	Quantity of Explosives Used (Pounds)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosive per Shot Fired
Bulkley Valley Collieries	6,375	5,524	7,065	0.86	0.90
Reschke mine	300	235	350	0.78	0.86
Gething mine	2,250	3,084	3,000	1.37	0.75
Totals for district	8,925	8,843	10,415	0.99	0.85

East Kootenay District

Colliery	Quantity of Explosives Used (Pounds)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosive per Shot Fired
Michel Colliery	36,606	486,700	60,719	13.29	0.60

Province

Colliery	Quantity of Explosives Used (Pounds)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosive per Shot Fired
Totals for Province	116,089	646,788	171,410	5.57	0.67

Quantity of Different Explosives Used

	Lb.
Monobel of different grades	113,139
Permissible rock powder	2,950
Total	116,089

MACHINE-MINED COAL

In 1959, mining-machines produced approximately 40,926 tons or 6.3 per cent of the total output from underground mining. A total of 110,840 tons of strip-mined coal was removed by mechanical means.

SAFETY LAMPS

There were 1,073 safety lamps in use in the mines of the Province. Of this number, 989 were approved electric lamps, mostly of the Edison type.

APPROVED SAFETY LAMPS—ELECTRIC AND FLAME

The following is a list of approved safety lamps, electric and flame:—

The Wolf lamp, flame type.

The Koehler lamp, flame type.

The Edison electric lamp (cap) under Approval No. 18 of the United States Bureau of Mines, and all Edison lamps up to and including Model P, carrying the Approval Certificate No. 2.6 of the United States Bureau of Mines, Model R-4, Approval No. 29.

The Wheat electric lamp and having Approval No. 20, as issued by the United States Bureau of Mines.

The Wolf electric lamp, No. 830C.

The electric lamp manufactured by the Portable Lamp and Equipment Company, under Approval No. 27 of the United States Bureau of Mines.

M.S.A. single-cell trip lamp, carrying United States Bureau of Mines Approval No. 1009, approved for use on haulage trips in mines.

The Davis M.L. model pneumatic electric lamp.

ELECTRICITY

Electricity is used for various purposes on the surface and underground at three collieries. A total of 12,385 horsepower was used in and about these mines. Detailed information as to how and where this power was used is given in the report of the Senior Electrical Inspector of Mines.

INSPECTION COMMITTEES

The provisions of the *Coal-mines Regulation Act,* section 65, General Rule 19, require that an inspection committee of workmen shall inspect the mine regularly on behalf of the workmen and make a true report of the conditions found. In all the larger mines of the Province this rule is fully observed, and copies of the report are sent to the Inspectors for the district. The work of these committees is valuable and assists in furthering the interests of safety at the various mines.

COAL DUST

The danger of accumulations of coal dust on the roadways and in the working-places is fully realized, and as a rule the regulations regarding the control of coal dust are adequately carried out. Large quantities of limestone dust are used continually in the larger mines to combat this hazard. It is used in the roadways, working-places, and for the tamping of shots.

Dust samples are taken regularly from roof, sides, and floor of mine roadways and analysed. The reports of the analyses are forwarded to the District Inspector each month.

DIESEL LOCOMOTIVES

Early in August, 1950, the first diesel underground locomotive to be used in any mine in British Columbia made its trial runs in No. 9 mine, Elk River Colliery, The Crow's Nest Pass Coal Company Limited.

MILLISECOND DELAY DETONATORS

I” February, 1951, a” amendment to the *Coal-mines Regulation Act* was passed to allow, with the permission of the Chief Inspector of Mines, more than one shot to be fired at a time in any coal mine or district of a mine. For further details see 1954 Annual Report.

DANGEROUS OCCURRENCES

On September 25th, 1959, at about 9.30 a.m., a fire occurred at the 100-horsepower electric motor driving the main surface fan at “A” North mine, Michel Colliery. The fire was put out by the “se of extinguishers and the damage was confined to the motor.

It is thought that one of the motor bearings had failed, thus allowing contact between the rotor and the stator coils.

The me” in the mine were withdrawn immediately and no one was injured or suffered ill effects through exposure to smoke.

0” November 16th, 1959, in “A” North mine, Michel Colliery, the trailing cable of a “ Borecut ” continuous miner pulled out of the connecting plug, causing a short circuit accompanied by a severe electrical flash. The incident was caused by slack in the cable being caught by a projecting piece of lagging that had been placed beneath the tail conveyor. The machine was being moved toward the face to assist in the timbering cycle when the short circuit occurred.

BUMPS AND OUTBURSTS

0” March 16th, 1959, at 4.20 p.m., a severe bump occurred on the No. 3 slope, “ B ” South mine, Michel Colliery. Approximately 100 feet of the slope was affected. The floor from the entrance to No. 5 room to about 50 feet up the slope was heaved to the roof. From the 50-foot point to 100 feet from No. 5 room the heaving gradually diminished to zero. Several sets of timber were broken, thus allowing the roof to cave at these points. No one was injured.

It was reported that the bump was felt in several of the houses in Michel, but workmen employed in “A” East mine workings below the affected area were ““aware of the incident.

On April 15th, 1959, at about 1.30 p.m., a bump occurred “ear the face of a pillar extraction off No. I raise, South level section, “B ” South mine, Michel Colliery. The bump was fairly severe and caused the high side of the roadway to heave for a distance of 40 feet, starting from a point 12 feet outby the face. The heaving of the floor ranged from zero at the face to about 2 feet at a point 30 feet from the face of the roadway.

The two miners working at the face were shaken, but otherwise uninjured.

On April 16th, 1959, a bump occurred in the gob area in the vicinity of No. 2 room, No. 3 slope, “ B ” South mine, Michel Colliery. Although the ventilation was momentarily disrupted, no other damage was done.

PROSECUTIONS

There were no prosecutions instituted at the various mines during the year.

SUPERVISION OF COAL MINES

During 1959 eighteen companies operated twenty-two mines, employing 765 me” underground. In the supervision of underground employees there were two managers, eight overmen, three shiftbosses. and forty-seven firebosses, or approximately one official for every twelve me”.

BOARD OF EXAMINERS FOR COAL-MINE OFFICIALS

FIRST-, SECOND-, AND THIRD-CLASS CERTIFICATES AND MINE SURVEYORS' CERTIFICATES

The Board of Examiners, formed on July 10th, 1919, consists at present of R. B. Bonar, Deputy Chief Inspector of Mines, chairman and secretary; A. R. C. James, Inspector of Mines, member; and D. R. Morgan, Inspector of Mines, member.

The examinations are held at least once a year and more often if necessary.

All officials, before engaging in multiple blasting with millisecond delay detonators, are required to obtain a permit to do so from the Board of Examiners (Coal-mine Officials). This permit is issued only after the applicant has successfully passed oral and practical examinations in such work.

In addition to the examinations and certificates already specified as coming under the Board of Examiners, the Act provides that every coal-miner shall be the holder of a certificate of competency as such. Examinations are held as circumstances warrant in coal-mining districts, and no certificate is granted where the candidate has failed to satisfy the Board as to his fitness, experience in a coal mine, and a general working knowledge of the English language.

During 1959 there were thirteen candidates for coal-miners' certificates. In addition to the certificates granted above, substitute certificates were issued to those who had lost their original certificates. Permits to act as coal-miners, as provided by the Act, have been granted to younger men by Inspectors in their respective districts. This method allows promising men with less than one year's experience underground to work at the coal face as miners under the guidance of an experienced miner.

The Board of Examiners desires to thank the different coal-mining companies for the use of their premises for the holding of examinations where necessary.

NOTES ON COAL MINES

VANCOUVER ISLAND INSPECTION DISTRICT

By R. B. Bonar

The gross output of coal from the Vancouver Island Inspection District was 149,668 tons, a decrease of 32,636 tons or 11.9 per cent from the 1958 output. Only one large coal mine, the Tsable River mine, is now in production on the Island. Operations in the once important Nanaimo coalfield are now restricted to nine very small mines, providing employment for no more than twenty-one men. These mines operate in outcrop, pillars, and barriers left during earlier working.

The Island coal-mining industry has suffered a rapid decline in the past few years. Production has declined by as much as 60 per cent since 195 1. This condition has resulted from loss of markets due to competition from other fuels, high costs of production, and from the depletion of reserves in the Nanaimo coalfield.

In 1959 there were forty-three accidents, including one fatal reported and investigated.

The annual mine-rescue and first-aid meet organized by the Vancouver Island Mine Safety Association was held at Cumberland on Saturday, May 30th. Two teams from the Tsable River mine and a visiting team from Bralorne mine participated in the mine-rescue competition, and a very high standard of performance was maintained. The winning team was the Tsable River team No. 1, captained by John Thomson.

Nanaimo (49° 123° S.W.)

Chambers No. 5 Mine, Extension

R. H. Chambers and associates, operators; R. H. Chambers, manager. This mine is in Section 14, Range 7, in the Douglas district, near Extension. The present workings consist of a 600-foot slope driven in a section of the Wellington seam in the vicinity of the old Vancouver slope workings. The slope pillars and the pillars between the rooms driven to the right off the slope are being mined on the retreat.

The coal is mined by picking out the middle band of carbonaceous shale with hand-picks. It is then blasted and hand-loaded into cars which are hauled to the tipple by a gasoline-driven hoist. A small shaker screen sorts the coal into Z-inch, 1- to 2-inch, and under l-inch sizes.

Total production in 1959 was 761 tons over a working period of 145 days, with a crew of three men. Working conditions were found to be satisfactory in the course of inspections. No accidents were reported.

Lewis Mine (Timberlands)

Glyn Lewis, operator and fireboss. This property comprises two small mines operating in the Wellington seam in a small area of outcrop coal that was left when No. 8 mine was abandoned bv Canadian Collieries (Dunsmuir) Limited. The seam outcrops on the side of a ridge parallel to and immediately south of the Nanaimo River valley at an elevation of 540 feet above sea-level. The coal measures dip southward at 8 degrees. The two mines are one-third of a mile apart.

The new mine, which commenced production in May, 1951, is in Range 1, Section 2, of the Cranberry district. It operates in an area of coal outcrop about 1 acre in extent, which is bounded on the west by a thrust fault that also formed the western boundary of the old No. 8 mine. The seam is 6 feet thick, including two thin rock bands.

The coal is blasted off the solid and hand-loaded into cars which are hauled to the surface up the slope by a small hoist driven by a gasoline-operated engine. A shaker screen sorts the coal into lump, nut, and pea sizes. Total production in 1959 was 801 tons over a working period of 166 days, with a crew of three men. Working conditions were found to be satisfactory, and no accidents were reported.

Undun Mine No. 1

J. Unsworth and A. Dunn, operators; A. Dunn, fireboss. This mine, which was brought into production in August, 1954, is three-quarters of a mile northwest of the Village of Extension. It operated in the Wellington seam, and the output came from the mining of pillars and small areas of coal left near the outcrop in the old Extension No. 6 mine.

Due to the depletion of reserves of coal, this mine was abandoned in June, 1959. and the portal sealed off.

Total production in 1959 was 246 tons over a working period of sixty-one days, with a crew of two men. Working conditions were found to be satisfactory, and no accidents were reported.

Undun No. 2 Mine

J. Unsworth and A. Dunn, operators; A. Dunn, fireboss. This mine, which was brought into production in September, 1959, was established by cleaning up and retimbering the old

No. 1 mine slope (Extension) for a distance of over 200 feet. It was hoped to find and mine pillars of coal north of the old slope and between the old workings and the outcrop.

To the end of the year, 203 tons of coal was produced by a crew of two men over a working period of fifty-nine days. Conditions as found during inspections were satisfactory, and no accidents were reported.

Big Flame Mine

Albert Addison, operator. This mine is in Range 5, Section 13, of the Cranberry district. Reopening of this mine, formerly known as the Clifford mine, was commenced early in 1955. During the year, only prospecting was done in an attempt to find coal of economical thickness and grade.

Extension Mine

H. Brodrick and associates, operators; H. Brodrick, fireboss. This mine was started early in 1957 in outcrop coal near the portal of the No. 2 slope, old Extension colliery. Due to depletion of reserves of. coal, the mine was abandoned early in January, 1959.

NORTH WELLINGTON (49” 124” SE.)

Loudon No. 6 Mine

William Loudon and associates, operators; W. Loudon, tie-boss. This mine is about 1 mile southeast of Wellington and has been opened up by a flat-dipping slope driven in a small area of outcrop coal in the No. 2 Upper Wellington seam adjacent to the old No. 9 workings. The top portion of the seam, varying from 2 to 3 feet and consisting of carbonaceous shale, is blasted off the solid and stowed. The bottom 20 inches to 2 feet of coal is broken up with light shots and hand-loaded into cars which are hauled to the surface by a small gasoline-powered hoist. Production in 1959 amounted to 630 tons over a working period of 159 days with a crew of two men. Working conditions were found to be satisfactory during the course of inspections, and no accidents were reported.

Carruthers and Wakelem No. 3 Mine

R. B. Carruthers and W. Wakelem, operators; R. B. Carruthers, fireboss. This mine, near the Loudon mine, is also in the No. 2 or Upper Wellington seam adjacent to the abandoned workings of the old No. 9 mine. Production in 1959 amounted to 308 tons over a working period of 100 days, with a crew of two men. Working conditions were found to be satisfactory in the course of inspections. No accidents were reported.

Stronach No. 2 Mine

Charles Stronach, operator; H. Gilmour, fireboss. This mine is in a section of the No. 2 or Upper Wellington seam adjacent to the old No. 9 mine. All the output comes from the mining of pillars and small areas of coal left in the early workings. Production in 1959 amounted to 408 tons over a period of 123 days, with a crew of two men. Working conditions were found to be satisfactory in the course of inspections. No accidents were reported.

White Mine

Joseph White, operator and fireboss. This mine is about 200 feet south of Stronach No. 2 mine and is operated as a prospect in search of pillars of coal thought to have been left during the early workings of the old Wellington slope and latterly the Pacific No. 2 mine.

The finding of coal pillars has proved to be disappointing, and only 68 tons of coal was produced in fifty-nine working-days with a crew of two men. The mine was closed down during the latter part of the year.

Conditions were found to be satisfactory, and no accidents were reported.

COMOX (49° 124° N.W.)

Canadian Collieries Resources Ltd. Head office, 566 Hornby Street, Vancouver 1. F. Ronald Graham, chairman of the board; N. R. Whittall, president; E.. 0. T. Simpson, vice-president, mining; W. W. Johnstone, district superintendent.

Tsable River Mine.—S. J. Lawrence, manager; T. Ecclestone, overman, L. Cooper, A. Cullen, and A. Somerville, shiftbosses; W. Bennie, J. Cochrane, M. Frobisher, W. High, L. Hutchinson, C. Lewis, G. Nicholas, J. Thomson, and A. Maxwell, firebases; S. Gough, surface foreman.

The layout and method of operating this mine are fully described in the 1954 Annual Report. In 1959 production came from the extraction of pillars formed by earlier development in the seam and from development work and extraction of pillars in the northeast section beyond the second fault system.

In the latter part of the year the company announced that its coal contracts would not be renewed after May 31st, 1960. Shortly after this announcement was made, all development work was stopped underground. The extraction of pillars was intensified, especially in the northeast section, where only the most economical coal was produced.

All the coal, both in development and pillar-extraction areas, is blasted off the solid. Electrical multiple blasting with millisecond delay detonators is used throughout the mine.

Total production in 1959 amounted to 146,225 gross tons over a working period of 183 days, with a crew averaging 205 men underground and seventy-five on the surface. Conditions at the mine were usually found to be satisfactory in the course of inspections.

First-aid arrangements have been maintained at a satisfactory standard. A suitably equipped first-aid room is provided on the surface, and an ambulance is held in readiness for emergencies. Five employees hold industrial first-aid certificates, and twenty-four employees hold other first-aid certificates. Two mine-rescue teams of six men each are maintained, and these attend periodic practices at the Cumberland mine-rescue station.

Forty-three accidents, including one fatal accident. at or in the mine were reported and investigated. This mine won the Ryan Trophy, emblematic of having the lowest accident record in a British Columbia coal mine, in 1956, 1957, and 1958, and has again won the award for 1959. This very excellent record is due to the maintaining of the intensified safety programme put into effect by the management and ably assisted and advised by the Director of the Safety Division of the British Columbia Mining Association.

Regular inspections of the mine were made each month by the inspection committee appointed by the workmen, and copies of its reports were forwarded to the office of the District Inspector through the courtesy of the committee.

NICOLA-PRINCETON INSPECTION DISTRICT

By David Smith, except as noted.

Coal production in 1959 in the Nicola-Princeton district was 1,577 tons, a fact which serves to indicate the severe blows wrought to this once thriving industry by the introduction of other fuels such as oil and natural gas. Operations were restricted to two small mines, although some further exploration work was carried out on the Mullin's strip mine near Blakebum.

No accidents were reported by either of the coal mines in 1959, nor were there any prosecutions under the *Coal-mines Regulation Act.*

MERRITT (50° 120" SW.)

Coldwater Coal Mines

This property, 1 mile south of Merritt, is operated by the owners, S. Gerrard and partners. Fireboss (permit), S. Gerrard. Mining of coal has been confined to the splitting of pillars and extraction of remnants of coal in the abandoned workings of the old Middlesboro No. 5 mine. Total production in 1959 was 416 tons, sold locally. A crew of two men was employed. Working conditions were satisfactory, and no methane was detected in the course of inspections.

HAT CREEK (50" 121" N.W.)*

Inland Resources Company Limited

Company office, 602 West Hastings Street, Vancouver 2. R. R. Wilson, president, Vancouver. This company holds Coal Licences Nos. 12 and 144 covering 960 acres in the Hat Creek area. The property is at Upper Hat Creek, 30 miles from Ashcroft and 15 miles from Pavilion. An unusually thick deposit of lignite coal occurs in a small basin of Tertiary sedimentary rocks. Little is known of the structure of the coal measures, but near the coal outcrop they appear to be steeply folded and to have undergone some faulting. The Hat Creek coal deposit has been known of for many years and was reported on by Dawson in 1877. Various early attempts were made to develop the property. In 1925 Hat Creek Coal Company drilled seven holes and drove an adit 100 feet. Mining for local requirements on a very small scale was carried on from 1933 to 1945. The property remained inactive from 1945 to 1957.

In 1957 the present company, under the technical direction of Dolmage, Mason and Stewart, consulting engineers, drilled eight holes, totalling 5,700 feet, on the west side of the creek with the object of further exploring the extent and structure of the deposit. This work was continued in 1959, when six additional holes, totalling 6,200 feet, were diamond drilled.

Five test trenches were excavated. The work was done from July to October, 1959. A crew of eight men was employed. It is reported that this work has indicated very substantial reserves of coal on the property.

[References: *Minister of Mines*, B.C., Ann. Rept., 1925, pp. 305-333; *Geol. Surv., Canada, Mem. 262,* pp. 108-110.]

PRINCETON (49° 120" S.W.)

Blue Flame Colliery

This mine is about 10 miles by road south of Princeton and about half a mile west of the Hope-Princeton Highway. T. Bryden, fireboss, and a partner work the mine on a lease basis. Total production for 1959 was 1,161 tons, most of which was sold to the Princeton brewery. Working conditions were satisfactory, and no methane was detected in the course of inspections.

---

* By A. R. C. James.

EAST KOOTENAY INSPECTION DISTRICT

By D. R. Morgan

Coal-mining activities in the East Kootenay Inspection District were confined to the Michel and Corbin areas of the Crowsnest Pass coalfield during 1959. They included both underground and open-cast operations, but, as in the past few years, activities were again restricted due to shortage of markets for the coal. This resulted in irregular operation and loss of production. Two companies were in operation and produced 597,540 tons of coal, a decrease of 94,102 tons or 15.7 per cent less than was produced in 1958. Most of the production was obtained by The Crow's Nest Pass Coal Company Limited, whose activities were confined to the Michel Colliery, following the closure of the Elk River Colliery in 1958. The company produced 569,221 tons, a decrease of 95,042 tons or 16.7 per cent less than in 1958. The colliery operated 165 days out of a possible 236 days, eleven days less than in 1958. The remainder of the production from the district was obtained by Coleman Collieries Limited, operating a large strip mine on both sides of the interprovincial boundary on Tent Mountain, near Corbin. This company produced 28,319 tons from the British Columbia side in 1959, a decrease of 2,825 tons or 9.9 per cent less than was produced by the same operation in 1958. Operations at the strip mine were temporarily suspended for a period of nearly five months during 1959, and since that time activities have been confined mainly to the Alberta side. Operating days on the British Columbia side during 1959 only amounted to forty-one out of a possible 236 days.

The accident record for 1959 showed one fatal accident, which occurred at the Michel Colliery. This was worse than the record for 1958, which was free of fatal accidents. Improvement was shown in both frequency and severity rates of other accidents. Two serious accidents were reported, both of which occurred underground and resulted in a fractured limb, a decrease of two on the number reported in 1958. Minor accidents resulting in the loss of one or more working-days totalled 13 1, of which 112 occurred underground and nineteen on the surface. This number was twenty-one less than in 1958. No accidents were reported from the British Columbia side of the stripping operation on Tent Mountain. Five dangerous occurrences were investigated at the Michel Colliery, and are reported more fully in another part of the report under the heading " Dangerous Occurrences."

The East Kootenay Mine Safety Association held its thirty-eighth annual mine-rescue and first-aid competitions at Fernie on June 13th, and the various contests were well attended. Four teams representing Fernie, Michel, and Kimberley entered the mine-rescue contest, and the British Columbia Department of Mines shield was won by the Fernie team, captained by Albert Littler. There were 109 competitors in the first-aid competitions, and the Rotary shield and the British Columbia Department of Mines cup were won by the Sullivan mine team, captained by W. McArthur. These teams represented the East Kootenay District in the respective contests at the Provincial competitions held at Kamloops on June 27th. The Fernie mine-rescue team was successful in winning the Provincial championship, and the Sullivan team placed second in the first-aid competition.

The Crow's Nest Pass Coal Company Limited

T. G. Ewart, president, Fernie; Thomas F. Gleed, vice-president, 1010 White Building, Seattle, Wash.; James Littler, general superintendent, Fernie: W. R. Prentice, secretary, Fernie; J. F. Cleeve, treasurer, Fernie. This company has conducted large-scale coal-mining operations in the East Kootenay District since 1897, and present operations are confined to the Michel

Colliery. They include underground and open-cast mines, and are directed from a. head office in Fernie. The coal production is sold mainly on the industrial market, and a large amount of the fines are utilized for the making of coke and briquettes, which are also sold on the industrial markets. A brief synopsis of the operations follows.

MICHEL COLLIERY.—(49° 114" N.W.) William Chapman, manager; Irving Morgan, senior overman; Walter McKay, safety supervisor; William Gregory, afternoon-shift overman.

The colliery is at Michel, on the Crowsnest branch of the Canadian Pacific Railway, 24 miles east of Fernie. It is a large colliery and has been in operation since 1899. Present operations include five underground mines, driven on both sides of the valley, and a stripping operation on Baldy Mountain, near Michel. They also include a modern by-product plant and a briquette plant, which are located on the colliery-site. The mines are developed in two seams, and are named according to the seam worked and the direction of development. Four of the mines, on the south side of the valley, have been developed from a pair of rock tunnels, each 5,000 feet long, which have been driven across the synclinal structure of the coal measures. The mines are operated on both sides of the syncline, and connections have been made to the respective outcrops for ventilation. The remaining mine, "A" North, is being developed from the outcrop of the "A" seam on the north side of the valley and is completely independent of the other mines. The mines in general are operated by the room-and-pillar system, and the pillars are extracted on the retreat. All the mines are mechanized, and the chief motive power is compressed air, although electricity is rapidly becoming the leading power. Main road haulage is by means of compressed-air locomotives, and battery locomotives are used at the "A" North mine. The production of all the mines is cleaned and treated for market at a modern preparation plant located near the entrances to the rock tunnels. A description of this plant has been given in past reports.

Underground operations are under the direct supervision of seven overmen and twenty-four firebosses.

"A" *East* Mine.-Daniel Chester, overman; Frank McVeigh, Roger Pasiaud, Thomas Taylor, Harry Sanders, and Albert Littler, firebosses.

This mine has been developed in the "A" seam, is on the eastern limb of the Michel syncline, and all the workings are on the left side of the rock tunnels. The mine has been in operation for many years, and present activities are confined mainly to dip workings which are rapidly retreating toward the main rock tunnels. The mine is worked by the room-and-pillar system.

The seam is 10 to 12 feet thick and dips at an angle of 20 degrees in a southwesterly direction. The coal is friable, of good quality, and is overlain by a weak shale roof, which requires careful attention for its support. During advancement of the rooms the coal is mined by pneumatic picks and occasionally has to be blasted from the solid by the use of millisecond delay detonators. It is loaded by duck-bill conveyors or directly by hand onto conveyors. The pillars are extracted by the short-wall method and, as the coal is friable, pneumatic picks are used to full advantage, and no shot-firing is necessary. The coal from the pillars is loaded by hand onto shaker, chain, and belt conveyors and transferred to loading points in the rooms. From the loading points the coal is hauled in trips of cars by compressed-air hoists to the main east level, and from there to the surface by compressed-air locomotives via the main rock tunnel.

Most of the production in 1959 was obtained from two sections of workings known. as the No. 1 and No. 3% Slopes, and the remainder came from a small section of pillar workings above the main east level known as the No. 5% incline. The average daily production of the mine was 650 tons with a crew of 130 men employed. Nearly all the production was obtained from the extraction of pillars, further new development being restricted owing to adverse mining conditions and the depletion of coal reserves. Activities in the No. 5 incline and the No. 3½ Slope sections were confined entirely to the extraction of pillars left to support the main roadways. In the No. 1 Slope district, the major operation, the coal reserves are also very limited. The district is at the outer end of the main east levels and has been developed by means of three slopes driven to the base of the Michel syncline. Efforts made to continue the slopes and develop a large area of workings on the western limb of the syncline were abandoned in 1958 owing to excessive roof pressures and costly maintenance. Activities have since been confined to the eastern limb of the syncline and the extraction of pillars already formed. These activities up to the present have been confined mainly to the left side of the slopes because old slope workings from the "A" West mine are on the right side and are known to be flooded. It is estimated that over 250,000 tons of coal has been left unworked in the old pillars, and preparations are being made to dewater the workings by drilling 150-foot holes from the present slope workings in order to enter the area. Every precaution is to be taken against the possibility of flooding, the present workings, and electric pumps have been installed in the No. 1 Slope district to cope with the additional water when necessary. The electric pumps have replaced the former compressed-air pumps. Conditions in general were found to be fairly good during the course of inspections, but a great deal of difficulty is being experienced in maintaining sufficient clearance on the roadways in the No. 3% Slope section during the year owing to the convergence of the pillar extractions on the roadway. Some difficulties were also experienced at times in maintaining an adequate amount of ventilation in the working-places in that section owing to leakages in the gob areas.

The mine is ventilated by an electrically driven aerodyne fan which delivers 90,000 cubic feet of air per minute to the workings at 5.4-inch water-gauge. The quantity was found to be sufficient for the normal requirements of the mine.

"A" West Mine.-Harry Corrigan, overman; Reginald Taylor, James Walsh, John McInnis, Thomas Krall, Stanley Menduk, Paul Kusnir, Robert Taylor, William Verkerk, Sidney Hughes, William Cytko, and Roger Girou, firebosses.

This mine is in the "A" seam, and is on the eastern limb of the Michel syncline. It is entered from the right side of the rock tunnels, and the present workings have been developed from two inclines driven from the main west level to the outcrop of the seam. The coal varies from 12 to 28 feet in thickness, is of good quality, and dips at an angle of 20 to 35 degrees in a southerly direction. A description of the general layout of the mine and the method of working is included in the 1957 Annual Report.

The mine has been a major operation for many years, and during 1959 it had an average daily production of 1,200 tons with a crew of 204 men. Most of the production was obtained from panels of workings in the upper region of the mine where the coal is 28 feet thick, and the pillars are extracted by the caving system. A very high percentage of the coal was recovered and the caving was controlled without much difficulty. Extraction of pillars in the No. 9 right belt-road section was completed early in the year, and since that time most of the production was obtained from the No. 4 left belt-road section which was developed in 195X. Extraction of pillars in this section is now rapidly nearing completion, and two further panels, Nos. 1 and 2 left belt-roads, are being developed from a lower elevation on the inclines for future extraction. The No. 2 left belt-road section will be in close proximity to the No. 3 left belt-road section, which was sealed off in 1956 due to a gob fire, but a sufficient barrier of coal will be left between the two workings. The new panels are in early stages of development, and the belt roads and companion roadways had only advanced 200 and 400 feet respectively at the end of December. The remainder of the production from the mine was obtained from the extraction of pillars left alongside the No. 1 entry in the old No. 4 left belt-road section. Only the top 12 feet of the seam is extracted in this area, and the operation is rapidly nearing completion.

The mine is ventilated by an electrically driven axivane fan which delivers 85,000 cubic feet of air per minute to the mine workings at a 3.5.inch water-gauge. This quantity was found to be sufficient for the requirements of the mine, and no indications of any gas were found in the active workings during the course of inspections. Periodic checks were maintained on the tire seals in the old No. 3 left belt-road section, and indications were that the fire was still inactive.

Upper "A" South Mine. -Vans H. Hulbert, overman; James Anderson, Michael Tymchuk, and Ronald Saad, firebosses.

This mine is in an early stage of development, having been opened in October, 1956, in order to develop a large area of "A" seam virgin coal left between the old abandoned "A" South mine workings and the outcrop of the seam. The mine is on the Sparwood limb of the syncline, and entry was made via two inclines driven in the underlying No. 1 seam which were later connected to the "A" seam by means of two rock raises. Contact was made with the seam in November, 1958.

The coal is 26 feet thick, is of good quality, and pitches 35 degrees in a westerly direction. It is intended to continue the inclines on the full pitch of the seam to the outcrop, and develop workings on both sides of the inclines for future extraction of the pillars by the caving system. Very little progress was made in the advancement of the inclines during 1959, as a great deal of activity had to be directed to regrading of the inclines after meeting the seam and installing conveyors on the No. 1 incline. A large fault, encountered after the inclines had advanced 250 feet, has caused considerable difficulty. The fault is of the reverse type, is large, and has a displacement of 75 feet. Diamond-drill holes were bored to test the fault, and it is intended to drive two rock tunnels to meet the continuation of the seam on the other side of the fault. No. 1 level, which was being driven to commence development on the right side of the inclines, was stopped when the inclines met the fault. It will probably be continued at a later date to extract the coal from the outby side of the fault. The level had advanced 350 feet when it was stopped. A crew of thirty-one men employed at the mine produced an average of 130 tons daily when the working-places were in the coal.

Conditions in general were found to be satisfactory during the course of inspections. Nearly all the equipment is electrically driven and is of the permissible type. The mine is ventilated by the old No. 3 seam fan, which also ventilates the "A" West mine workings, and was found to be satisfactory to meet the present requirements of the mine.

"A" North Mine.-John Whittaker, overman; Thomas Slee, fireboss.

This mine is operated in the "A" seam on the north side of the Michel Valley, approximately half a mile east of the colliery preparation plant. It is being developed from four main levels which follow the strike of the seam from the outcrop. The mine has been in operation since 1951.

The mine is expected to become a large operation and, up to the present, activities have been confined to development. The coal is 12 feet thick when normal but is very irregular and faulty. It is of good quality and dips 15 to 20 degrees in a southerly direction. The coal at most of the working-places is mined by pneumatic picks or is blasted from the solid with millisecond delay detonators. It is then loaded by hand onto shaker and chain conveyors and transported to various loading points alongside the levels, where it is loaded into IO-ton-capacity bottom-dumping cars and taken from the mine by battery locomotives. The bottom two levels are more highly mechanized and are advanced by two continuous miners which mine and load the coal. One of the machines has been in operation since the end of 1956, and the other was put into operation in June, 1959. Nearly all the equipment is operated by electricity and, with the exception of one of the continuous miners which is on trial by special permit, is of the flameproof permissible type. Compressed air, which is mainly used for operating pneumatic picks, is supplied by three portable electric compressors located inside the mine on the main intake airway. All the production from the mine is brought to the preparation plant by means of trucks, which are loaded from bins at two of the mine portals.

Operations were considerably restricted during 1959 owing to the state of the coal market, and development was curtailed. Most of the activities were directed to the driving of the No. 0 and No. 1 development levels at the lower end of the mine, which are not so far advanced as the remainder of the developments. The levels were driven 1,150 feet and encountered a great deal of difficulty in places owing to thinning of the seam.

No. 2 and No. 3 levels in the upper part of the mine were idle for a considerable period, and only minor development was carried out at the No. 4 incline panel of workings above the levels. Both the levels and the panel were idle during the last three months of 1959, but operations are expected to be resumed in the "ear future. Twelve men were employed for most of the year, with a" average daily output of 120 tons.

Conditions in general were found to be satisfactory during the course of inspections. The mine is ventilated by a" axivane fan which delivers 90,000 cubic feet of air per minute to the workings at a I .6-inch water-gauge. Small auxiliary fans capable of producing 5,000 cubic feet of air per minute are also used for ventilating the faces of the main levels and "arrow headings ahead of the last crosscuts. These were found to be sufficient to meet the requirements of the mine.

"B" South Mine.—Andrew Davey, overman; Arnold Webster, Robert Doratty, John Krall, and Kenneth Kniert, firebosses.

The mine is operated in the "B" seam, on the western limb of the Michel syncline, and has been developed from the left side of the main rock tunnels. The seam is 5½ feet thick, dips 30 degrees in an easterly direction, and is overlain by a strong, sandstone roof. The coal is of excellent quality, friable, and gassy. It is mined by pneumatic picks, and no shot-firing is allowed. The workings have been developed by the room-and-pillar system, and the pillars are extracted on the retreat. A full description of the workings has bee" given in past Annual Reports.

The mine has been in operation for many years, and activities are rapidly nearing completion due to depletion of the coal reserves. Extraction of pillars in the No. 3 Slope district, the last major operation, was completed toward the end of 1959, and since that time operations have bee" restricted to the extraction of roadside pillars along the main south level and the old No. 3 incline. Conditions in general were found to be satisfactory, with the exception of low parts of the roadway on the No. 3 main haulage slope before it was stopped. Three bumps occurred and are dealt with under "Dangerous Occurrences" in another part of the Report. A portion of the workings in the slope area was abandoned due to one of the bumps.

The mine is ventilated by an electrically driven axivane fan which delivers 65,000 cubic feet of air per minute to the workings at a 4.3-inch water-gauge. This quantity was found to be sufficient for the requirements of the mine.

During 1959, 33,650 pounds of Monobel No. 4, 2,950 pounds of CXL-ite, and 60,719 electric detonators were used at the colliery for coal and rock blasting. Fourteen misfired shots were reported.

Two hundred and sixteen tons of limestone dust were used for application on the roadways at the various mines to minimize the coal-dust hazard and for tamping shots. Monthly mine-dust samples were regularly taken at all the mines and analysed. All the samples were above the minimum requirements of incombustible content.

Regular monthly examinations were made at all the mines by the miners' inspection committees, and a meeting was held at the colliery office each month by the pit committee. Copies of the findings and recommendations were sent to the office of the District Inspector through the courtesy of the committee members. All the report books kept at the mines in accordance with the *Coal-mines Regulation* Act were examined periodically and found to be in order.

Baldy Mountain Strip Mine.-William Chapman, manager; C. M. Matson, foreman.

This operation is at a high elevation on Baldy Mountain, 4 miles east of Michel, and access is by means of a private road leading from the colliery preparation plant. The coal deposit is large, and stripping operations have been conducted at various elevations along the outcrops of the seams. The work is carried out on a contract basis, and four pits have been started or worked since the company commenced operating in the area in 1948.

Two pits were operated during 1959 by Mannix Limited, of Calgary. The operation produced 82,521 tons with a crew of two men in the pits and six truck-drivers to transport the coal to the preparation plant. This was decrease of 24,340 tons from the corresponding figure in 1958. Most of the production was obtained from the No. 2 pit, where a large area of overburden had previously been removed. The pit has been in operation for many years, and it is estimated that over 60,000 tons of coal are left to be worked. All the coal is exposed. Extraction of coal from the No. 3 pit, which was in operation during 1958, was completed in February, 1959, and the pit was abandoned. No rock work was carried out during 1959, and coal-loading operations were confined to a single-shift basis. The coal at both the pits is 40 feet thick, of fairly good quality, but some sections have inferior coking qualities.

Conditions in general were found to be satisfactory during the course of inspections, but some difficulty was experienced with the high wall in the No. 3 pit before abandonment, and a small quantity of coal had to be left behind as a protection against sliding. The roadway leading from the mine to the preparation plant was kept in very good condition.

By-product Plant.-George Lancaster, superintendent. This plant is adjacent to the preparation plant at the Michel Colliery, and a full description of its operation is included in the 1954 Annual Report. No appreciable change has been made at the plant since that time, with the exception of a small drying unit that was in course of construction at the end of 1959. The unit will be used for drying and screening the fine coke product (breeze) in order to reduce its moisture content and make it more suitable for market. The unit will have a capacity of 4 tons per hour (dry basis).

Coke-making during 1959 was confined to the Curran-Knowles ovens, and the production was 134,134 tons, a decline of 39,785 tons from the corresponding figure in 1958. The production was restricted due to lack of markets, and was affected to a marked degree by an industrial strike in the United States.

Briquette Plant.-George Lancaster, superintendent. This plant was put into operation in 1954 and is located adjacent to the preparation plant. A full description of the plant is included in the 1954 Annual Report, and no appreciable change has been made since that time.

Operations were considerably restricted owing to lack of markets for briquettes, and the plant was idle for several long periods during 1959. The production was 18,846 tons, as compared with 33,272 tons in 1958, 84,436 tons in 1957, and 188,355 tons in 1956, showing a large and continual decline during the past four years.

Coleman Collieries Limited

(49” 114” N.W.) D. B. Young, general manager, Coleman, Alta.; John C. Shearer, strip-mine manager. This company operates a large stripping operation on both sides of the interprovincial boundary on Tent Mountain, near Corbin, and access is by means of a roadway leading from the No. 3 highway near Crowsnest Lakes. Most of the property is in the Province of Alberta, but a large quantity of coal has been produced in the British Colombia part since 1951. The present activities are confined to an open-pit known as the No. 2, in operation since 1954, at the top of the mountain, at an elevation of 7,200 feet. The coal is in the form of a synclinal basin and is over 100 feet thick in parts. The overburden has been removed during the past few years, and activities are now confined to the loading of coal by power-shovel. The coal is trucked to the company’s preparation plant at Coleman, Alta.

Mining activities were considerably restricted during 1959 owing to shortage of markets, and the operation was completely shut down for a period of nearly five months in the early part of the year. Production of coal from the British Columbia side was further restricted because a new lift of coal is being extracted on the Alberta side advancing toward British Columbia.

Conditions in general were found to be satisfactory during the course of, inspections, although some difficulty was experienced in the spring when a small portion of the hangingwall slid into the pit. The wall was later thoroughly checked and scaled.

NORTHERN INSPECTION DISTRICT

By David Smith

The coal mines of the Northern District produced a total of 8,843 tons of coal in 1959. The output is sold entirely on the domestic market, which limits all operations to seasonal work only.

No accidents or dangerous occurrences were reported from the coal mines of this district during 1959.

TELKWA (54° 127” N.E.)

Bulkley Valley Collieries Limited

Company office, Telkwa. F. M. Dockrill, president; F. Bond and L. Gething, firebosses. This property is on Goat Creek, a tributary of the Telkwa River, about 7 miles southeast of Telkwa. Total production in 1959 was 5,524 tons. The mine was closed at the end of March and operations were resumed in September. In the fall a noticeably better demand for coal was apparent, and it is thought that this may be due to the closing-down of the mine at Mercoal in Alberta. An average crew of fourteen men was employed.

Conditions in the mine were found satisfactory in the course of inspections, and no methane was detected. No accidents were reported.

PEACE RIVER (56° 122° S.E.)

King Gething Mines Q. F. (King) Gething, operator and fireboss. This property is on Lot 1039, 12 miles by road from Hudson Hope. Total production for 1959 was 3,084 tons. A crew of three men was employed. Conditions at the working-faces were found to be satisfactory in the course of inspections, and no methane was detected. A survey of the underground workings was brought up to date. No accidents were reported.

Reschke Coal Ltd. Company office, Fort St. John. E. B. Summer, operator and fireboss (permit). This property is 23 miles by road from Hudson Hope and is about 1 mile north of the Peace River at an elevation of 2,600 feet. Operations have been less than seasonal due to a loss of markets, and only a very small amount of coal for local purposes has been obtained. Total production was 235 tons. Conditions were found to be satisfactory in the course of inspection, and no methane was detected. No accidents were reported.

Inspection of Electrical Equipment and Installations at Mines, Quarries, and Well Drilling Rigs

By L. Wardman, Senior Electrical Inspector

ELECTRIC POWER

In 1959 electric power was used by thirty-three mining companies in operations at thirty-seven lode mines, two placer mines, and three collieries. Twenty-eight metallurgical mills, two coal-cleaning plants, and one coking plant were in operation during the year. Electric power was used at twenty-nine non-metallic mineral and structural-material mines and quarries for one or more of the following operations: Loading, crushing, separating, and conveying of materials. Forty-seven drilling rigs using electric power for lighting, and energizing motors were used in drilling operations at 140 wells. Sixty-four of these were completed as oil or gas wells.

LODE-METAL MINES

Of those mines using electricity, operations at five were terminated either indefinitely or permanently; operations at five were recommenced, and electrical equipment installed at four others was put into service. One mine at which operations were commenced in 1958 was not operated in 1959.

The kilovolt-ampere generating capacity of mining-company-owned plants operated in 1959 was as follows:—

Prime Mover	Generator Kva. Capacity
Diesel engines	11,215
Water-wheels	10,840
Steam turbines	1,800
Total	23,855

The electric power produced was approximately 58,348,245 kilowatt-hours during 1959. The power purchased from public utilities and from the generating division of The Consolidated Mining and Smelting Company of Canada, Limited, amounted to 210,687,318 kilowatt-hours. The total amount of power used for mining and concentrating purposes at lode mines amounted to 269,035,563 kilowatt-hours.

A general breakdown of the connected load is as follows:—

Equipment	Horsepower
Hoists (incline and shaft)	5,937
Hoists (scrapers)	5,645
Fans (mine ventilating)	4,079
Pumps (mine unwatering)	5,317
Rectifiers and M.G. sets	7,135
Air compressors (supplying mining equipment)	17,445
Crushing	9,496
Sink float	1,450
Milling, concentrating, separating	39,291
Workshops	2,106
Miscellaneous	7,504
Total	105,405

In addition to electrically powered equipment, there is approximately 7,055 horsepower of prime movers driving direct-connected or belt-connected equipment according to the following table:—

Prime Mover	Horsepower
Diesel engines	6,450
Water-wheels	570
Gasoline engines	35
Total	7,055

On surface and underground haulage systems there were in use 112 battery locomotives, eighty-three trolley locomotives, and sixteen diesel locomotives. One of the diesel locomotives was moved to a new property in 1959.

Placer Mines

One of the three placer mines using electric power in 1958 did not operate in 1959. The equipment in use was as follows:—

	Kilowatts
Power plants—Diesel-engine-driven generators	583
Equipment—	Horsepower
Trommel screens	75
Pumps	100
Conveyors	25
Dragline shovel	51
Compressors	15
Miscellaneous	8
Total	274

Non-metallic Mines and Quarries

Electric power was used at twenty-nine non-metallic mineral mines and quarries. At several of these properties power is produced by company-owned diesel-driven generators; for the others, power is purchased from the local utility company. The capacity of the company-owned plants was approximately 2,800 kilovolt-amperes.

Approximately 9,000,000 kilowatt-hours of power was generated and 38,000,000 kilowatt-hours was purchased, making a total of 47,000,000 kilowatt-hours of power consumed.

The distribution of electric power was as follows:—

Equipment	Horsepower
Incline hoists	400
Scraper hoists	800
Pumps	600
M.G. sets and rectifiers	250
Air compressors	800
Shovels	150
Crushers	4,900
Conveyors	2,300
Screens	2,100
Dust collecting	220
Workshop	750
Miscellaneous	1,700
Total	14,970

At these properties there was also diesel-driven equipment totalling 3,700 horsepower.

Coal Mines

There was no change in the number of collieries using electric power in 1959. The distribution of electric power is as follows:—

	Horsepower	
Surface—		
Compressed air	4,440	
Ventilation	555	
Hoisting	545	
Haulage	15	
Coal washing and screening	2,551	
Pumping	225	
Briquetting	642	
Coke	1,180	
Miscellaneous	613	
Total		10,766
Underground—		
Ventilation	65	
Hoisting	60	
Haulage	112	
Pumping	250	
Miners (Borecut)	175	
Coal-cutters	100	
Conveyors	652	
Compressed air	200	
Miscellaneous	5	
Total		1,619
Total for surface and underground		12,385

Five permissible battery locomotives were in use underground.

A total of 28,737,640 kilowatt-hours of power was used for mining and coal-processing operations.

ELECTRICAL INSTALLATIONS

LODE MINES

Lillooet

Bridge River (50° 122° N.W.)

Bralorne Division (Bralorne Pioneer Mines Limited).—A dangerous occurrence took place on June 5th, 1959, when the Crown hoist overspeeded, causing damage to motor, rope, and several guides. Details of this incident are written in the section on dangerous occurrences.

Highland Valley (50° 120° S.W.)

Bethlehem Copper Corporation Ltd. During the period of operation in 1959, two 90-kva. Caterpillar-diesel-driven electrical generating units supplied power for this property. A 60- by 20-inch Roots blower driven by a 100-horsepower motor was used for ventilating the adit, and a 15-kw. M.G. set was used to charge locomotive batteries.

The equipment in the sampling plant consisted of the following: A 24- by 18-inch jaw crusher driven by a 40-horsepower motor; two conveyors driven by two 3-horsepower motors; a Dillon screen driven by a l-horsepower motor; and a water pump driven by a 3-horsepower motor.

MERRITT (50” 120” S.W.)

Craigmont (Birkett Creek Mine Operators Ltd.) A 2,300.volt ZOO-kw. diesel-driven alternator was installed to supply power for development work. Formerly a 75-kw. and a 52-kw. 440-volt Caterpillar-diesel-driven alternator were supplying power. The 52-kw. unit was removed from service and the 75-kw. unit was retained as a stand-by unit. A 2,300-volt power-line was built from the 3500 level to the 3000 level to supply power to equipment at the latter level. Two 150-kva. 2,300–440-volt transformers at the 3500 level step down the voltage for equipment at that level and three 37½-kva. 2,300–440-volt transformers step down the voltage for equipment at the 3000 level.

Each adit is ventilated by a dual fan driven by two 20-horsepower motors. Two car dumps driven by 5-horsepower motors are used on the waste dump.

In the assay laboratory there are three 5-, one 3-, and one %-horsepower motors driving the crusher, pulverizer, pump, and fan respectively.

HEDLEY

French (French Mines **Ltd.**).—(49° 120” S.E.) A three-drum Joy-Sullivan slusher driven by a 20-horsepower motor and a Canadian Ingersoll-Rand two-drum slusher driven by a 12-horsepower motor were installed at the mine.

OLALLA

Keremeos Mines Ltd. (49” 119° S.W.) A mill and power plant was built on the property. The power plant consists of a 100-kva. 2,300-volt 900-r.p.m. Westinghouse alternator driven by a 150-horsepower diesel engine. A bank of three 37½-kva. single-phase transformers step down the power from 2,300 volts to 460 volts for the mill motors.

The equipment in the mill consists of the following: A crusher driven by a 15-horsepower motor; a ball mill driven by a 30-horsepower wound rotor induction motor; a classifier driven by a 3-horsepower motor; and six flotation cells driven by three 3-horsepower motors.

CAMP MCKINNEY

Cariboo-Amelia **(H. & W.** Mining Co. **Ltd.**).—(49° 119° S.E.) A 250-kva. diesel-driven 3-phase a.c. generator was used to supply power for two 40-horsepower pump motors. In the fall a main transformer station was installed, and during November and December power was purchased from the West Kootenay Power and Light Company Limited. Other electrically driven equipment consists of a shaft hoist driven by a 75-horsepower motor and an air compressor driven by a 100-horsepower motor.

GREENWOOD

Mother Lode (Consolidated Woodgreen Mines **Limited**).—(49° 118” S.W.) When preparations were made to reopen the property, the transformers were reinstalled and connected to the power-lines and distribution system. A bin to contain the mill feed was built and two conveyors were installed, driven by a 7½- and a 3-horsepower motor respectively. A dust-collecting system consisting of a separating cone and a fan driven by a 30-horsepower motor was installed to collect the dust produced by the crushers.

PHOENIX

Phoenix Copper Company Limited (49" 118" SW.) In 1959 the entire plant was brought into production and the following electrical work was done. In the mill a ZOO-horsepower ball-mill motor switch-gear was installed, and also a 15-horsepower motor with 440-volt switch-gear. Two 40- and one 20-horsepower pumping units were installed underground. The assay office wiring was completed and a 15-horsepower M.G. set was installed in the crushing plant.

ROSSLAND

Velvet (Mid-West Copper and Uranium Mines Ltd.).-(49" 117" S.W.) Preparations were commenced to operate the mine and mill. The mine shaft was retimbered as necessary and a hoist driven by a 150-horsepower motor was installed. The electrical equipment in the compressor building and mill was overhauled. Later in the year operations were suspended.

SALMO

Jersey, Emerald, and Dodger (Canadian Exploration Limited) (49" 117" S.E.) A 90-kva. substation, No. 418, was built in the Jersey 4472 drift and was put into operation at the end of February. A 2,300.volt power-cable 250 feet long was run through a diamond-drill hole from the Dodger 4330 drift to the Jersey 4772 drift to supply this station. A 75-kva. substation, No. 419, was built in the Jersey F zone and was put into operation at the end of October. A 2,300.volt power-cable 1,200 feet long supplies power from the Dodger substation No. 420 to this station.

A new 75-horsepower hoist has been installed in the Jersey 4000 mine. A second diesel-electric locomotive was assembled and put into service. Three slusher hoists requiring a total of 100 horsepower were installed.

ASPEN CREEK

H.B. (The Consolidated Mining and Smelting Company of Canada, Limited).—(49° 117" S.E.) A 30-horsepower motor driving a slusher was added to the mine equipment. Replacement of mill motors with larger sizes resulted in an increased mill load of 7 horsepower.

NELWAY

Reeves MacDonald Mines Limited.—(49° 117" S.E.) A 4- by 8-foot double-drum hoist driven by a 200-horsepower 2,300-volt Westinghouse motor was installed for No. 3 shaft. A Bean Royal 55 piston pump driven by a IO-horsepower 440-volt motor was installed at the bottom of No. 2 shaft.

NORTH KOOTENAY LAKE

Riondel (49" 116° N.W.)

Bluebell (The Consolidated Mining and Smelting Company of Canada, Limited)

A building was put up adjacent to the compressor building to house the new stand-by power plant. A new 375-kva. 600-volt diesel-driven alternator and the 375-kva. 600-volt diesel-driven alternator from the old diesel plant were installed in this building. A 750-kva. 600–6,900-volt bank of transformers was installed to step up the line voltage to 6,900 volts. These units will operate in conjunction with the 187½-kva. alternator which was previously installed in the compressor building. The power-lines were reconnected to supply the emergency power to No. 8 level instead of No. 5 level.

A remote-control system was installed for No. 1 and No. 2 substations.

A hoist driven by a 75-horsepower 600-volt motor was installed on the No. 6 level.

A temporary pumping system, consisting of three 6½-horsepower Flygt pumps, one 65-horsepower Flygt pump, and two 20-horsepower S.S.H.B. pumps, was installed at the No. 8 level for the No. 2 winze.

In the mill, six flotation cells driven by three lo-horsepower motors and three pumps driven by three 7½-horsepower motors were installed.

DUNCAN LAKE

Duncan Mine (The Consolidated Mining and Smelting Company of Canada, Limited)

(50° 116" S.W.) Two residences, a warehouse, cook-house, bunk-house, dry, compressor building, shop, and power-plant building were built and wired for lighting. A 35-kva. 550-volt, a.c. generator supplies power for lighting and motors. A fan driven by a IO-horsepower motor ventilates the adit which is being driven. A pump driven by a 15-horsepower motor is used to pump water from the lake to the camp. Equipment in the shop taken 10 horsepower in motors. A 15-kva. and a 7½-kva. transformer step down the voltage for lighting. A 900-c.f.m. compressor driven by a 175-horsepower diesel supplies air for mining. A 38-horsepower Hunslet diesel locomotive is used on the haulage.

WINDERMERE

Toby Creek (50" 116" S.E.)

Mineral King (Sheep Creek Mines Limited).-A Canadian Ingersoll-Rand vacuum pump driven by a 20-horsepower motor was installed in the concentrator. The blacksmith-shop was moved to a new location and rewired.

KIMBERLEY

Sullivan (The Consolidated Mining and Smelting Company of Canada, Limited)

(49° 115" N.W.) In the mine the *No.* 27 shaft hoist with accompanying electrical equipment was moved to a new location. At the concentrator a 20-horsepower motor driving a fan was installed in the substation, and a 2-horsepower motor driving a fan was installed in the toolroom. A %-horsepower motor driving a fan and two 2-horsepower motors driving Deister tables were installed in the tin plant. A 5-horsepower motor driving a pump was installed in the sink-and-float plant, and the main power switchboard in the float-loading building was rebuilt. A Z-horsepower crane motor was installed in the boiler-shop. A 25-horsepower pump motor was replaced with a 40-horsepower motor; a 7½-horsepower conveyor motor at the 3800 crushing plant was replaced with a 15-horsepower motor; and a 5-horsepower threading-machine motor was replaced with a lo-horsepower motor.

The acetylene building was rewired with explosion-proof fittings, and the reagent building and shifters' office were rewired and "no fuse" breakers were installed. A "no fuse" breaker was installed in the carpenters' shop. The lighting circuits on the rougher floor were renovated, and 25-kva. dry-type transformer was installed. Wiring and controls were installed for an automatic sampler. A 65,000-volt oil circuit-breaker and a 69,000.volt ground detector were installed in the step-down substation. Lightning-arresters for 69,000 volts potential were installed in the concentrator substation. A "dead man" control was installed on No. 3 locomotive.

HOPE

Pride of Emory (Giant Nickel Mines **Limited).**—(49° 121" S.W.) The equipment was overhauled and operation of the property was recommenced. In addition to maintenance and repair work, a 20-horsepower motor was installed for driving the tailings-disposal pump.

HOWE SOUND

Britannia (Howe Sound Company, **Britannia** Division) (49" 123" N.E.) When operation of the mine and mill recommenced in 1959, the following electrical work was done. In the Victoria mine, an 18-horsepower motor driving a slusher was installed on the 2500 level. Four 3-kw. M.G. sets for charging batteries were installed, one on each of the 2300, 2600, 2900, and 3300 levels respectively. A 25-kw. M.G. set was installed on the 4100 level for trolley 250-volt power. Two 7½-horsepower motors driving fans were also installed on the 4100 level. A 250-volt trolley conductor was installed on 234 drift E on the 4100 level. A ¾-horsepower grinding wheel was installed on the 2200 level, and a 5-horsepower grinding wheel on the 2600 level.

At No. 7 shaft on the 4100 level, a 75-horsepower fan motor and a load-distribution centre were installed. Also on the 4100 level at No. 6 shaft, a 20-horsepower motor driving a slusher was installed.

In No. 8 mine thirteen motors driving slushers were installed, distributed as follows: A 30-horsepower on the 4200 level; three 20- and one 50-horsepower on the 4500 level; one 20-, two 30-, and one 50-horsepower on the 4600 level; one 50-horsepower on the 4800 level; and two 30- and one 50-horsepower on the 4900 level. Also installed were a 15-horsepower fan unit on the 4200 level; four 3-kw. M.G. sets for charging batteries, one on each of the 4200, 4300, 4600, and 4800 levels respectively; two 27-kw. M.G. sets for charging batteries on the 4500 and 4800 levels respectively; and one IO-kw. M.G. set for charging batteries on the 5 100 level.

In the 4100 level portal shops, four grinding wheels were installed, and in the Beach machine-shop a grinding wheel and shaper were converted from belt drive to electric-motor drives.

In the mill three cone-crusher feeder conveyors were replaced with one conveyor driven by a IO-horsepower motor, and a Ty Rock screen driven by a S-horsepower motor. A Dorr classifier driven by a IO-horsepower motor was installed on the grinding floor. One 5- and one 75-horsepower motor driving pumps were installed in the flotation section. A 5-horsepower motor was added to No. 12 conveyor.

Benson (Elk) Lake

Empire Development Company Limited.-(50" 127° S.E.) A scalping plant consisting of a magnetic-head pulley and three conveyors was installed immediately following the primary crusher. The connected load for motor-driven equipment has been increased by 95 horsepower.

Nimpkish Lake

Nimpkish Iron Mines, Ltd.

(51° 126" S.W.) A power plant, and a crushing, milling, and separating plant were built in 1959. The power plant consists of two 2,300-volt 3-phase 60-cycle alternators driven by diesel engines. One has a capacity of 650 kw. and the other has a capacity of 200 kw. The crushing equipment consists of a jaw crusher driven by a 75-horsepower 440-volt motor and a cone crusher driven by a 100-horsepower 440-volt motor.

The mill contains a rod mill driven by a 32-horsepower 440-volt motor, a vacuum pump driven by a 150.horsepower motor, and four separators driven by 5-horsepower motors. Other equipment consists of conveyors and feeders.

Cowichan Lake

Blue Grouse (Cowichan Copper Co. Ltd.)

(48" 124° N.W.) An XVHB-2 Ingersoll-Rand compressor driven by a 250-horsepower 2,300.volt synchronous motor was installed in the mill to supply air for drills in the mine. The 2,300.volt service which supplied one 225-horsepower 2,300-volt motor was rebuilt to supply both the above-mentioned motors. This service now consists of a main 400-ampere disconnector and oil circuit-breaker and two ZOO-ampere branch circuit switches, with the essential motor-control equipment.

A thousand feet of 440-volt power-line was installed to supply the 7½-horsepower mine water-supply pumps.

Head Bay

Hualpai Enterprises Ltd.

(49" 126" N.W.) A power plant and a separation plant for iron ore were built. The power units consist of the following: A 125-kva. Caterpillar diesel generating unit, a 75-kva. Caterpillar diesel generating unit, a 60-kva. General Motors generating unit, and a 60-kva. stand-by unit.

The separating plant consists of the following: A jaw crusher driven by a 20-horsepower motor; a cone crusher driven by a 50-horsepower motor; two screens driven by 5-horsepower motors; three magnets energized by three 2-horsepower M.G. sets; one wet separator driven by a 3-horsepower motor; an M.G. set driven by a S-horsepower motor; a feeder driven by a 7½-horsepower motor; and six conveyors driven by a 25-, a 10-, a 7½-, two 5-, and a 3-horsepower motor respectively.

At the dock a 60-kva. electric plant supplies the dock, loading equipment, which consists mainly of a conveyor driven by a 25-horsepower motor.

McDame

Cassiar Asbestos Corporation Limited

(59" 129° S.W.) An additional 449-horsepower was added to the connected load in 1959, as follows: Primary and secondary screens, conveyors, and aspirating fans requiring 205 horsepower were installed in the mill to handle larger tonnages. A general warehouse was built which requires 31 horsepower in electric power. A directors' lodge was built, and the townsite, trailer park, school, and the hospital nurses' quarters were enlarged. These improvements and other miscellaneous additions constitute the remainder of an added load of 213 horsepower.

EAST KOOTENAY

Michel Colliery (The Crow's Nest Parr Coal Corn- **pany** Limited)

(49" 114° S.W.) On the surface at "A" North mine, two 100-kva. 6,600–550-volt transformers were installed to supply battery-charging equipment and a crane. A 10-kva. 550–1 10-volt transformer was installed to supply yard lighting. The power-line serving the "A" South mine fans was rebuilt for 6,600 volts and extended to supply, in addition to the fans, a hoist installation and underground electrical equipment in "A" South when the workings are extended to the surface. This line at present is energized at 2,200 volts, but will be raised to 6,600 volts in 1960.

The pumping equipment, switch-gear, and cables which were in a "B" seam slope were moved to "A" East mine.

The condensation of moisture in the electrical apparatus caused four failures as follows: Failure of a cable on the Borecut, failure of a motor starter, failure of a tugger cable, and failure of a starter plug.

Two dangerous occurrences involving electrical equipment happened in 1959. These. occurrences are described in the section on dangerous occurrences.

Lode-metal Deposits Referred to in the 1959 Annual Report

The names of the properties are arranged alphabetically within five areas. Each area consists of the mining divisions listed below. The table shows the principal metals produced or indicated in the deposits in 1959:—

Northern British Columbia.—Atlin, Liard.

Central British Columbia.—Cariboo, Clinton, Omineca.

Coast and Islands.—Alberni, Nanaimo, New Westminster, Skeena, Vancouver, Victoria.

South Central British Columbia.—Greenwood, Kamloops, Lillooet, Nicola, Osoyoos, Similkameen, Vernon.

Southeastern British Columbia.—Fort Steele, Golden, Nelson, Revelstoke, Slocan, Trail Creek.

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Uranium	Chromium	Tin	Nickel	Molybdenum	Antimony	Sulphur	Mercury	Germanium	Page
Northern British Columbia																					
Balsom Group	Liard	57° 132° N.E.														3					6
Bird Group	Liard	57° 130° S.W.			3																7
Fort Reliance (Toad, Toad River, Beaver Lake)	Liard	58° 125° N.W.			3																19
Magnum Copper (Al, Caribou, Canyon, Don)	Liard	58° 125° N.E.			3																21
West Group	Liard	58° 127° S.E.				3															18
Central British Columbia																					
Aurum	Cariboo	53° 121° S.W.	1	2																	22, A45
Boss Mountain	Cariboo	52° 120° S.W.														3					24
Cariboo Gold Quartz	Cariboo	53° 121° S.W.	1	2																	22, A45
Cronin Babine	Omineca	54° 126° N.W.	2	1		1	1		2												18, A45
Glacier Gulch	Omineca	54° 127° N.E.														3					17
Grotto	Omineca	54° 128° N.E.	3	3	3	3	3														17
Huestis Molybdenum	Omineca	54° 128° N.E.														3					15
Lucky	Cariboo	54° 121° S.W.			3																22
McDonald Island	Omineca	54° 126° N.E.			3																18
Silver Standard	Omineca	55° 127° S.W.	2	1	2	1	1		2												A45
Snell Group	Omineca	55° 125° N.E.																	3		18
Sunset	Cariboo	52° 122° S.E.			3																23
Tudyah Lake	Cariboo	55° 123° S.E.	3																		22
Coast and Islands																					
A.M.	N. West'r.	49° 121° S.E.			3																122
Alice	Skeena	55° 129° S.E.														3					10
Avallin	Victoria	48° 124° N.W.			3																138
Beaver Group	Skeena	54° 128° N.W.	3																		15
Berton	Alberni	49° 125° S.W.	3																		137
Big Interior Group	Alberni	49° 125° S.W.			3																135
Blue Grouse	Victoria	48° 124° N.E.		2	1																138, A46
Britannia	Vancouver	49° 123° N.E.	2	2	1	2	1		2												127, A46
Buccaneer	Alberni	49° 125° S.W.	1	2	2	2															A45
Bugaboo Creek Iron	Victoria	48° 124° N.E.								3											140
Chalco	Nanaimo	50° 125° S.E.			3																131
Copper Duke	Vancouver	49° 123° N.E.								3											127
Copper King	Nanaimo	50° 124° S.W.			3																130
Domineer	Nanaimo	49° 125° N.W.			3																135
Double Ed	Skeena	55° 129° S.W.			3																10

Shipping Mines.—(1) Metal contributed at least 10 per cent of gross value of the shipment. (2) Metal contributed less than 10 per cent of gross value of the shipment. Production for 1959 is listed in Table XV.

Non-shipping Mines.—(3) Metal present, indicated by assay or mineralogical determination.

LODE-METAL DEPOSITS REFERRED TO IN THE 1959 ANNUAL REPORT—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Uranium	Chromium	Tin	Nickel	Molybdenum	Antimony	Sulphur	Mercury	Germanium	Page
Coast and Islands—Continued																					
Frances	Nanaimo	50° 127° N.E.			3		3														132
Granduc	Skeena	56° 130° S.E.			3																7
Harriet Harbour	Skeena	52° 131° S.E.								3											11
Hualpai	Nanaimo	49° 126° N.W								1											134, A45
Iron Mountain	Skeena	54° 128° S.W.								3											15
King Solomon	Victoria	48° 123° N.W			3																140
Matteer	Nanaimo	49° 124° S.E.	1	2	1																131, A45
Merry Widow, Kingfisher	Nanaimo	50° 127° S.E.								1											132, A46
Musketeer	Alberni	49° 125° S.W.	1	2	2	2															A45
Nadira	Victoria	48° 124° N.W			3																138
Nimpkish, Klaanch	Nanaimo	50° 126° S.W.								3											133, A46
Pride of Emory	N. West'r.	49° 121° S.W.			1										2						124, A46
Quatsino	Nanaimo	50° 127° S.E.			3																133
Red Cliff	Skeena	56° 129° S.W.	3		3																8
Silbak Premier	Skeena	56° 130° S.E.	1	1		2	2														7, A46
Sunloch, Gabbro	Victoria	48° 124° S.E.			3																141
Taiga Mines	Vancouver	49° 124° N.E.																		3	127
Texada (Prescott, Paxton, Yellow Kid, Yellow Jacket)	Nanaimo	49° 124° N.W	2	2	1					1											130, A46
Tofino	Alberni	49° 125° S.W	3																		137
Toric	Skeena	55° 129° N.W		1		1															8, A46
South Central British Columbia																					
Aberdeen	Nicola	50° 120° S.W.			3																34
Ace Mining	Lillooet	50° 122° N.W	3																		25
B Group	Similk'n	49° 120° S.W.								3											53
Bethlehem	Kamloops	50° 120° S.W.			3																29
Betty Lou, Lou	Kamloops	50° 120° S.W.			3																34
Big Ben	Similk'n	49° 120° S.W.			3		3														119
Bounty Fraction	Greenw'd	49° 119° S.E.		1		2	1														57, A46
Bralorne	Lillooet	50° 122° N.W	1	2																	26, A47
Bridge River	Lillooet	50° 122° N.W	3																		28
Cadamet	Nicola	50° 121° S.E.			3																30
Cariboo-Amelia	Greenw'd	49° 119° S.E.	3																		56
Copper Mountain	Similk'n	49° 120° S.W	2	2	1																A47
Copper Nos. 1 to 4	Lillooet	51° 122° S.W			3																25
Craigmont	Nicola	50° 120° S.W			3																31
Crescent	Greenw'd	49° 118° S.W	2	1		2	2														A46
D.M.	Kamloops	50° 120° N.W			3																39
Deep Gulch	Similk'n	49° 120° S.W			3																53
El Alamein	Similk'n	49° 120° N.W	3																		53
Fairview	Osoyoos	49° 119° S.E.	1																		56, A47
French	Osoyoos	49° 120° S.E.	1	2																	55, A47
Golconda	Similk'n	49° 119° S.W			3											3					56
Highland-Bell	Greenw'd	49° 119° S.E.	2	1		2	1		2												57, A46
Horn Silver	Osoyoos	49° 119° S.W	3	3																	56
Hurley River	Lillooet	50° 122° N.W	3														3				28
Lodestone Mountain	Similk'n	49° 120° N.W								3											39
Malakwa	Vernon	50° 118° N.W														3					119
Matt	Kamloops	50° 120° N.W			3																38
Minex-Amador	Kamloops	50° 120° S.W			3																30
Mother Lode	Greenw'd	49° 118° S.W	1	2	1																58, A46
Noranda Exploration	Kamloops	50° 120° S.W			3																35
Phoenix	Greenw'd	49° 118° S.W	1	2	1																58, A46
Pioneer	Lillooet	50° 122° N.W	1	2																	27, A47
Rexspar	Kamloops	51° 119° N.W										3									39
Salem	Similk'n	49° 120° N.W			3																35
Stemwinder	Greenw'd	49° 118° S.W	3	3	3																58
Torwest	Nicola	50° 120° S.W			3																36
Trojan	Kamloops	50° 120° N.W			3																29
Vanex	Nicola	50° 120° S.W			3																38

LODE-METAL DEPOSITS REFERRED TO IN THE 1959 ANNUAL REPORT—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	*Tungsten*	Cadmium	Iron	Manganese	Uranium	Chromium	Tin	Nickel	Molybdenum	*Antimony*	Sulphur	Mercury	Germanium	Page
Southeastern British Columbia																					
Vimy Ridge	Nicola	50° 120° S.W.			3																35
Aspen	Nelson	49° 117° S.E.		3		3	3														62
Banker	Slocan	49° 116° N.W.	2	1		1	2														66, A48
Bannockburn	Revelstoke	50° 117° N.E.		3		3	3														70
Big Mac	Nelson	49° 117° S.E.		3		3	3														61
Black Diamond	*Slocan*	*49° 116° N.W.*		*1*		*1*	2														A48
Black Warrior	Revelstoke	50° 117° N.E.		3		3	3														70
Bluebell	Slocan	49° 116° N.W.		2	2	1	1		2												64, A48
Bosun	Slocan	49° 117° N.E.		1		2	2														70, A48
Caledonia	Slocan	50° 117° S.E.	2	1		1	1		2												67, A48
Double " B "	Nelson	49° 117° S.E.	3	3		3	3														62
Estella	Fort Steele	49° 115° N.W.		2		1	1		2												A47
Galena Farm	Slocan	49° 117° N.E.	2	1		1	1														70, A48
Gold Belt	Nelson	49° 117° S.E.	1	2		2	2														A48
Goodenough, Ymir	Nelson	49° 117° S.E.	3	3		3	3														61
H.B.	Nelson	49° 117° S.E.		2		1	1		2												61, A48
Highlander	Slocan	49° 116° N.W.	2	2		1	1		2												66, A49
Hope	Slocan	49° 117° N.E.		1		1	2														68, A48
J.G.	Slocan	50° 116° S.W.		3		3	3														71
Jersey	Nelson	49° 117° S.E.		2		1	1		2												62, A48
Kilarney	Trail Cr'k	49° 118° N.E.		1		1	2														A49
Kinbasket	Golden	51° 118° N.E.		3		3	3														104
Kootenay Belle	Nelson	49° 117° S.E.	1	2		2	2														A48
L.T.	Slocan	49° 117° N.E.		1		2	2														A49
Lakeshore	Slocan	49° 116° N.W.		2		1	1		2												66, A49
Laura M.	Slocan	49° 116° N.W.		2		1	1		2												A49
Lead King	Revelstoke	51° 118° S.E.		3		3	3														117
Little Slide	Revelstoke	51° 118° S.E.		3		3	3														118
Lone Bachelor	Slocan	49° 117° N.E.		1		1	2														69, A49
Lucky Jim	Slocan	50° 117° S.E.	2	1		1	1		2												A49
Maestro	Slocan	49° 116° N.W.		1		1	2														A49
Mag	Slocan	50° 116° S.W.				3	3														72
Mammoth, etc.	Slocan	49° 117° N.E.	2	1		1	1		2												69, A49
Mastodon	Revelstoke	51° 118° N.E.		3		3	3														106
Midway	Fort Steele	49° 115° S.W.	1	1		2	2														A47
Mineral King	Golden	50° 116° S.E.		2	2	1	1		2												74, A47
Molly	Fort Steele	49° 116° N.E.						3													74
Nugget	Nelson	49° 117° S.E.	3																		61
Option	Nelson	*49° 116° S.E.*	3		3			3													73
Ottawa	Slocan	49° 117° N.E.		1		2	2														A49
Ptarmigan	Golden	50° 116° N.E.	2	1		2	2														90, A47
Queen	Nelson	49° 117° S.E.	1	2		2	2														A48
Red Ledge	Golden	50° 116° S.E.		3		3	3														89
Reeves MacDonald	Nelson	49° 117° S.E.		2		1	1		2												63, A48
Richmond-Eureka	Slocan	49° 117° N.E.	2	1		1	1		2												68, A49
Ruth	Slocan	49° 117° N.E.	2	1		1	1		2												68, A49
Scranton	Slocan	49° 117° N.E.	3	3		3	3														67
Second Relief	Nelson	49° 117° S.E.	1	2		2	2														A48
Silver Mountain	Slocan	49° 117° N.E.	2	1		1	1		2												68, A49
Silversmith, etc.	Slocan	49° 117° N.E.		3		3	3														68
Snap, Lucky Jim	Slocan	50° 117° S.E.		3		3	3														68
Stanmack	Revelstoke	*51° 118°* S.E.	3																		105
Sullivan	Fort Steele	49° 115° N.W.	2	2	2	1	1														73, A47
Tamarac	Nelson	49° 117° S.E.	1	2																	61, A48
Texas, Cowboy, Fourth of July	Slocan	50° 117° S.E.		3		3	3														67
Tungsten King	Nelson	49° 117° S.E.				3	3	3													63
Utica	Slocan	49° 117° N.E.		3		3	3														67
Velvet	Trail Cr'k	49° 117° S.W.	1	2	1																60, A49
Victor	Slocan	49° 117° N.E.	2	1		1	1		2												68, A49
W.D.	Trail Cr'k	49° 117° S.W.	1	2		2	2														60, A49
Wagner	Revelstoke	50° 117° N.E.		3		3	3														70
Westmont	Slocan	49° 117° N.E.	2	1		1	1														70, A49
Wonderful	Slocan	49° 117° N.E.		3		3	3														69
Yale	*Slocan*	49° *116°* N.W.		2		2	*1*		2												A49

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

Mc and Mac

M

N

Q

R

S

T

U

V

W

X

Y

Z

Printed by DON McDIARMID, Printer to the Queen's Most Excellent Majesty
in right of the Province of British Columbia.
1960

2,685-360-3839