Minister of Mines and Petroleum Resources

PROVINCE OF BRITISH COLUMBIA

ANNUAL REPORT

for the Year Ended December 31

1964

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BRITISH COLUMBIA
DEPARTMENT OF MINES AND PETROLEUM RESOURCES

VICTORIA, B.C.

HON. DONALD L. BROTHERS, *Minister.*

P. J. MULCAHY, *Deputy Minister.*

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Major-General the Honourable GEORGE RANDOLPH PEARKES,
V.C., P.C., C.B., D.S.O., M.C.,
Lieutenant-Governor of British Columbia.

MAY IT PLEASE YOUR HONOUR:

The Annual Report of the Mineral Industry of the Province for the year 1964 is herewith respectfully submitted.

DONALD L. BROTHERS,
Minister of Mines and Petroleum Resources.

Minister of Mines and Petroleum Resources Office,
March 31, 1965.

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ANNUAL REPORT OF THE MINISTER OF MINES AND PETROLEUM RESOURCES, 1964

Introduction

A report of the Minister of Mines of the Province of British Columbia has been published each year from 1874 to 1959. Beginning in 1960, it is the Report of the Minister of Mines and Petroleum Resources.

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 and Petroleum Resources now contains introductory sections dealing with Statistics and Departmental 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 lode-metal properties, 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 and Petroleum Resources 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 *

For the third year in succession it is possible to say that the value of British Columbia mineral production exceeds that of any previous year. The value for 1964 amounted to more than $267 million, a gain of $11.6 million or 4.5 per cent over 1963. The value for each of the four classes of mineral products—metals, industrial minerals, structural materials, and fuels—exceeded that of 1963, and for each the 1964 value is the highest value to date. The percentage gains over 1963 were for structural materials, 11.1 per cent; for metals, 4.6 per cent; for industrial minerals, 5.0 per cent; and for fuel, 0.4 per cent.

Notwithstanding the low gain by fuel, all fuels except oil gained. Most items in the industrial-minerals group showed moderate gains over 1963. Structural materials were mostly produced at high rate; cement and sand and gravel showed the greatest gains over previous years.

Metals accounted for 67.6 per cent of the total value; industrial minerals, 6.5 per cent; structural materials, 9.9 per cent; and fuels, 16 per cent.

The increase in metals reflects increased prices for copper, lead, zinc, and for several of the by-product metals. The 1964 quantities of copper and lead were considerably below those of 1963, but increased prices gave values moderately higher than those of 1963.

The year-average prices for gold, silver, copper, lead, zinc, and coal are tabulated on page A 20. Most of the metal is exported, and the returns from it are affected by the premium on United States funds. The premium in Canadian funds averaged 7.856 cents on the United States dollar, compared with 7.87 cents in 1963. In 1964 the premium ranged from 8.126 cents in July to 7.403 cents in November and was 7.451 cents in December.

The price for silver was constant in the United States throughout 1964, the equivalent in Canadian funds varying with the exchange premium. The prices for copper, lead, and zinc all rose during 1964 and were at their highest in December, the averages for 1964 being substantially higher than for 1963. Increased prices for by-product metals, notably for antimony, cadmium, and tin, gave the by-products of siver-lead-zinc mining a value of more than $8 million, more than a million dollars above their 1963 value.

Phoenix copper increased its rate of milling in 1964; Zeballos iron resumed production; Mount Washington copper began producing in December; Bethlehem began recovering by-product molybdenum, which, although contributing only $47,063 to the total value of metals, marks the beginning of regular production. At the end of 1964 Bethlehem was nearly ready to increase its daily tonnage. In the autumn Cominco's iron smelter at Kimberley increased its pig-iron production from 100 to 300 tons daily, and the capacities of the acid and fertilizer plants there were doubled. These increases were paralleled by increased use of iron sinter, credited as iron concentrate, and an increase in sulphur used. Resumption of production at Zeballos also contributed to the iron output, as did by-product iron concentrate from the Coast Copper mine.

Although 1964 silver and lead output figures for British Columbia mines are considerably below 1963 quantities, and zinc is moderately below, the report of the Consolidated Mining and Smelting Company shows that its output of lead from the Trail smelter was much closer to its 1963 output, and silver and zinc exceeded 1963

* By Hartley Sargent, Chief of the Mineralogical Branch.

output. Shipments from British Columbia silver-lead-zinc mines were less than in 1963, and customs and other figures show that lead and zinc concentrates and ore brought into British Columbia from foreign countries and other parts of Canada exceeded 1963 imports. The lead and zinc content of concentrates shipped to foreign smelters contained some 22 million pounds of lead and 48 million pounds of zinc, approximately 8 per cent of the lead and 12 per cent of the zinc British Columbia produced.

The international nature of the industry is indicated by the number of countries from which lead and zinc concentrates are received, and the number of countries to which refined silver, lead, and zinc are shipped. All the nickel, 96 per cent of the iron, and 88 per cent of the copper went to Japan in the form of concentrates. The remainder of the copper went to the Tacoma smelter. Iron sinter smelted at Kimberley amounted to about 4 per cent of the iron output for 1964. Asbestos went to 19 countries in North America, South America, Asia, and Europe, and 40 per cent of the coal went to Japan.

Preparations were being made for molybdenum production at Boss Mountain early in 1965, and at Endako by mid-year. Three new mines—Granisle, copper; Tasu, iron and copper; and Western (Buttle Lake), copper, zinc, and gold—are all scheduled for production in 1966. At Alice Arm, British Columbia Molybdenum Limited has scheduled production for 1967, and Granduc was working toward copper production in 1968.

Exploration for ores of metals has been at a lively pace for more than a decade. In 1964, 118 companies reported having worked on 253 properties. Interest was focused most sharply on molybdenum and copper, but gold, silver-lead-zinc, and iron all received attention, and a revival of interest in antimony and mercury became apparent. Long-established companies continued their exploratory operations, and several new companies entered the field. Recently several oil companies have entered mining exploration or shown interest in the possibilities.

In 1964 the Geological Survey's programme included 26 ground projects in British Columbia, 9 being 4 miles to the inch and 3 being 1 mile to the inch mapping projects, and 14 being studies relating to stratigraphy and palæontology, hydrology, and other special projects. The time assigned for several of the projects was considerably less than the field season.

An airborne magnetometer survey, of four map-sheets in the vicinity of Revelstoke, was carried out by contract, the expense being borne by the Geological Survey of Canada and the British Columbia Department of Mines and Petroleum Resources.

The British Columbia Department had 10 of its staff geologists assigned to field projects and three geologists, not on the permanent staff, doing independent or semi-independent work. The projects in the main involved detailed studies of mines and their immediate settings, but also included studies of larger areas on Vancouver Island, in the southern Interior, central British Columbia, and near Alice Arm and Stewart.

As a measure of the active interest of companies, syndicates, and individuals in exploration, figures from the office of the Chief Gold Commissioner are of interest. Assessment work was recorded on 32,047 mineral claims in 1964, compared with 24,648 in 1963, cash paid in lieu of performing assessment work increased from $62,080 to $96,596, and 29,244 mineral claims were recorded, compared with 25,160 in 1963.

The needs of mines being developed and the need to provide access to parts of northern British Columbia, whose important mineral potential is already demonstrated, call for building roads in areas that currently depend largely on aircraft for transportation. The Stewart–Cassiar road progresses slowly. Roads of more local concern are under construction or are proposed.

Because of increased production, 1964 fuel values were greater than those of 1963, for coal by 1.5 per cent; natural gas, 13.7 per cent; and liquid by-products, 1.2 per cent. Oil output decreased by 5.6 per cent. Coal output increased moderately, at the Crow's Nest Pass and Telkwa collieries. Of the coal mined, more than 90 per cent came from the Crowsnest Pass area.

Exploration for petroleum and natural gas, including geophysical and geological work, and exploratory and development drilling were greatly reduced compared with 1963. Interest in offshore possibilities increased. Offshore exploration included seismic surveys off the west coast of Vancouver Island and the Queen Charlotte Islands and in Hecate Strait. Development drilling in northeastern British Columbia amounted to 385,676 feet, slightly greater than in 1963, but the footage drilled in exploratory and wildcat wells was substantially below that of 1963. The number of successfully completed gas wells declined 47 per cent from 1963, but successful completions of oil wells increased 45 per cent over 1963. More than half the new oil wells were in a newly discovered pool in the Nancy area.

Pressure-maintenance schemes account for the slightly decreased production of petroleum, at the same time increasing the petroleum ultimately recoverable. This increase and new discoveries give an increase of 65 per cent in oil reserves. Gas reserves declined 7 per cent. Submitted gas analyses were reviewed completely, and new calculations give an increase of 10 per cent for reserves of natural-gas liquids and a decrease of 6 per cent for reserves of sulphur.

A gas-conservation plant was completed and began delivering associated gas from the Boundary Lake oil field to the gas pipe-line. A new transmission-line, consisting of 220 miles of 30-inch pipe, from the Fort Nelson area to the Westcoast Transmission Company Limited Pipeline at Chetwynd was nearly completed by the end of 1964. A plant 15 miles south of Fort Nelson to treat high-pressure gas containing carbon dioxide, nitrogen, and hydrogen sulphide, was completed. It is to begin delivering gas of pipe-line standards to the 30-inch transmission line early in 1965. Oil- and gas-gathering lines were also considerably increased.

Direct revenue to the Government from sales of free miners' certificates and from recording fees, lease rentals, cash paid in lieu of assessment work, etc., amounted to $583,455.70, compared with $366,140.38 in 1963.

Royalty on iron concentrates amounted to $269,774, and payments on industrial minerals and structural materials amounted to $37,091. Fees and rentals from coal licences and leases amounted to $5,362.45, compared with $4,737.45 in 1963.

Revenue to the Government from petroleum and natural gas was rentals, fees, and miscellaneous, $8,444.59; sale of Crown reserves, $13,093,872; royalties, gas, $1,583,292; oil, $3,502,222; a grand total of $26,755,820, compared with $20,350,040 in 1963.

Returns received by the Bureau of Economics and Statistics give the following data: Average number employed through 1964 in placer, lode, coal, industrial-mineral, and structural-material mining, 11,645. Major expenditures by those branches of the industry (except that items marked with an asterisk (*) are not reported or are reported incompletely by producers of structural materials and coal): Salaries and wages, $62,499,415; fuel and electricity, $10,032,340; process supplies,* including explosives, chemicals, drill steel, lubricants, etc., $26,351,879; Federal taxes,* $17,271,386; Provincial taxes,* $8,098,167; Provincial royalties, $306,865; municipal and other taxes,* $1,623,280; levies* for workmen's compensation (including silicosis), $1,521,597; unemployment insurance,* $680,310. The lode-mining industry spent $39,516,641 on freight and treatment charges on ores and concentrates. Taxes, levies, and unemployment insurance are incomplete for lode-metal companies in respect of preparation of new properties for production, and exploration and development. Work done by contract is reported as lump sums not broken down in any way.

Returns from lode-metal companies show capital expenditures of $21,900,000, and expenditures on exploration and development of $18,980,000 in addition to salaries and wages on exploration and development amounting to $4,495,528, included in the salaries and wages item in the preceding paragraph. The capital expenditures include preparation for increasing production at two properties and preparations for converting from surface to underground mining at four properties. They include expenditures of $13,600,000† at three properties being prepared for production. The exploration and development expenditures cover work reported by 118 companies on 253 properties, consisting largely of properties under exploration, but include one property being prepared for production. Industrial-mineral producers reported capital expenditures of $1,810,021 and $18,023 on exploration and development, and structural-material producers reported capital expenditures of $908,896. The sum of the expenditures by the lode-metal, industrial-mineral, structural-materials, and coal-mining segments of the industry, including fees, licences, royalties, and the items noted in this and the preceding paragraph, exceed $211,000,000. Dividends amounted to $38,927,308.

Reports from 23 petroleum and natural-gas companies show the following expenditures: Salaries and wages, $1,225,144; fuel and electricity, $173,521; and process supplies, $1,278,074. These returns do not cover the petroleum and natural-gas industry completely. The Canadian Petroleum Association presented the following estimates of total expenditures by the petroleum and natural-gas industry in British Columbia in 1964: Exploration—geological and geophysical, $7,500,000; exploratory drilling, $10,700,000; land acquisition and rentals, $21,600,000; overhead, $3,000,000; total exploration, $42,800,000; development drilling, $7,300,000; capital expenditures, $8,900,000; operation of wells and flow-lines, $4,500,000; capital expenditures and operation of natural-gas plants, $15,200,000; general — taxes (excluding income tax), $500,000; royalties, $5,200,000; all other expenses, $500,000; total general, $6,200,000; grand total, $84,900,000.

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† For two properties include proportion of expenditure reported for a period ending in 1965.

Statistics

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

CO-OPERATION WITH DOMINION BUREAU OF STATISTICS

In the interests of uniformity and to avoid duplication of effort, beginning with the statistics for 1925, the Dominion Bureau of Statistics and the various Provincial departments have co-operated in the collection and processing of mineral statistics.

Producers of metals, industrial minerals, structural materials, coal, and petroleum and natural gas 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 pubished considerably later than the Report of the Minister of Mines and Petroleum Resources for British Columbia. Differences between the figures published by the two organizations arise mainly from the facts that the Dominion Bureau bases its quantities of lode metals on returns made by smelter operators, whereas the British Columbia mining statistician uses the returns covering shipments from individual mines in the same period, and the Dominion Bureau uses average prices for metals considered applicable to the total Canadian production, whereas the British Columbia mining statistician uses prices considered applicable to British Columbia production. Peat, included under the classification of fuel by the Dominion Bureau, has not been regarded as mineral or fuel, and accordingly has not been included in the British Columbia statistics of mineral production. The value of peat for the current year is shown in a note under Table I.

METHODS OF COMPUTING PRODUCTION

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, 1963).*

Beginning with the 1960 Report, Tables I and II were given new forms, Table VIII was amalgamated with Table VII, and subsequent tables were renumbered. Beginning with the 1963 Report, the parts of Tables I and III dealing with metals were combined, so that all metals are now listed alphabetically in a single section. Beginning with the 1964 Report, Table II gives the value for each group of products for each year after 1886.

In this 1964 Report, most of the explanatory notes that had appeared as footnotes to the production tables have been concentrated, arranged alphabetically in a section headed "Notes on Products," immediately following this introductory section.

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

Data from the certified returns made by producers of lode metals, industrial minerals and structural materials, and coal are augmented by data obtained from

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

the operators of customs smelters. For placer gold, returns from operators are augmented by data obtained from the Royal Canadian Mint and from Gold Commissioners and other sources. For petroleum, natural gas, and liquid by-products, production figures are supplied by the Petroleum and Natural Gas Branch of the Department of Mines and Petroleum Resources and are compiled from the monthly disposition report, and Crown royalty statement filed with the Department by the producers.

Values are in Canadian funds. Weights are avoirdupois pounds and tons (2,000 lb.) and troy ounces.

Lode 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.

Gross and Net Contents and Calculated Value

The gross contents for any metal are the total assay contents, obtained by multiplying the assay by the weight of ore, concentrates, or bullion.

The value is calculated by multiplying the quantity, gross for gold, net for silver, copper, lead, and zinc, by the average price for the year and by using appropriate prices for other products. Beginning with 1963, net contents are obtained from the gross as tabulated:—

	Lead Concentrates	Zinc Concentrates	Copper Concentrates	Copper-Nickel Concentrates	Copper Matte
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Silver	98	98	95	.	95
Copper	(1)		(2)	85	(3)
Lead	98	50	----	----	50
Zinc	90	90	50	----	----
Cadmium	----	70	70	----	----
Nickel	----	----	----	88	----

[1] Less 26 pounds per ton of concentrates.
[2] Less 20 pounds per ton of concentrates for 1963; less 10 pounds for 1964 and other years.
[3] Less 10 pounds per ton of matte.

Formerly the net silver content in copper concentrates was taken as 95 per cent of the gross; the net lead content of lead ores and concentrates was taken as 95 per cent; and the net zinc content in lead ores, lead concentrates, and zinc concentrates was taken as 85 per cent, except that for zinc concentrates exported to foreign smelters the net zinc content was calculated by deducting from the gross 8 units; that is, 160 pounds per ton of concentrates. The net copper content of copper concentrates for 1963 was obtained by deducting from the gross content 20 pounds of copper per ton of concentrates; formerly the deduction was 10 pounds, and for 1964 the deduction is also 10 pounds.

Other metals, including by-product metals refined in British Columbia and iron, tin, and tungsten exported as ores and concentrates, are treated similarly, except that quantities and values for several are as reported by shippers for sales in the year. The value of by-product iron ore used in making pig iron at Kimberley has been computed from the value per ton of ore of comparable grade, at the point of export from British Columbia; 1960 and 1961 valuations have been recalculated on this basis.

Average 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 20.

Placer Gold and Silver

Beginning with 1962, Mint reports giving the fine-gold content have been available for all but a negligible part of the reported placer-gold production, and the value of the fine-gold content has been used. Previously the value had been calculated, taking the average fineness as 822½.

A record of the silver content of placer gold, received at the Royal Canadian Mint since 1947, has been incorporated in the appropriate tables.

Industrial Minerals and Structural Materials

Prices for these materials approximate the prices at the point of origin.

Fuel

Coal

The price per ton used in valuing coal (*see* p. A 20) is the weighted average of the f.o.b. prices at the mines for coal sold and used.

Petroleum and Natural Gas

The values for natural gas, natural-gas liquid by-products, and for petroleum, including condensate/pentanes plus, are the aggregates of amounts received for the products at the well-head.

NOTES ON PRODUCTS

Antimony.—Production began in 1939. 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 at the Trail smelter. *See* Tables I, III, and VIIc.

Arsenious Oxide.—Production began in 1917. Principal productive periods: Omineca, 1928, 16,997 pounds, $340; Osoyoos, 1917–30 and 1942, 22,002,423 pounds, $272,861. *See* Table VIID.

Asbestos.—Production began in 1952. From 1953 to 1961 asbestos was valued at the shipping point in North Vancouver. Beginning with 1962 the value has been taken as the value at that pricing point less shipping cost from the mine to North Vancouver. The values for the preceding years have been recalculated on the same basis. *See* Tables I, III, and VIID.

Barite.—Production began in 1940. *See* Tables I, III, VIID.

Bentonite.—Principal productive period, 1926–44, 791 tons. *See* Table VIID.

Bismuth.—Production began in 1929. Recovered as by-product at Trail smelter. *See* Tables I, III, and VIIc.

Cadmium.—Production began in 1928. 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. *See* Tables I, III, and VIIc.

Chromite.—Produced in 1918 and 1929. *See* Table VIIc.

Coal.—All coal produced, including that used in making coke, is shown as primary mine production. Quantity from 1836 to 1909 is gross mine output and includes material lost in picking and washing. For 1910 and subsequent years the quantity is that sold and used. First production: Cariboo, 1942; Fort Steele, 1898; Kamloops, 1893; Liard, 1923; Nanaimo, 1836; Nicola, 1907; Omineca, 1918; Osoyoos, 1926; Similkameen, 1909; Skeena, 1912. For washery loss, change in stock, and differences between gross mine output and coal sold, refer to the table " Production and Distribution by Collieries and by Districts " in section headed " Coal " or " Coal-mining " in this and preceding Annual Reports. 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* Tables I, III, VIIA, VIIIA, and VIIIB.

Cobalt.—Production of 1,730 pounds, 1928. *See* Table VIIc.

Diatomite.—First production, 1928. *See* Table VIID.

Fluorspar.—Principal productive periods: Greenwood, 1918–29 and 1942, 35,309 tons, $783,578; Osoyoos, 1958, 32 tons, $1,386. *See* Table VIID; *see also* note *re* fluxes.

Fluxes.—First production, 1911, mainly quartz and limestone. *See* Tables I, III, and VIID. In 1958, 32 tons of fluorspar is included with the fluxes. *See* Table III.

Fuel.—*See* Coal, Petroleum, and Natural Gas.

Gold, Lode.—Gold is mainly the product of lode-gold mines, but a substantial part is a by-product from copper and silver-lead-zinc mines. *See* page A 20 and Tables I, III, VI, and VIIB.

Gold, Placer.—First year of production for major placer-producing divisions: Atlin, 1898, Cariboo, 1858; Lillooet, 1874; and Quesnel, 1858. *See* Tables I, III, VI, and VIIA.

Granules.—First production, 1930. *See* Tables I, III, and VIID.

Gypsum and Gypsite.—First production, 1911. *See* Tables I, III, and VIID.

Hydromagnesite.—First production, 1904. Principal productive periods: Atlin, 1915–16, 1,450 tons, $20,325; Clinton, 1921, 803 tons, $7,211. *See* Table VIID.

Indium.—Production began in 1942. Not reported as individual metal since 1958, but value taken into total value of all metals.

Iron Concentrates.—Principal productive period began in 1951. Includes sinter used in making pig iron: 1964, 73,460 tons of sinter valued at $769,126 used in making 48,425 tons of pig iron. *See* Tables I, III, and VIIc.

Iron Oxide and Ochre.—Principal productive periods: Golden, 1927–39, 27 tons, $920; Nelson, 1948–50, 7,292 tons, $55,901; Vancouver, 1918–50, 10,669 tons, $97,389; Victoria, 1923, 120 tons, $840. *See* Table VIID.

Lead.—Revisions were 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. *See* Tables I, III, VI, and VIIB.

Magnesium.—Produced 204,632 pounds, 1941 and 1942. *See* Table VIIc.

Magnesium Sulphate.—Principal productive periods: Clinton, 1918 to 1920, 1,923 tons, $39,085; Kamloops, 1918–42, 8,742 tons, $193,967; Osoyoos, 1915–19, 3,229 tons, $21,300. *See* Table VIID.

Manganese.—Estimated manganese content of about 40 tons of ore shipped for testing by Olalla Mines Ltd. in 1956. Principal productive period, 1918–20. *See* Table VIIc.

Mercury.—Principal productive period, 1940–44. *See* Tables I, III, and VIIc.

Mica.—First production, 1932. *See* Tables I, III, and VIID.

Molybdenum.—Principal productive periods, 1914–18 and 1964. *See* Tables I, III, and VIIc.

Natro-alunite.—Principal productive period, 1912–27, 522 tons. *See* Table VIID.

Natural Gas.—Commercial production of natural gas began in 1954. The production shown in Tables I, III, and VIIA is the total dry and residue gas sold; that is, the quantity delivered to the main transmission-line. The quantity is net after deducting gas used on leases, metering difference, and gas used or lost in the cleaning plant. The quantity is reported as thousands of cubic feet at standard conditions (14.4 pounds per square inch pressure, 60° F. temperature up to and including the year 1960, and thereafter 14.65 pounds per square inch pressure, 60° F. temperature). Gross well output, other production, delivery, and sales data are tabulated in the Petroleum and Natural Gas section of this report.

Natural-gas Liquid By-products.—The liquid by-products are the butane and propane recovered in processing natural gas at Taylor, beginning with 1958. For natural gasoline, condensate/pentane plus, *see* under " Petroleum." *See* Tables I, III, and VIIA, and Petroleum and Natural Gas section of this report.

Nickel.—Production began in 1958. *See* Tables I, III, and VIIc.

Palladium.—Production recorded, 1928. *See* Table VIIc.

Perlite.—In 1953, 1,112 tons valued at $11,120 was produced. *See* Table VIID.

Petroleum, Crude.—Production of petroleum began in 1955, and is shown in Tables I, III, and VIIA. The quantity is " net sales," reported in barrels (35 imperial gallons=1 barrel). Natural gasoline, condensate/pentanes plus, recovered at the gas-processing plant at Taylor is credited as petroleum production (1962). Production in 1964 includes 11,639,024 barrels of crude petroleum and 991,342 barrels of condensate/pentanes plus, valued at $23,460,152 and $587,685. *See* Tables I, III, and VIIA. Gross well output, other production, delivery, and sales data are tabulated in the Petroleum and Natural Gas section of this report.

Phosphate Rock.—Produced 1927–33, 3,842 tons. *See* Table VIID.

Platinum.—Produced intermittently 1887–1963. *See* Tables I, III, and VIIc.

Rock.—Rubble, riprap, and crushed stone. *See* Tables I, III, and VIIE.

Selenium.—Produced 731 pounds in 1931. *See* Table VIIc.

Silver, Lode.—Produced yearly, beginning 1887, mainly from silver-lead-zinc ore and as a by-product from copper ore. *See* Tables I, III, VI, and VIIB.

Silver, Placer.—The accumulated value of placer silver is the value of the silver content of placer gold received at the Royal Canadian Mint in 1947 and subsequent years. *See* Tables I, III, VI, and VIIA. The silver shown in Table VI includes placer silver.

Sodium Carbonate.—Principal productive periods: Clinton, 1921–49, 9,524 tons, $109,895; Kamloops, 1931–35, 968 tons, $9,088. *See* Table VIID.

Structural Materials.—The figure $5,972,171 in Table VIIE is the total for structural materials in the period 1886–1919 that cannot be allotted to particular classes of structural materials or assigned to mining divisions, and includes $726,-323 shown against 1896 in Table II that includes unclassified structural materials in that and previous years not assignable to particular years. The figure $3,150,828 in Table VIIE under other clay products is the value in the period 1886–1910 that cannot be allotted to particular clay products or assigned to mining divisions.

Sulphur.—From 1916 to 1927 the figures include pyrites shipped. From 1928 the tonnages include the estimated sulphur content of pyrites shipped plus the sulphur contained in sulphuric acid made from waste smelter gases. Iron sulphide roasting at the Kimberley acid plant commenced in 1953, and the sulphur content is included. Elemental sulphur has been recovered from the natural-gas plant at Taylor since 1958. *See* Tables I, III, and VIID.

Talc.—Principal productive periods: Golden, 1927, 5 tons, $356; Lillooet, 1916–36, 296 tons, $5,129; Victoria, 1919–35, 1,504 tons, $29,386. *See* Tables I, III, and VIID.

Tin.—First production 1941. *See* Tables I, III, and VIIC.

Tungsten.—Principal productive period, 1937–58. *See* Table VIIC.

Volcanic Ash.—Cariboo, 30 tons. *See* Table VIID.

Zinc.—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. Revisions were 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. *See* Tables I, III, VI, and VIIB.

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 ,,	20.89 ,,	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
1960	27.92	33.95	88.633 ,,	28.985 ,,	11.589 ,,	12.557 ,,	6.64
1961	29.24	35.46	93.696 ,,	28.288 ,,	11.011 ,,	11.695 ,,	7.40
1962	29.25	37.41	116.029 ,,	30.473 ,,	10.301 ,,	12.422 ,,	7.43
1963	29.31	37.75	137.965 ,,	30.646 ,,	12.012 ,,	13.173 ,,	7.38
1964	29.96	37.75	139.458 ,,	33.412 ,,	14.662 ,,	14.633 ,,	6.94

[1] Beginning with 1962, the value of the fine-gold content has been used.

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.

Table I.—Mineral Production: Total to Date, Latest Decade, and Latest Year

	Total Quantity to Date	Total Value to Date	Total Quantity, 1955–64	Total Value, 1955–64	Quantity, 1964	Value, 1964
Metals		$		$		$
Antimony lb.	45,884,672	12,547,086	16,137,575	5,919,859	1,591,523	700,270
Bismuth lb.	6,009,477	10,546,386	1,894,531	4,065,128	213,428	480,213
Cadmium lb.	33,369,110	54,044,819	17,217,093	32,035,003	1,864,255	6,040,186
Chromite tons	796	32,295				
Cobalt lb.	1,730	420				
Copper lb.	3,355,160,467	611,303,497	555,516,031	176,422,637	115,554,700	38,609,136
Gold—placer, crude oz.	5,230,556	96,816,604	44,727	1,269,499	1,842	55,191
" lode oz.	16,321,506	477,340,842	1,842,840	64,552,901	138,487	5,227,884
Iron concentrates* tons	13,785,606	117,052,387	11,168,819	100,045,739	2,002,562	20,419,487
Lead lb.	14,501,971,504	1,137,350,475	3,086,773,148	390,351,273	268,737,503	39,402,293
Magnesium lb.	204,632	88,184				
Manganese tons	1,742	32,668				
Mercury lb.	4,169,210	10,432,457	5,623	23,098	5,548	22,848
Molybdenum lb.	59,548	93,261	33,659	56,563	28,245	47,063
Nickel lb.	21,286,459	16,532,393	21,005,006	16,444,669	3,398,560	2,854,790
Palladium oz.	749	30,462				
Platinum oz.	1,407	135,008	11	785		
Selenium lb.	731	1,389				
Silver—placer* oz.	20,695	17,946	5,516	5,434	230	321
" lode oz.	449,136,854	288,550,907	70,373,980	69,936,082	5,269,412	7,348,617
Tin lb.	15,748,886	12,321,941	7,071,624	5,635,429	352,350	535,572
Tungsten (WO_3) lb.	16,019,324	38,663,751	6,791,234	18,937,031		
Zinc lb.	12,670,200,226	1,120,002,479	4,165,115,048	507,696,145	400,796,562	58,648,561
Others		5,644,365		5,611,673		533,897
Totals		4,009,582,022		1,399,008,948		180,926,329
Industrial Minerals						
Arsenious oxide lb.	22,019,420	273,201				
Asbestos* tons	416,608	85,209,837	404,887	82,078,690	67,460	11,714,494
Barite tons	212,922	2,582,978	144,616	2,165,843	10,588	119,370
Bentonite tons	791	16,858				
Diatomite tons	3,675	136,195	2,276	105,180	1,143	64,555
Fluorspar tons	35,341	784,964				
Fluxes tons	3,856,908	6,656,173	919,667	2,777,220	73,021	237,298
Granules tons	218,014	3,212,729	172,106	2,575,683	19,289	397,639
Gypsum and gypsite tons	2,643,829	10,721,823	1,230,264	4,075,349	188,303	939,559
Hydro-magnesite tons	2,253	27,536				
Iron oxide and ochre tons	18,108	155,050				
Jade lb.	219,523	86,294	219,123	86,294	11,537	13,804
Magnesium sulphate tons	13,894	254,352				
Mica lb.	12,822,050	185,818	1,255,300	20,156		
Natro-alunite tons	522	9,398				
Perlite tons	1,112	11,120				
Phosphate rock tons	3,842	16,894				
Sodium carbonate tons	10,492	118,983				
Sulphur tons	5,290,556	58,183,156	2,411,004	30,643,648	278,385	3,860,436
Talc tons	1,805	34,871				
Totals		168,678,230		124,528,063		17,347,155
Structural Materials						
Cement tons	8,880,839	132,384,152	4,228,332	71,952,543	537,396	10,040,776
Clay products		52,093,131		22,660,515		3,008,158
Lime and limestone tons		35,927,325	5,840,172	15,664,733	1,211,320	2,055,195
Rock* tons		32,116,135	16,268,433	16,592,740	1,449,449	1,285,318
Sand and gravel tons		129,620,432	142,398,587	83,138,706	17,708,225	10,013,970
Stone tons	1,075,499	8,746,193	100,023	901,676	846	25,522
Not assigned		5,972,171				
Totals		396,859,539		210,910,913		26,428,939
Fuels						
Coal* tons	137,923,118	582,362,582	9,617,170	67,827,300	911,326	6,327,678
Natural gas—						
To pipe-line M s.c.f.	639,376,609	56,827,835	639,315,726	56,821,290	118,959,880	12,192,816
Liquid by-products* bbl.	3,048,373	723,556	3,048,373	723,556	706,563	226,100
Petroleum crude* bbl.	41,916,218	76,381,862	41,916,218	76,381,862	12,474,054	24,047,837
Totals		716,295,835		201,754,008		42,794,431[1]
Grand totals		5,291,415,626		1,936,201,932		267,496,854

* See notes on individual minerals listed alphabetically on pages A 16 to A 19.

[1] Does not include 71,341 tons of peat moss, valued at $3,991,084.

Table II.—Total Value of Production, 1836–1964

Year	Metals	Industrial Minerals	Structural Materials	Fuels	Total	Totals, 1836–1900, and by Decades[1]
	$	$	$	$	$	$
1836–86	52,808,750	....	43,650	10,758,565	63,610,965	....
1887	729,381	....	22,168	1,240,080	1,991,629	....
1888	745,794	....	46,432	1,467,903	2,260,129	....
1889	685,512	....	77,517	1,739,490	2,502,519	....
1890	572,884	....	75,201	2,034,420	2,682,505	....
1891	447,136	....	79,475	3,087,291	3,613,902	....
1892	511,075	....	129,234	2,479,005	3,119,314	....
1893	659,969	....	....	2,934,882	3,594,851	....
1894	1,191,728	....	....	3,038,859	4,230,587	....
1895	2,834,629	....	....	2,824,687	5,659,316	....
1896	4,973,769	....	726,323[1]	2,693,961	8,394,053	....
1897	7,575,262	....	150,000	2,734,522	10,459,784	....
1898	7,176,870	....	150,000	3,582,595	10,909,465	....
1899	8,107,509	....	200,000	4,126,803	12,434,312	....
1900	11,360,546	....	250,000	4,744,530	16,355,076	151,818,407
1901	14,258,455	....	400,000	5,016,398	19,674,853	....
1902	12,163,561	....	450,000	4,832,257	17,445,818	....
1903	12,640,083	....	525,000	4,332,297	17,497,380	....
1904	13,424,755	2,400	575,000	4,953,024	18,955,179	....
1905	16,289,165	....	660,800	5,511,861	22,461,826	....
1906	18,449,602	....	982,900	5,548,044	24,980,546	....
1907	17,101,305	....	1,149,400	7,637,713	25,888,418	....
1908	15,227,991	....	1,200,000	7,356,866	23,784,857	....
1909	14,668,141	....	1,270,559	8,574,884	24,513,584	....
1910	13,768,731	....	1,500,000	11,108,335	26,377,066	221,579,527
1911	11,880,062	46,345	3,500,917	8,071,747	23,499,071	....
1912	18,218,266	17,500	3,436,222	10,786,812	32,458,800	....
1913	17,701,432	46,446	3,249,605	9,197,460	30,194,943	....
1914	15,790,727	51,810	2,794,107	7,745,847	26,382,491	....
1915	20,765,212	133,114	1,509,235	7,114,178	29,521,739	....
1916	32,092,648	150,718	1,247,912	8,900,675	42,391,953	....
1917	27,299,934	174,107	1,097,900	8,484,343	37,056,284	....
1918	27,957,302	281,131	783,280	12,833,994	41,855,707	....
1919	20,058,217	289,426	980,790	11,975,671	33,304,104	....
1920	19,687,532	508,601	1,962,824	13,450,169	35,609,126	332,274,218
1921	13,160,417	330,503	1,808,392	12,836,013	28,135,325	....
1922	19,605,401	251,922	2,469,967	12,880,060	35,207,350	....
1923	25,769,215	140,409	2,742,388	12,678,548	41,330,560	....
1924	35,959,566	116,932	2,764,013	9,911,935	48,752,446	....
1925	46,480,742	101,319	2,766,838	12,168,905	61,517,804	....
1926	51,867,792	223,748	3,335,885	11,650,180	67,077,605	....
1927	45,134,289	437,729	2,879,160	12,269,135	60,720,313	....
1928	48,640,158	544,192	3,409,142	12,633,510	65,227,002	....
1929	52,805,345	807,502	3,820,732	11,256,260	68,689,839	....
1930	41,785,380	457,225	4,085,105	9,435,650	55,763,360	532,421,604
1931	23,530,469	480,319	3,538,519	7,684,155	35,233,462	....
1932	20,129,869	447,495	1,705,708	6,523,644	28,806,716	....
1933	25,777,723	460,683	1,025,586	5,375,171	32,639,163	....
1934	35,177,224	486,554	1,018,719	5,725,133	42,407,630	....
1935	42,006,618	543,583	1,238,718	5,048,864	48,837,783	....
1936	45,889,944	724,362	1,796,677	5,722,502	54,133,485	....
1937	65,224,245	976,171	2,098,339	6,139,920	74,438,675	....
1938	55,959,713	916,841	1,974,976	5,565,069	64,416,599	....
1939	56,216,049	1,381,720	1,832,464	6,280,956	65,711,189	....
1940	64,332,166	1,073,023	2,534,840	7,088,265	75,028,294	521,652,996
1941	65,807,630	1,253,561	2,845,262	7,660,000	77,566,453	....
1942	63,626,140	1,434,382	3,173,635	8,237,172	76,471,329	....
1943	55,005,394	1,378,337	3,025,255	7,742,030	67,151,016	....
1944	42,095,013	1,419,248	3,010,088	8,217,966	54,742,315	....
1945	50,673,592	1,497,720	3,401,229	6,454,360	62,026,901	....
1946	58,834,747	1,783,010	5,199,563	6,732,470	72,549,790	....
1947	95,729,867	2,275,972	5,896,803	8,680,440	112,583,082	....
1948	124,091,753	2,358,877	8,968,222	9,765,395	145,184,247	....
1949	110,219,917	2,500,799	9,955,790	10,549,924	133,226,430	....
1950	117,166,836	2,462,340	10,246,939	10,119,303	139,995,418	941,496,981

[1] *See* note on structural materials, page A 18.

TABLE II.—TOTAL VALUE OF PRODUCTION, 1836–1964—*Continued*

Year	Metals	Industrial Minerals	Structural Materials	Fuels	Total	Totals, 1836–1900, and by Decades[1]
	$	$	$	$	$	$
1951	153,598,411	2,493,840	10,606,048	10,169,617	176,867,916	
1952	147,857,523	2,181,464	11,596,961	9,729,739	171,365,687	
1953	126,755,705	3,002,673	13,555,038	9,528,279	152,841,695	
1954	123,834,286	5,504,114	14,395,174	9,161,089	152,894,663	
1955	142,609,505	6,939,490	15,299,254	9,005,111	173,853,360	
1956	149,441,246	9,172,792	20,573,631	9,665,983	188,853,652	
1957	125,353,920	11,474,050	25,626,939	8,537,920	170,992,829	
1958	104,251,112	9,958,768	19,999,576	10,744,093	144,953,549	
1959	105,076,530	12,110,286	19,025,209	11,431,938	147,643,963	
1960	130,304,373	13,762,102	18,829,989	14,468,869	177,365,333	1,657,632,647
1961	128,565,774	12,948,308	19,878,921	18,414,318	179,807,321	
1962	159,627,293	14,304,214	21,366,265	34,073,712	229,331,650	
1963	172,852,866	16,510,898	23,882,190	42,617,633	255,863,587	
1964	180,926,329	17,347,155	26,428,939	42,794,431	267,496,854	
Totals	4,009,582,022	168,678,230	396,859,539	716,295,835	5,291,415,626	

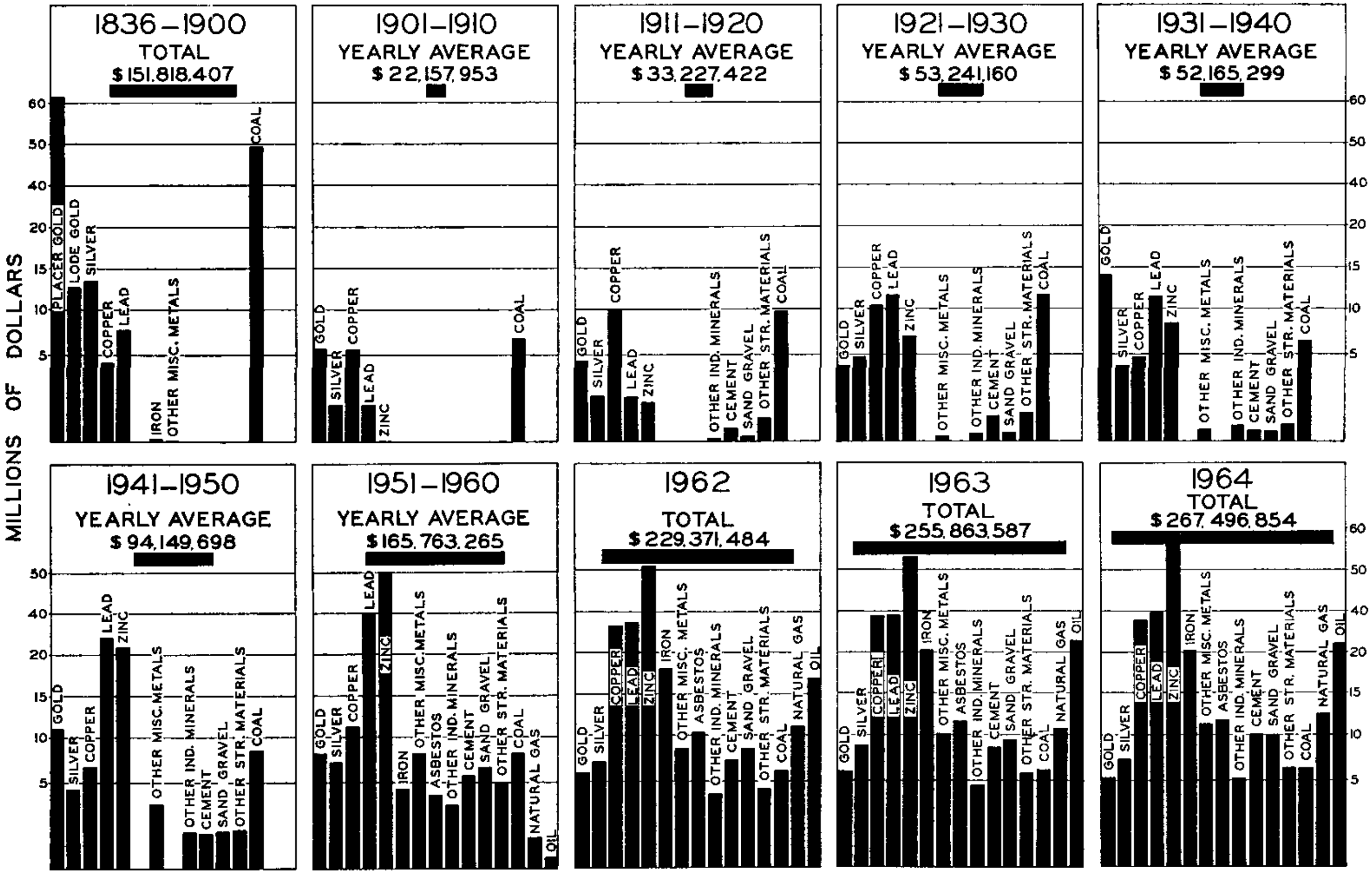
Table III.—Quantity and Value of Mineral Products for Years 1955–1964

Description	1955		1956		1957		1958		1959	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Metals		$		$		$		$		$
Antimony .... lb.	2,021,726	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	3,236,338	1,946,397	3,172,627	1,425,108	2,166,164	1,695,821	2,170,651
Copper .... lb.	44,238,031	16,932,549	43,360,575	17,251,872	31,387,441	8,170,465	12,658,649	2,964,529	16,233,546	4,497,991
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	223,403	7,495,170	194,354	6,604,149	173,146	5,812,511
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
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
Mercury .... lb.	75	250	—	—	—	—	—	—	—	—
Molybdenum .... lb.	—	—	—	—	—	—	—	—	—	—
Nickel .... tons	—	—	—	—	—	—	1,408,490	996,507	1,061,532	743,072
Platinum .... oz.	—	—	—	—	—	—	4	260	—	—
Silver—placer* .... oz.	1,004	882	474	423	301	262	642	555	942	824
,, lode .... oz.	7,902,145	6,942,113	8,404,600	7,511,443	8,129,047	7,076,904	7,040,416	6,086,299	6,197,159	5,420,593
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	—	—
Zinc .... lb.	429,198,565	52,048,909	443,853,004	58,934,801	449,276,797	50,206,681	432,002,790	43,234,839	402,342,850	44,169,198
Others	—	—	—	—	—	—	—	—	—	632,933
Totals	—	142,609,505	—	149,441,246	—	125,353,920	—	104,251,112	—	105,076,530
Industrial Minerals										
Asbestos* .... tons	17,187	3,234,751	20,356	5,398,730	31,714	7,342,966	30,078	6,398,679	33,883	7,878,947
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*	70,570	248,913
Granules (quartz, limestone, granite) .... tons	6,355	73,858	13,200	173,214	17,295	221,864	22,674	284,330	19,072	254,251
Gypsum and products .... tons	149,719	383,934	72,978	391,919	66,499	142,751	70,498	211,494	112,223	282,030
Jade .... lb.	—	—	—	—	—	—	—	—	15,000	5,000
Mica .... lb.	505,300	2,861	198,000	4,884	180,000	1,200	—	—	—	—
Sulphur .... tons	227,530	2,796,783	212,885	2,523,190	228,882	2,887,465	211,300	2,410,395	251,552	3,253,677
Totals	—	6,939,490	—	9,172,792	—	11,474,050	—	9,958,768	—	12,110,286
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	—	578,578	—	604,063	—	658,873	—	405,485	—	538,566
Clays .... tons	8,033	46,757	7,985	30,263	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 .... tons	334,057	5,474,875	396,138	6,339,071	443,469	7,078,108	414,396	6,755,619	427,181	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 .... tons	9,650,699	4,886,890	13,762,227	8,535,348	16,829,816	10,503,274	14,173,169	8,442,676	11,349,121	7,342,698
Stone .... tons	26,079	148,454	35,266	139,150	2,403	236,110	2,141	64,335	13,710	69,710
Totals	—	15,299,254	—	20,573,631	—	25,626,939	—	19,999,576	—	19,025,209
Fuels										
Coal—sold and used .... 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.	168,651	18,130	187,846	20,143	7,126,346	433,830	58,039,491	3,368,327	64,525,633	3,921,583
Natural-gas liquid by-products* .... bbl.	—	—	—	—	—	—	150,704	30,935	303,954	43,695
Petroleum, crude* .... bbl.	582	480	148,454	299,322	373,284	763,751	845,168	1,406,971*	1,374,116	1,994,596
Totals	—	9,005,111	—	9,665,983	—	8,537,920	—	10,744,093	—	11,431,938
Provincial totals	—	173,853,360	—	188,853,652	—	170,992,829	—	144,953,549	—	147,643,963

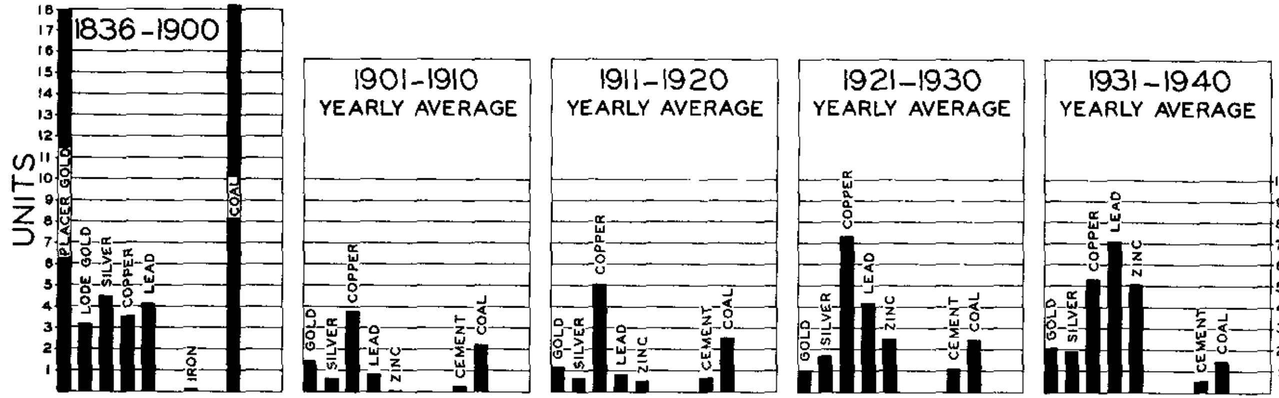
Description	1960 Quantity	1960 Value	1961 Quantity	1961 Value	1962 Quantity	1962 Value	1963 Quantity	1963 Value	1964 Quantity	1964 Value
Metals		$		$		$		$		$
Antimony .... lb.	1,651,786	538,482	1,331,297	469,948	1,931,397	748,223	1,601,253	624,489	1,591,523	700,270
Bismuth .... lb.	213,009	419,628	283,363	637,567	228,601	507,494	157,099	348,760	213,428	480,213
Cadmium .... lb.	1,778,866	2,525,990	907,432	1,451,891	2,086,692	3,839,513	1,981,004	4,754,410	1,864,255	6,040,186
Copper .... lb.	33,064,429	9,583,724	31,692,412	8,965,149	108,979,144	33,209,215	118,247,104	36,238,007	115,554,700	38,609,136
Gold—placer, crude .... oz.	3,847	107,418	3,416	99,884	3,315	96,697	4,620	135,411	1,842	55,191
,, lode, fine .... oz.	205,580	6,979,441	159,821	5,667,253	158,850	5,942,101	154,979	5,850,458	138,487	5,227,884
Indium .... oz.										
Iron concentrates* .... tons	1,160,355	10,292,847	1,335,068	12,082,540	1,793,847	18,326,911	2,060,241	20,746,424	2,002,562	20,419,487
Lead .... lb.	333,608,699	38,661,912	384,284,524	42,313,569	335,282,537	34,537,454	314,974,310	37,834,714	268,737,503	39,402,293
Mercury .... lb.									5,548	22,848
Molybdenum .... lb.	9,023	9,500							28,245	47,063
Nickel .... lb.	3,779,878	2,645,915	4,180,677	3,194,037	3,476,467	2,902,850	3,699,402	3,107,498	3,398,560	2,854,790
Platinum .... oz.					5	375	2	150		
Silver—placer* .... oz.	406	360	429	402	437	507	651	898	230	321
,, lode .... oz.	7,446,237	6,599,823	7,373,568	6,908,738	6,189,367	7,181,400	6,422,029	8,860,152	5,269,412	7,348,617
Tin .... lb.	621,718	522,243	1,119,350	727,578	650,941	442,640	927,062	648,943	352,350	535,572
Tungsten (WO_3) .... lb.										
Zinc .... lb.	403,399,319	50,656,726	387,951,190	45,370,891	413,430,817	51,356,376	402,863,154	53,069,163	400,796,562	58,648,561
Others		760,364		676,327		535,537		633,389		533,897
Totals		130,304,373		128,565,774		159,627,293		172,852,866		180,926,329
Industrial Minerals										
Asbestos* .... tons	40,748	9,482,923	45,113	8,648,503	55,133	10,297,360	63,215	11,681,337	67,460	11,714,494
Barite .... tons	23,573	279,716	15,478	151,388	6,511	57,062	8,207	69,588	10,588	119,370
Diatomite .... tons	44	1,430	214	8,817	211	10,228	458	16,030	1,143	64,555
Fluxes (quartz, limestone) .... tons	83,370	294,559	53,335	190,500	62,743	228,477	60,490	223,012	73,021	237,298
Granules (quartz, limestone, granite) .... tons	19,063	257,067	17,463	253,015	18,251	311,902	19,444	348,543	19,289	397,639
Gypsum and products .... tons	107,900	337,200	153,300	459,900	147,900	443,700	160,954	482,862	188,303	939,559
Jade .... lb.	50,300	10,325	69,751	20,876	56,935	20,760	16,000	15,529	11,537	13,804
Mica .... lb.	122,000	3,186	250,000	8,025						
Sulphur .... tons	264,705	3,095,696	242,377	3,207,284	239,191	2,934,725	254,197	3,673,997	278,385	3,860,436
Totals		13,762,102		12,948,308		14,304,214		16,510,898		17,347,155
Structural Materials										
Brick—common .... No.	2,262,653	187,673	244,532	14,809	1,179,165	54,849	1,086,688	63,499	614,288	49,826
,, face, paving, sewer .... No.	1,775,591	145,091	3,728,779	326,346	3,313,179	309,582	2,845,704	292,535	648,267	60,594
,, firebrick, blocks		621,865		584,969		640,307		758,008		811,572
Clays .... tons	8,003	22,671	7,908	28,396	8,105	30,027	2,573	33,151	1,853	38,585
Structural tile, hollow blocks		83,842		45,753		36,665		31,376		31,017
Drain-tile, sewer-pipe, flue-linings		616,858		686,998		898,908		846,202		1,071,324
Pottery—glazed or unglazed		48,825		11,890		23,947		14,562		13,332
Other clay products		346,883		667,303		513,153		785,250		931,908
Cement .... tons	384,853	6,432,752	417,336	7,122,046	397,435	7,112,890	476,071	8,546,768	537,396	10,040,776
Lime and limestone .... tons	565,945	1,602,019	758,882	1,864,315	559,028	1,513,579	907,203	1,723,796	1,211,320	2,055,195
Rubble, riprap, crushed rock .... tons	1,148,305	1,075,373	1,539,640	1,016,086	1,897,272	1,284,301	1,913,906	1,259,002	1,449,449	1,285,318
Sand and gravel .... tons	12,355,955	7,597,278	11,424,958	7,439,710	17,757,391	8,862,767	17,387,026	9,514,095	17,708,225	10,013,970
Stone .... tons	4,328	48,859	5,400	70,300	8,023	85,290	1,827	13,946	846	25,522
Totals		18,829,989		19,878,921		21,366,265		23,882,190		26,428,939
Fuels										
Coal—sold and used .... tons	788,658	5,242,223	919,142	6,802,134	825,339	6,133,986	850,541	6,237,997	911,326	6,327,678
Natural gas delivered to pipe-line .... M s.c.f.	80,115,399	7,101,949	95,967,110	8,818,891	108,699,997	10,226,323	105,525,373	10,719,298	118,959,880	12,192,816
Natural-gas liquid by-products* .... bbl.	428,553	53,910	473,948	82,592	370,402	96,347	614,249	189,977	706,563	226,100
Petroleum, crude* .... bbl.	1,589,474	2,070,787	1,810,984	2,710,701	9,841,363	17,617,056	13,458,739	25,470,361	12,474,054	24,047,837
Totals		14,468,869		18,414,318		34,073,712		42,617,633		42,794,431
Provincial totals		177,365,333		179,807,321		229,371,484		255,863,587		267,496,854

* *See* notes on individual minerals listed alphabetically on pages A 16 to A 19.

TABLE IV.—VALUES FOR 1836 TO 1900 ARE TOTALS FOR THE PERIOD OF PRODUCTION; VALUES FOR SUBSEQUENT PERIODS ARE AVERAGE PER YEAR OR VALUES FOR THE PARTICULAR YEAR



Tarle V.—Quantities for 1836–1900 Are Totals for the Period of Production; Quantities for Subsequent Periods Are Averages per Year or Quantities for the Particular Year



UNIT VALUES

GOLD-200,000 OZ.
SILVER-5,000,000 OZ
COPPER-10,000,000 LBS.
LEAD-50,000,000 LBS.
ZINC-50,000,000 LBS.
IRON-500,000 TONS
ASBESTOS-25,000 TONS
CEMENT-500,000 BBLS.
COAL-1,000,000 TONS
NATURAL GAS-50 000 000 MSCF.
OIL-1,000,000 BBLS.

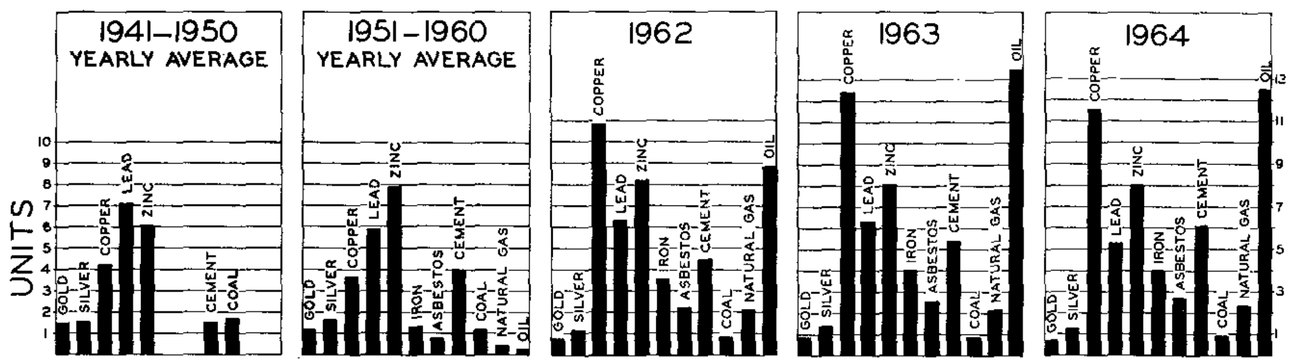


Table VI.—Production of Gold, Silver, Copper, Lead, and Zinc, 1858–1964

Year	Placer Gold (Crude)		Gold (Fine)		Silver*		Copper		Lead		Zinc		Total Value
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
	Oz.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
1858–86, incl.	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	64,441	1,287,820	3,322,161	2,225,877	3,825,756	191,286	24,199,977	721,384			4,970,393
1897	30,210	513,520	106,143	2,122,860	5,472,971	3,272,836	5,325,180	266,258	38,841,135	1,390,517			7,565,991
1898	37,840	643,346	110,061	2,201,217	4,293,025	2,376,190	7,282,278	876,056	31,693,559	1,077,581			7,174,390
1899	79,110	1,344,900	138,316	2,857,588	2,939,413	1,663,708	7,728,255	1,352,445	21,862,436	878,870			8,097,511
1900	75,220	1,278,724	167,153	3,455,050	3,958,175	2,309,200	9,977,080	1,615,289	63,358,621	2,699,077			11,357,340
1901	57,060	970,100	210,384	4,348,637	4,396,447	2,462,008	27,603,746	4,446,963	51,582,906	2,010,186			14,237,894
1902	63,130	1,073,140	236,491	4,888,269	3,817,917	1,891,779	29,652,043	3,450,291	22,536,381	824,832			12,128,311
1903	62,380	1,060,420	232,828	4,812,554	2,996,204	1,521,472	34,359,921	4,547,878	18,089,283	689,744			12,632,068
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	4,933,103	3,439,417	1,971,818	37,692,251	5,876,222	56,580,703	2,399,022	*	139,200	16,288,665
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	40,832,721	8,166,544	47,738,703	2,291,458	*	46,100	17,090,947
1908	38,060	647,000	255,582	5,282,879	2,631,389	1,321,483	47,274,614	6,240,249	43,195,733	1,632,799	*	99,296	15,223,706
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	4,725,512	1,892,364	958,293	36,927,656	4,571,644	26,872,397	1,069,521	2,634,544	129,092	11,880,062
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	5,627,595	3,465,856	1,968,606	46,460,305	7,094,489	55,364,677	2,175,832	6,758,768	324,421	17,700,943
1914	33,240	565,000	247,170	5,109,008	3,602,180	1,876,736	45,009,699	6,121,319	50,625,048	1,771,877	7,866,467	346,125	15,790,065
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	4,587,333	3,301,923	2,059,739	65,379,364	17,784,494	48,727,516	3,007,462	37,168,980	4,043,985	32,063,513
1917	29,180	496,000	114,523	2,367,191	2,929,216	2,265,749	59,007,565	16,038,256	37,307,465	2,951,020	41,848,513	3,166,259	27,284,475
1918	18,820	320,000	164,674	3,403,811	3,998,172	3,215,870	61,483,754	15,143,449	43,899,661	2,928,107	41,772,916	2,899,040	27,910,277
1919	16,850	286,500	152,426	3,150,644	3,403,119	3,592,673	42,459,339	7,939,896	29,475,968	1,526,855	56,737,651	3,540,429	20,036,997
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	135,765	2,804,197	2,673,389	1,591,201	39,036,993	4,879,624	41,402,288	1,693,354	49,419,372	1,952,065	13,153,641
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	3,480,306	57,146,548	2,777,322	19,600,647
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	58,344,462	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	4,335,069	7,654,844	5,286,818	72,306,432	10,153,269	237,899,199	18,670,329	98,257,099	7,754,450	46,480,027
1926	20,912	355,503	201,427	4,163,859	10,748,556	6,675,606	89,339,768	12,324,421	263,023,936	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	8,424	143,208	180,662	3,734,609	10,627,167	6,182,461	97,908,316	14,265,242	305,140,792	13,961,412	181,763,147	9,984,613	48,271,545
1929	6,983	118,711	145,223	3,002,020	9,960,172	5,278,194	102,793,669	18,612,850	307,999,153	15,555,189	172,096,841	9,268,792	51,835,756
1930	8,955	152,235	160,836	3,324,975	11,328,263	4,322,185	92,362,240	11,990,466	321,803,725	12,638,198	250,479,310	9,017,005	41,445,064
1931	17,176	291,992	146,133	3,020,837	7,550,331	2,254,979	64,134,746	5,365,690	261,902,228	7,097,812	202,071,702	5,160,911	23,192,221
1932	20,400	395,542	181,651	4,263,389	7,150,655	2,264,729	50,608,036	3,228,892	252,007,574	5,326,432	192,120,091	4,621,641	20,100,625
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	14,790,028	254,581,393	8,439,373	45,013,866
1937	54,153	1,558,245	460,781	16,122,767	11,305,367	5,073,962	46,057,584	6,023,411	419,118,371	21,417,049	291,192,278	14,274,245	64,469,679
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	378,743,663	12,002,390	278,409,102	8,544,375	55,026,441
1940	39,067	1,236,928	583,524	22,461,516	12,327,944	4,715,315	77,980,223	7,865,085	466,849,112	15,695,467	312,020,671	10,643,026	62,617,337
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	5,708,461	4,110,092	41,783,921	8,519,741	313,733,089	42,887,313	253,006,168	28,412,593	92,645,194
1948	20,332	585,200	286,230	10,018,050	6,720,134	5,040,101	43,025,388	9,616,174	320,037,525	57,734,770	270,310,195	37,654,211	120,648,506
1949	17,886	529,524	288,396	10,382,256	7,637,882	5,671,082	54,856,808	10,956,550	265,378,899	41,929,866	288,225,368	38,181,214	107,650,492
1950	19,134	598,717	283,983	10,805,553	9,509,456	7,667,950	42,212,133	9,889,458	284,024,522	41,052,905	290,344,227	43,769,392	113,783,975
1951	23,691	717,911	261,274	9,627,947	8,218,914	7,770,983	43,249,658	11,980,155	273,456,604	50,316,015	337,511,324	67,164,754	147,577,765
1952	17,554	494,756	255,789	8,765,889	8,810,807	7,326,803	42,005,512	13,054,893	284,949,396	45,936,692	372,871,717	59,189,656	134,768,689
1953	14,245	403,230	253,552	8,727,294	8,378,819	7,019,272	49,021,013	14,869,544	297,634,712	39,481,244	382,300,862	40,810,618	111,311,202
1954	8,684	238,967	258,388	8,803,279	9,826,403	8,154,145	50,150,087	14,599,693	332,474,456	45,482,505	334,124,560	34,805,755	112,084,344
1955	7,666	217,614	242,477	8,370,306	7,903,149	6,942,995	44,238,031	16,932,549	302,567,640	45,161,245	429,198,565	52,048,909	129,673,618
1956	3,865	109,450	191,743	6,603,628	8,405,074	7,511,866	43,360,575	17,251,872	283,718,073	44,702,619	443,853,004	58,934,801	135,114,236
1957	2,936	80,990	223,403	7,495,170	8,129,348	7,077,166	31,387,441	8,170,465	281,603,346	39,568,086	449,276,797	50,206,681	112,598,558
1958	5,650	157,871	194,354	6,604,149	7,041,058	6,086,854	12,658,649	2,964,529	294,573,159	34,627,075	432,002,790	43,234,839	93,675,317
1959	7,570	208,973	173,146	5,812,511	6,198,101	5,421,417	16,233,546	4,497,991	287,423,357	33,542,306	402,342,850	44,169,198	93,652,396
1960	3,847	107,418	205,580	6,979,441	7,446,643	6,600,183	33,064,429	9,583,724	333,608,699	38,661,912	403,399,319	50,656,726	112,589,404
1961	3,416	99,884	159,821	5,667,253	7,373,997	6,909,140	31,692,412	8,965,149	384,284,524	42,313,569	387,951,190	45,370,891	109,325,886
1962	3,315	96,697	158,850	5,942,101	6,189,804	7,181,907	108,979,144	33,209,215	335,282,537	34,537,454	413,430,817	51,356,376	132,323,750
1963	4,620	135,411	154,979	5,850,458	6,422,680	8,861,050	118,247,104	36,238,007	314,974,310	37,834,714	402,863,154	53,069,163	141,988,803
1964	1,842	55,191	138,487	5,227,884	5,269,642	7,348,938	115,554,700	38,609,136	268,737,503	39,402,293	400,796,562	58,648,561	149,292,003
Totals	5,230,556	96,816,604	16,321,506	477,340,842	449,157,549	288,568,853	3,355,160,467	611,303,497	14,501,971,504	1,137,350,475	12,670,200,226	1,120,002,479	3,731,382,750

* *See* notes on individual minerals listed alphabetically on pages A 16 to A 19.

TABLE VIIA.—PRODUCTION, 1963 AND 1964, AND

Division	Period	Placer			Lode Metals	Industrial Minerals	Structural Materials
		Quantity (Crude)	Gold* Value	Silver* Value			
		Oz.	$	$	$	$	$
Alberni	1963				7,951,884		213,735
	1964				**9,131,133**		**90,942**
	To date	1,617	33,253		36,128,604	9,398	1,554,307
Atlin	1963	186	5,548	37			12,739
	1964	**317**	**8,720**	**60**			**430**
	To date	735,470	17,378,926	1,604	38,045,476	20,325	309,425
Cariboo	1963	1,760	53,138	284	695,494	16,030	523,763
	1964	**1,023**	**31,446**	**165**	**754,393**	**64,555**	**373,185**
	To date	2,607,373	54,077,253	2,343	41,800,725	279,375	6,966,130
Clinton	1963	21	642	3			
	1964	**9**	**189**	**4**			**31,834**
	To date	10,171	243,069	23	848,354	162,427	142,762
Fort Steele	1963				68,617,438	541,549	171,807
	1964				**70,504,477**	**855,100**	**67,610**
	To date	20,531	468,450	5	1,809,201,216	7,546,421	5,351,732
Golden	1963				3,382,581	552,450	9,378
	1964				**2,663,952**	**1,058,929**	**48,732**
	To date	469	11,268		54,834,493	6,666,009	1,739,499
Greenwood	1963				4,088,631		27,257
	1964				**4,419,970**		**26,116**
	To date	5,074	115,662	2	137,557,578	2,823,897	858,698
Kamloops	1963				6,053,988		832,928
	1964	**21**	**604**	**4**	**8,838,231**		**824,396**
	To date	27,592	604,710	7	18,046,081	6,528,308	10,939,726
Liard	1963					13,475,931	537,586
	1964					**13,339,110**	**261,181**
	To date	50,184	1,248,151	7	6,391	91,816,989	2,886,361
Lillooet	1963	25	755	4	3,308,082	15,529	209,952
	1964				**2,831,057**	**11,404**	**196,717**
	To date	91,916	1,894,304	36	136,641,810	89,023	2,027,666
Nanaimo	1963				13,388,639	44,000	1,896,475
	1964				**11,913,569**	**74,510**	**2,186,199**
	To date	866	19,300		101,026,394	896,610	39,405,121
Nelson	1963				13,164,583	81,438	237,217
	1964				**17,838,859**	**76,956**	**320,795**
	To date	3,585	88,988		267,890,996	240,032	3,694,284
New Westminster	1963				3,641,406	88,000	5,841,366
	1964				**3,409,162**	**84,000**	**6,637,614**
	To date	11,608	243,614		19,326,859	1,066,261	86,807,623
Nicola	1963				17,622,062		38,392
	1964				**18,114,466**		**5,250**
	To date	234	4,764		62,075,519	10,050	561,407
Omineca	1963	2,336	66,989	519	20,239		172,500
	1964	**180**	**5,587**	**32**	**22,440**	**2,400**	**342,796**
	To date	56,255	1,498,840	756	33,069,267	13,860	4,486,952
Osoyoos	1963				3,531	358,042	111,826
	1964	**13**	**302**	**1**	**9,112**	**399,401**	**64,304**
	To date	234	5,315	6	51,140,478	4,875,345	1,296,365
Revelstoke	1963				1,382		68,768
	1964						**74,662**
	To date	7,582	164,477	57	11,237,401		1,459,551
Similkameen	1963	10	301		172		131,000
	1964	**33**	**906**	**10**	**1,594**		**142,450**
	To date	12,194	289,493	10	120,194,164	18,558	2,747,827
Skeena	1963				3,112,191		193,334
	1964				**4,033,464**		**334,117**
	To date	4,603	105,569		218,806,143	1,229,400	7,830,000
Slocan	1963				7,331,224		38,490
	1964				**8,190,919**		**63,582**
	To date	366	9,397		210,398,536		1,137,032
Trail Creek	1963				75,010		66,232
	1964				**12,186**		**68,907**
	To date	851	24,260		83,743,121		2,065,110
Vancouver	1963				5,476,475	11,004	5,097,385
	1964				**4,947,375**	**810**	**6,152,684**
	To date	182	5,306		225,080,604	6,460,128	63,189,998
Vernon	1963	27	603	4			134,723
	1964						**98,362**
	To date	2,732	72,885	26	197,845	3,978	2,951,651
Victoria	1963				2,539,116	75	5,778,979
	1964				**3,979**	**70**	**6,511,971**
	To date	628	15,680		12,928,756	188,451	131,597,637
Not assigned[1]	1963	255	7,435	47	12,242,429	1,326,850	1,536,358
	1964	**246**	**7,437**	**45**	**13,230,479**	**1,379,910**	**1,504,103**
	To date	1,578,239	18,193,670	13,064	222,520,661	38,233,385	14,852,675
Totals	1963	4,620	135,411	898	172,716,557	16,510,898	23,882,190
	1964	**1,842**	**55,191**	**321**	**180,870,817**	**17,347,155**	**26,428,939**
	To date	5,280,556	96,816,604	17,946	3,912,747,472	168,678,230	396,859,539

* *See* notes on individual minerals listed alphabetically on pages A 16 to A 19.

[1] *Re* "not assigned," *see* footnotes under Tables VIIB and VIIC.

NOTE.—For individual metals, industrial minerals, and structural materials, *see* Tables VIIB, VIIC, VIID, and VIIE.

Total to Date, by Mining Divisions—Summary

Fuels								
Coal*		Petroleum*		Natural Gas (Direct to Pipe-line)		Liquid By-products*		Division Totals
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
Tons	$	Bbl.	$	M S.C.F.	$	Bbl.	$	$
								8,165,619
								9,222,075
								37,725,562
								18,324
								9,210
								55,755,756
								1,288,709
								1,223,744
290	1,100							103,126,926
								645
								32,027
								1,396,635
766,907	5,454,401							74,785,195
846,059	**5,668,799**							**77,095,986**
55,537,404	247,433,871							2,070,001,695
								3,944,409
								3,771,613
								63,251,269
								4,115,888
								4,446,086
								140,855,837
								6,886,916
								9,663,235
15,087	59,765							36,178,597
1,146	10,414	13,458,739	25,470,361	105,525,373	10,719,298	614,249	189,977	50,403,567
50	**750**	**12,474,054**	**24,047,837**	**118,959,880**	**12,192,816**	**706,563**	**226,100**	**50,067,794**
99,433	699,521	41,916,218	76,381,862	639,376,609	56,827,835	3,048,373	723,556	230,590,673
								3,534,322
								3,039,178
								140,652,839
76,728	711,085							16,040,199
58,382	**588,622**							**14,762,900**
74,277,423	300,619,487							441,966,912
								13,483,238
								18,236,610
								271,914,300
								9,570,772
								10,130,776
								107,444,357
60	660							17,661,114
								18,119,716
2,929,584	11,080,836							73,732,576
5,700	61,437							321,684
6,835	**69,507**							**442,762**
445,297	2,909,153							41,978,828
								473,399
								473,120
1,122	5,008							57,322,517
								70,150
								74,662
								12,861,486
								131,473
								144,960
4,617,442	19,553,725							142,803,777
								3,305,525
								4,367,581
36	116							227,971,228
								7,369,714
								8,254,501
								211,544,965
								141,242
								81,093
								85,832,491
								10,584,864
								11,100,869
								294,736,036
								135,330
								98,362
								3,226,385
								8,318,170
								6,516,020
								144,730,524
								15,113,119
								16,121,974
								293,813,455
850,541	6,237,997	13,458,739	25,470,361	105,525,373	10,719,298	614,249	189,977	255,863,587
911,326	**6,327,678**	**12,474,054**	**24,047,837**	**118,959,880**	**12,192,816**	**706,563**	**226,100**	**267,496,854**
137,923,118	582,362,582	41,916,218	76,381,862	639,376,609	56,827,835	3,048,373	723,556	5,291,415,626

Table VIIb.—Production, 1963 and 1964, and Total to Date, by Mining Divisions—Lode Gold, Silver, Copper, Lead, and Zinc

Division	Period	Lode Gold		Silver		Copper		Lead		Zinc		Division Total
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
		Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
Alberni	1963	411	15,515	114	157			143	17			15,689
	1964	734	27,709	101	141							27,850
	To date	303,757	11,364,987	162,684	79,053	2,290,699	343,518	121,344	5,419	67	8	11,792,985
Atlin	1963											
	1964											
	To date	344,197	12,126,732	3,375,333	2,893,952	24,777,661	8,160,266	23,765,211	3,437,907	91,067,749	10,864,497	37,483,354
Cariboo	1963	18,308	691,127	3,165	4,367							695,494
	1964	19,867	749,979	3,165	4,414							754,393
	To date	1,157,977	41,677,079	136,428	95,253	2,352	920	24,560	3,724	505	19	41,776,995
Clinton	1963											
	1964											
	To date	23,390	827,328	31,564	14,214	57,548	5,905	193	7			847,454
Fort Steele	1963	358	13,515	4,018,637	5,544,313			252,795,953	30,365,850	238,141,121	31,370,330	67,294,008
	1964	325	12,269	2,840,038	3,960,660			188,345,245	27,615,180	245,548,918	35,931,173	67,519,282
	To date	6,356	191,526	218,712,215	134,806,686	28,592	6,193	12,225,976,483	923,774,077	9,020,818,088	733,852,560	1,792,631,042
Golden	1963			183,117	252,637			7,408,011	889,850	16,250,939	2,140,736	3,283,223
	1964			89,006	124,126			4,455,688	653,293	12,097,985	1,770,298	2,547,717
	To date	169	4,844	3,964,436	3,272,911	1,168,211	365,531	243,699,296	23,625,830	294,564,731	26,715,687	53,984,803
Greenwood	1963	12,570	474,517	926,088	1,277,677	6,857,135	2,101,438	793,217	95,281	957,831	126,175	4,075,088
	1964	13,349	503,924	871,310	1,215,111	7,477,199	2,498,282	601,148	88,140	695,773	101,812	4,407,269
	To date	1,218,404	27,482,291	36,600,800	24,335,107	480,408,832	82,318,803	18,808,719	1,605,416	20,230,609	1,681,715	137,423,332
Kamloops	1963	2,346	88,562	85,119	117,434	19,082,399	5,847,992					6,053,988
	1964	3,654	137,938	133,995	186,867	25,339,289	8,466,363					8,791,168
	To date	53,868	1,834,828	523,371	486,292	50,839,680	15,501,396	538,097	45,030	438,023	29,826	17,897,372
Liard	1963											
	1964											
	To date	114	4,120	540	446	56	22	10,102	1,724			6,312
Lillooet	1963	87,016	3,284,854	16,836	23,228							3,308,082
	1964	73,848	2,787,762	14,662	20,447							2,808,209
	To date	3,880,505	135,945,108	932,245	622,913	400	41	62,513	2,548	15	2	136,570,612
Nanaimo	1963	17,539	662,097	63,454	87,544	11,672,147	3,577,046					4,326,687
	1964	13,668	515,967	60,643	84,572	13,985,371	4,672,792					5,273,331
	To date	123,064	3,375,606	815,665	622,848	56,593,395	14,359,364					18,357,818
Nelson	1963	1,187	44,809	112,035	154,569			19,762,519	2,373,874	72,247,522	9,517,166	12,090,418
	1964	943	35,598	140,678	196,187			24,032,074	3,523,582	84,976,320	12,434,585	16,189,952
	To date	1,334,099	41,730,235	8,667,992	5,569,262	14,915,405	1,689,196	400,761,576	47,891,100	1,004,645,116	125,916,954	222,796,747
New Westminster	1963					1,742,179	533,908					533,908
	1964					1,659,200	554,372					554,372
	To date	4,466	114,164	15,114	7,720	8,974,649	2,670,982	28,425	1,119	12,755	481	2,794,466
Nicola	1963					57,501,996	17,622,062					17,622,062
	1964					54,215,450	18,114,466					18,114,466
	To date	8,541	235,481	275,599	134,205	197,271,843	61,603,956	2,239,124	90,923	323,735	10,954	62,075,519
Omineca	1963	12	453	5,784	7,980			34,205	4,109	51,271	6,754	19,296
	1964	8	302	6,392	8,914			60,984	8,941	13,017	1,905	20,062
	To date	25,131	775,967	9,578,180	7,620,352	6,748,062	1,546,025	28,132,836	3,567,604	31,675,820	3,922,280	17,432,228

		Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
Osoyoos	1963	69	2,605	483	666			1,245	150	836	110	3,531
	1964	126	4,757	2,426	3,383			4,347	637	2,286	335	9,112
	To date	1,655,733	50,313,477	599,877	399,994	2,843,616	417,190	140,765	7,208	16,164	1,589	51,139,458
Revelstoke	1963			425	586			2,933	352	3,371	444	1,382
	1964											
	To date	37,300	1,069,260	4,108,010	2,767,062	153,686	51,037	36,046,708	3,853,366	27,123,973	3,311,432	11,052,157
Similkameen	1963			4	6			133	16			22
	1964	1	38	73	102	4,352	1,454					1,594
	To date	184,016	6,327,410	4,219,541	2,582,405	601,197,221	111,137,823	382,677	13,376	72,275	3,964	120,064,978
Skeena	1963	634	23,934	9,222	12,723			5,870	705	7,886	1,039	38,401
	1964	1,941	73,272	38,257	53,352							126,624
	To date	2,413,741	60,959,725	68,776,448	44,062,324	689,106,270	98,026,007	59,948,914	5,429,782	17,073,030	2,522,114	210,999,952
Slocan	1963	44	1,661	442,620	610,661			24,765,984	2,974,890	26,719,582	3,519,770	7,106,982
	1964	104	3,926	535,255	746,456			21,905,027	3,211,715	26,734,109	3,912,002	7,874,099
	To date	15,982	462,927	73,305,455	47,980,857	13,662	1,861	959,551,244	80,893,199	767,693,797	77,283,725	206,622,569
Trail Creek	1963	1,276	48,169	1,159	1,599	76,650	23,490	6,419	771	7,448	981	75,010
	1964	158	5,965	356	496	15,419	5,152	707	104	3,205	469	12,186
	To date	2,984,326	63,331,158	3,673,007	2,102,416	122,561,732	18,245,404	145,957	12,213	133,019	16,156	83,707,347
Vancouver	1963	9,778	369,119	51,903	71,608	12,851,985	3,938,619	193,135	23,199	7,613,418	1,002,916	5,405,461
	1964	8,854	334,238	43,060	60,051	11,789,676	3,939,166	57,108	8,373	3,812,989	557,955	4,899,783
	To date	485,590	15,671,124	5,036,004	3,202,676	997,791,681	173,289,540	18,486,991	1,870,034	231,390,548	29,920,253	223,953,627
Vernon	1963											
	1964											
	To date	5,224	176,082	12,823	8,084	654	100	24,913	2,933	10,816	1,146	188,345
Victoria	1963	1,822	68,781	19,065	26,303	7,975,045	2,444,032					2,539,116
	1964	17	642	359	501	8,488	2,836					3,979
	To date	40,720	927,715	909,140	548,719	48,977,926	11,113,114	210,097	19,848	3,568,709	283,923	12,893,319
Not assigned[1]	1963	1,609	60,740	482,799	666,094	487,568	149,420	9,204,543	1,105,650	40,861,929	5,382,742	7,364,646
	1964	890	33,598	489,636	682,837	1,060,256	354,253	29,275,175	4,292,328	26,911,960	3,938,027	9,301,043
	To date	14,836	411,668	4,704,383	4,335,156	48,436,634	10,449,303	482,864,759	41,196,088	1,159,340,682	103,663,194	160,055,409
Totals	1963	154,979	5,850,458	6,422,029	8,860,152	118,247,104	36,238,007	314,974,310	37,834,714	402,863,154	53,069,163	141,852,494
	1964	138,487	5,227,884	5,269,412	7,348,617	115,554,700	38,609,136	268,737,503	39,402,293	400,796,562	58,648,561	149,236,491
	To date	16,321,506	477,340,842	449,136,854	288,550,907	3,355,160,467	611,303,497	14,501,971,504	1,137,350,475	12,670,200,226	1,120,002,479	3,634,548,200

[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.

TABLE VIIC.—PRODUCTION, 1963 AND 1964, AND TOTAL TO DATE, BY MINING DIVISIONS—OTHER METALS

Division	Period	Antimony		Bismuth		Cadmium		Chromite		Iron Concentrates		Manganese		Mercury	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
		Lb.	$	Lb.	$	Lb.	$	Tons	$	Tons	$	Tons	$	Lb.	$
Alberni	1963									750,901	7,936,195				
	1964									**846,459**	**9,103,283**				
	To date									2,299,380	24,335,619				
Atlin	1963														
	1964														
	To date					319,212	561,762								
Cariboo	1963														
	1964														
	To date														
Clinton	1963														
	1964														
	To date							126	900						
Fort Steele	1963									61,597*	674,487				
	1964					**518,672**	**1,680,497**			**73,460***	**789,126**				
	To date					520,509	1,684,320			235,644	2,475,729				
Golden	1963					41,399	99,358								
	1964					**35,875**	**116,235**								
	To date	40,062	14,906			446,126	834,784								
Greenwood	1963					5,643	13,543								
	1964					**3,920**	**12,701**								
	To date					54,655	102,851	670	31,395						
Kamloops	1963														
	1964														
	To date									21,167	95,851			10,987	5,795
Liard	1963														
	1964														
	To date														
Lillooet	1963														
	1964													**5,548**	**22,848**
	To date	13,466	4,821											7,331	26,403
Nanaimo	1963									908,735	9,061,952				
	1964									**653,404**	**6,640,238**				
	To date									10,405,903	82,668,576				
Nelson	1963					447,569	1,074,165								
	1964					**508,922**	**1,648,907**								
	To date					5,914,764	11,175,560								
New Westminster	1963														
	1964														
	To date														
Omineca	1963					393	943								
	1964					**734**	**2,378**								
	To date	104,489	15,217			263,241	521,439							4,150,892	10,400,259
Osoyoos	1963														
	1964														
	To date											16			

		Lb.	$	Lb.	$	Lb.	$	Tons	$	Tons	$	Tons	$	Lb.	$
Revelstoke	1963														
	1964														
	To date	9,394	3,455			103,612	176,102								
Similkameen	1963														
	1964														
	To date														
Skeena	1963									339,008	3,073,790				
	1964									**429,239**	**3,906,840**				
	To date					141,890	316,764			822,962	7,474,687				
Slocan	1963					93,434	224,242								
	1964					**97,784**	**316,820**								
	To date	31,865	8,133			1,991,656	3,759,674					541	8,160		
Trail Creek	1963														
	1964														
	To date					115	210			550	1,925				
Vancouver	1963					29,589	71,014								
	1964					**14,689**	**47,592**								
	To date					539,172	1,126,977								
Vernon	1963														
	1964														
	To date														
Victoria	1963														
	1964														
	To date					7,000	10,929					1,167	24,508		
Not assigned	1963	1,601,253*	624,489	157,099*	348,760	1,862,977*	3,271,145								
	1964	**1,591,523***	**700,270**	**213,428***	**480,213**	**683,659***	**2,215,056**								
	To date	45,685,396*	12,501,054	6,009,477*	10,546,386	23,067,158*	33,773,447								
Totals	1963	1,601,253	624,489	157,099	348,760	1,981,004	4,754,410			2,060,241	20,746,424				
	1964	**1,591,523**	**700,270**	**213,428**	**480,213**	**1,864,255**	**6,040,186**			**2,002,562**	**20,419,487**			**5,548**	**22,848**
	To date	45,884,672	12,547,086	6,009,477	10,546,386	33,369,110	54,044,819	796	32,295	13,785,606	117,052,387	1,724	32,668	4,169,210	10,432,457

* *See* notes on individual minerals listed alphabetically on pages A 16 to A 19.

TABLE VIIc.—PRODUCTION, 1963 AND 1964, AND TOTAL TO DATE, BY MINING DIVISIONS—OTHER METALS—*Continued*

Division	Period	Molybdenum		Nickel		Palladium		Platinum		Tin		Tungsten (WO_3)		Other* Value	Division Total
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value		
		Lb.	$	Lb.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	$	$
Alberni	1963														7,936,195
	1964														**9,103,283**
	To date														24,335,619
Atlin	1963														
	1964														
	To date											292	360		562,122
Cariboo	1963														
	1964														
	To date							59	2,299			27,698	21,431		23,730
Clinton	1963														
	1964														
	To date														900
Fort Steele	1963									927,062	648,943				1,323,430
	1964									**352,350**	**535,572**				**2,985,195**
	To date									15,748,886	12,321,941			88,184[1]	16,570,174
Golden	1963														99,358
	1964														**116,235**
	To date														849,690
Greenwood	1963														13,543
	1964														**12,701**
	To date														134,246
Kamloops	1963														
	1964	**28,245**	**47,063**												**47,063**
	To date	28,245	47,063												148,709
Liard	1963														
	1964														
	To date							2	79						79
Lillooet	1963														
	1964														**22,848**
	To date	1,469	2,440					3	113			32,353	37,921		71,198
Nanaimo	1963														9,061,952
	1964														**6,640,238**
	To date														82,668,576
Nelson	1963														1,074,165
	1964														**1,648,907**
	To date	15,035	18,378									13,739,939	33,900,311		45,094,249
New Westminster	1963			3,699,402	3,107,498										3,107,498
	1964			**3,398,560**	**2,854,790**										**2,854,790**
	To date			21,286,459	16,532,393										16,532,393
Omineca	1963														943
	1964														**2,378**
	To date	960	1,840					3	154			2,210,892	4,697,710	420[2]	15,637,039
Osoyoos	1963														
	1964														
	To date	612	1,020												1,020

		Lb.	$	Lb.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	$	$
Revelstoke	1963														
	1964														
	To date											7,784	5,687		185,244
Similkameen	1963							2	150						150
	1964														
	To date							1,287	129,186						129,186
Skeena	1963														3,073,790
	1964														**3,906,840**
	To date	7,813	13,020									366	331	1,389[3]	7,806,191
Slocan	1963														224,242
	1964														**316,820**
	To date														3,775,967
Trail Creek	1963														
	1964														
	To date					749	30,462	53	3,177						35,774
Vancouver	1963														71,014
	1964														**47,592**
	To date														1,126,977
Vernon	1963														
	1964														
	To date	5,414	9,500												9,500
Victoria	1963														
	1964														
	To date														35,437
Not assigned	1963													633,389	4,877,783
	1964													**533,897**	**3,929,436**
	To date													5,644,365	62,465,252
Totals	1963			3,699,402	3,107,498			2	150	927,062	648,943			633,389	30,864,063
	1964	**28,246**	**47,063**	**3,398,560**	**2,854,790**					**352,350**	**535,572**			**533,897**	**31,634,326**
	To date	59,548	93,261	21,286,459	16,532,393	749	30,462	1,407	135,008	15,748,886	12,321,941	16,019,324	38,663,751	5,734,358	278,199,272

[1] Magnesium, page A 17. [2] Cobalt, page A 17. [3] Selenium, page A 18.

TABLE VIIIᴅ.—PRODUCTION, 1963 AND 1964, AND TOTAL

Division	Period	Asbestos		Barite		Diatomite		Fluxes (Quartz and Limestone)		Granules, (Quartz, Limestone, and Granite)	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
		Tons	$	Tons	$	Tons	$	Tons	$	Tons	$
Alberni	1963										
	1964										
	To date										
Atlin	1963										
	1964										
	To date										
Cariboo	1963					458	16,030				
	1964					1,143	64,555				
	To date					3,645	135,895			48	168
Clinton	1963										
	1964										
	To date										
Fort Steele	1963										
	1964										
	To date			8	80						
Golden	1963			8,207	69,588						
	1964			10,588	119,370						
	To date			212,914	2,582,898						
Greenwood	1963										
	1964										
	To date							1,790,502	1,540,319		
Kamloops	1963										
	1964										
	To date										
Liard	1963	63,215	11,681,337								
	1964	67,460	11,714,494								
	To date	416,608	85,209,837								
Lillooet	1963										
	1964										
	To date										
Nanaimo	1963							20,000	44,000		
	1964							31,012	74,510		
	To date							755,831	896,610		
Nelson	1963									3,752	81,438
	1964									3,418	76,956
	To date							7,601	8,174	8,011	175,957
New Westminster	1963									6,000	88,000
	1964									4,000	84,000
	To date									79,487	1,066,261
Nicola	1963										
	1964										
	To date										
Omineca	1963										
	1964										
	To date										
Osoyoos	1963							40,483	178,937	9,692	179,105
	1964							42,002	162,718	11,871	236,683
	To date							701,865	3,159,203	91,171	1,394,657
Similkameen	1963										
	1964										
	To date										
Skeena	1963										
	1964										
	To date							601,019	1,050,722		
Vancouver	1963										
	1964										
	To date									29,692	418,606
Vernon	1963										
	1964										
	To date										
Victoria	1963							7	75		
	1964							7	70		
	To date							90	1,145	9,605	157,080
Not assigned	1963										
	1964										
	To date										
Totals	1963	63,215	11,681,337	8,207	69,588	458	16,030	60,490	223,012	19,444	348,543
	1964	67,460	11,714,494	10,588	119,370	1,143	64,555	73,021	237,298	19,289	397,639
	To date	416,608	85,209,837	212,922	2,582,978	3,645	135,895	3,856,908	6,656,173	218,014	3,212,729

See notes on individual minerals listed alphabetically on pages A 16 to A 19.

[1] Arsenious oxide.
[2] Bentonite.
[3] Fluorspar.
[4] Hydromagnesite.
[5] Iron oxide and ochre.
[6] Magnesium sulphate.

TO DATE, BY MINING DIVISIONS—INDUSTRIAL MINERALS

Gypsum and Gypsite		Jade		Mica		Sulphur		Other Value	Division Totals	Period
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value			
Tons	$	Lb.	$	Lb.	$	Tons	$	$	$	
										1963
										1964
								9,398[7]	9,398	To date
										1963
										1964
								20,325[6]	20,325	To date
									16,030	1963
									64,555	**1964**
				10,013,800	143,012			300[12]	279,375	To date
										1963
										1964
873	6,236							156,191[4, 6, 10]	162,427	To date
						44,940	541,549		541,549	1963
						70,963	**855,100**		**855,100**	**1964**
112,878	298,824					440,714	7,230,623	16,894[9]	7,546,421	To date
160,954	482,862								552,450	1963
188,303	**939,559**								**1,058,929**	**1964**
1,280,503	4,081,835							1,276[5, 11]	6,666,009	To date
										1963
										1964
								783,578[3]	2,323,897	To date
										1963
										1964
1,246,918	6,323,178			424,700	2,075			203,055[6, 10]	6,528,308	To date
						75,795	1,794,594		13,475,931	1963
						69,161	**1,624,616**		**13,339,110**	**1964**
						336,174	6,607,152		91,816,989	To date
		16,000	15,529						15,529	1963
		10,337	**11,404**						**11,404**	**1964**
		218,323	83,894					5,129[11]	89,023	To date
									44,000	1963
									74,510	**1964**
									896,610	To date
									81,438	1963
									76,956	**1964**
								55,901[5]	240,032	To date
									88,000	1963
									84,000	**1964**
									1,066,261	To date
										1963
										1964
2,407	10,050								10,050	To date
										1963
		1,200	**2,400**						**2,400**	**1964**
		1,200	2,400					11,460[1, 8]	13,860	To date
									358,042	1963
									399,401	**1964**
				1,588,800	25,938			295,547[1, 3, 6]	4,875,345	To date
										1963
										1964
250	1,700							16,858[2]	18,558	To date
										1963
										1964
						41,624	178,678		1,229,400	To date
						777	11,004		11,004	1963
						270	**810**		**810**	**1964**
				634,250	10,815	633,736	5,933,318	97,389[5]	6,460,128	To date
										1963
										1964
				160,500	3,978				3,978	To date
									75	1963
									70	**1964**
								80,226[11]	188,451	To date
						132,685	1,326,850		1,326,850	1963
						137,991	**1,379,910**		**1,379,910**	**1964**
						3,838,308	38,233,385		38,233,385	To date
160,954	482,862	16,000	15,529			254,197	3,673,997		16,510,898	1963
188,303	**939,559**	**11,537**	**13,804**			**278,385**	**3,860,436**		**17,347,155**	**1964**
2,643,829	10,721,823	219,523	86,294	12,822,050	185,818	5,290,556	58,183,156	1,703,527	168,678,230	To date

[7] Natro-alunite.
[8] Perlite.
[9] Phosphate rock.
[10] Sodium carbonate.
[11] Talc.
[12] Volcanic ash.

TABLE VIIE.—PRODUCTION, 1963 AND 1964, AND TOTAL

Division	Period	Cement	Lime and Limestone	Building-stone	Rubble, Riprap, and Crushed Rock	Sand and Gravel
		$	$	$	$	$
Alberni	1963				85,283	128,452
	1964				**53,337**	**37,605**
	To date				199,487	1,354,820
Atlin	1963					12,739
	1964					**430**
	To date		1,108		98,478	209,839
Cariboo	1963				46,475	466,488
	1964				**50,113**	**323,072**
	To date		7,500		1,056,874	5,857,879
Clinton	1963					
	1964					**31,834**
	To date				1,606	141,156
Fort Steele	1963				63,499	108,308
	1964				**12,065**	**55,545**
	To date		43,873	71,941	1,311,838	3,908,162
Golden	1963					9,378
	1964					**48,732**
	To date		1,000	24,000	125,339	1,575,506
Greenwood	1963					27,257
	1964				**1,000**	**25,116**
	To date		42,560	30,500	171,319	493,036
Kamloops	1963				551,334	281,594
	1964				**580,216**	**244,180**
	To date		12,000	18,000	6,010,885	4,826,462
Liard	1963					537,586
	1964				**3,000**	**258,181**
	To date				36,665	2,849,696
Lillooet	1963				72,204	137,748
	1964				**57,382**	**139,335**
	To date		100	2,000	527,328	1,498,238
Nanaimo	1963		1,595,736		44,701	256,038
	1964		**1,869,821**		**78,554**	**237,824**
	To date		31,321,900	3,199,257	544,658	3,160,314
Nelson	1963			11,096	2,003	224,118
	1964			**18,279**	**3,711**	**298,805**
	To date		34,543	388,994	496,389	2,752,384
New Westminster	1963		53,626		265,982	3,016,383
	1964		**116,857**	**6,664**	**209,009**	**3,759,293**
	To date		1,592,818	20,974	9,310,882	35,008,306
Nicola	1963					38,392
	1964					**5,250**
	To date			8,000	133,341	420,066
Omineca	1963				18,691	153,809
	1964				**26,477**	**316,319**
	To date		3,077		689,598	3,789,003
Osoyoos	1963		1,000		650	110,176
	1964		**714**		**1,040**	**62,550**
	To date		33,784	14,850	150,647	1,097,084
Revelstoke	1963				5,564	63,204
	1964				**8,527**	**66,135**
	To date		1,000	5,575	339,653	1,113,323
Similkameen	1963				1,000	130,000
	1964				**5,500**	**136,950**
	To date	10,500	11,571	24,000	536,344	2,152,057
Skeena	1963		55,259		20,069	118,006
	1964		**47,983**		**112,683**	**173,451**
	To date		1,542,427	144,000	1,455,702	4,674,622
Slocan	1963				3,389	35,101
	1964				**4,660**	**58,922**
	To date		1,000	115,143	111,349	909,540
Trail Creek	1963			2,850	1,200	62,182
	1964				**5,513**	**63,394**
	To date		28,000	81,484	223,398	1,732,228
Vancouver	1963	4,028,311			4	1,069,070
	1964	**4,626,619**		**579**		**1,525,486**
	To date	22,483,010	40,885	4,011,360	7,498,921	28,067,230
Vernon	1963				2,937	131,786
	1964				**5,412**	**92,950**
	To date		46,499	81,052	205,430	2,457,416
Victoria	1963	4,518,457	18,175			933,939
	1964	**5,414,157**	**19,820**			**615,627**
	To date	109,890,642	846,182	45	456,413	15,116,496
Not assigned	1963				74,017	1,462,341
	1964				**67,119**	**1,436,984**
	To date		315,498	505,018	423,591	4,455,569
Totals	1963	8,546,768	1,723,796	13,946	1,259,002	9,514,095
	1964	**10,040,776**	**2,055,195**	**25,522**	**1,285,318**	**10,013,970**
	To date	132,384,152	35,927,325	8,746,193	32,116,135	129,620,432

* *See* note under structural materials, page A 18.

TO DATE, BY MINING DIVISIONS—STRUCTURAL MATERIALS

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	Unclassified Material	Division Totals
$	$	$	$	$	$	$	$	$	$
									213,735
									90,942
									1,554,307
									12,739
									430
									309,425
							10,800		523,763
									373,185
1,193	184	4,651	15,807				22,042		6,966,130
									31,834
									142,762
									171,807
									67,610
7,800							8,118		5,351,732
									9,378
									48,732
							13,654		1,739,499
									27,257
									26,116
114,361			6,922						858,698
									832,928
									824,396
72,379									10,939,726
									537,586
									261,181
									2,886,361
									209,952
									196,717
									2,027,666
									1,896,475
									2,186,199
1,104,295	38,939		35,758						39,405,121
									237,217
									320,795
19,110	2,864								3,694,284
63,499	292,535	758,008	33,151	31,376	846,202	14,562	466,042		5,841,366
49,826	**60,594**	**811,572**	**38,585**	**31,017**	**1,071,324**	**13,332**	**469,541**		**6,637,614**
1,780,773	5,472,618	13,648,983	952,215	2,909,788	13,609,337	379,231	2,121,698		86,807,623
									38,392
									5,250
									561,407
									172,500
									342,796
5,274									4,486,952
									111,826
									64,304
									1,296,365
									68,768
									74,662
									1,459,551
									131,000
									142,450
			1,363				11,992		2,747,827
									193,334
									334,117
			4,925				8,324		7,830,000
									38,490
									63,582
									1,137,032
									66,232
									68,907
									2,065,110
									5,097,385
									6,152,684
142,208	241,216	580,778	12,724			23,362	88,304		63,189,998
									134,723
									98,362
131,467	6,202	1,011	5	18,224	4,325		20		2,951,651
							308,408		5,778,979
							462,367		**6,511,971**
1,814,647	29,552	119,930	1,050	705,821	1,072,346	136,504	1,408,009		131,597,637
									1,536,358
									1,504,103
							3,180,828*	5,972,171*	14,852,675
63,499	292,535	758,008	33,151	31,376	846,202	14,562	785,250		23,882,190
49,826	**60,594**	**811,572**	**38,585**	**31,017**	**1,071,324**	**13,332**	**931,908**		**26,428,939**
5,193,507	5,791,575	14,355,353	1,030,769	3,633,833	14,686,008	539,097	6,862,989	5,972,171	396,859,539

TABLE VIIIA.—QUANTITY[1] AND VALUE OF COAL PER YEAR TO DATE

Year	Tons (2,000 Lb.)	Value	Year	Tons (2,000 Lb.)	Value
1836–59	41,871	$149,548	1913	2,713,535	$9,197,460
1860	15,956	56,988	1914	2,237,042	7,745,847
1861	15,427	55,096	1915	2,076,601	7,114,178
1862	20,292	72,472	1916	2,583,469	8,900,675
1863	23,906	85,380	1917	2,436,101	8,484,343
1864	32,068	115,528	1918	2,575,275	12,833,994
1865	36,757	131,276	1919	2,433,540	11,975,671
1866	28,129	100,460	1920	2,852,535	13,450,169
1867	34,988	124,956	1921	2,670,314	12,836,013
1868	49,286	176,020	1922	2,726,793	12,880,060
1869	40,098	143,208	1923	2,636,740	12,678,548
1870	33,424	119,372	1924	2,027,843	9,911,935
1871	55,458[2]	164,612	1925	2,541,212	12,168,905
1872	55,458[2]	164,612	1926	2,406,094	11,650,180
1873	55,459[2]	164,612	1927	2,553,416	12,269,135
1874	91,334	244,641	1928	2,680,608	12,633,510
1875	123,362	330,435	1929	2,375,060	11,256,260
1876	155,895	417,576	1930	1,994,493	9,435,650
1877	172,540	462,156	1931	1,765,471	7,684,155
1878	191,348	522,538	1932	1,614,629	6,523,644
1879	270,257	723,903	1933	1,377,177	5,375,171
1880	299,708	802,785	1934	1,430,042	5,725,133
1881	255,760	685,171	1935	1,278,380	5,048,864
1882	315,997	846,417	1936	1,352,301	5,722,502
1883	238,895	639,897	1937	1,446,243	6,139,920
1884	441,358	1,182,210	1938	1,388,507	5,565,069
1885	409,468	1,096,788	1939	1,561,084	6,280,956
1886	365,832	979,908	1940	1,662,027	7,088,265
1887	462,964	1,240,080	1941	1,844,745	7,660,000
1888	548,017	1,467,903	1942	1,996,000	8,237,172
1889	649,411	1,739,490	1943	1,854,749	7,742,030
1890	759,518	2,034,420	1944	1,931,950	8,217,966
1891	1,152,590	3,087,291	1945	1,523,021	6,454,360
1892	925,495	2,479,005	1946	1,439,092	6,732,470
1893	1,095,690	2,934,882	1947	1,696,350	8,680,440
1894	1,134,509	3,038,859	1948	1,604,480	9,765,395
1895	1,052,412	2,824,687	1949	1,621,268	10,549,924
1896	1,002,268	2,693,961	1950	1,574,006	10,119,303
1897	999,372	2,734,522	1951	1,573,572	10,169,617
1898	1,263,272	3,582,595	1952	1,402,313	9,729,739
1899	1,435,314	4,126,803	1953	1,384,138	9,528,279
1900	1,781,000	4,744,530	1954	1,308,284	9,154,544
1901	1,894,544	5,016,398	1955	1,332,874	8,986,501
1902	1,838,621	4,832,257	1956	1,417,209	9,346,518
1903	1,624,742	4,332,297	1957	1,085,657	7,340,339
1904	1,887,981	4,953,024	1958	796,413	5,937,860
1905	2,044,931	5,511,861	1959	690,011	5,472,064
1906	2,126,965	5,548,044	1960	788,658	5,242,223
1907	2,485,961	7,637,713	1961	919,142	6,802,134
1908	2,362,514	7,356,866	1962	825,339	6,133,986
1909	2,688,672	8,574,884	1963	850,541	6,237,997
1910	3,314,749	11,108,335	1964	911,326	6,327,678
1911	2,541,698	8,071,747			
1912	3,211,907	10,786,812	Totals	137,923,118	$582,362,582

[1] Quantity from 1836 to 1909 is gross mine output and includes material lost in picking and washing. For 1910 and subsequent years the quantity is that sold and used.

[2] Estimated breakdown of previously combined figure for three years.

TABLE VIIIB.—QUANTITY[1] AND VALUE OF COAL SOLD AND USED[2]

Mining Division and Period	Total Sales	Used under Company Boilers	Used in Making Coke	Total Sold and Used	
	Tons	Tons	Tons	Tons	$
Cariboo—					
Total to 1950	257	33	—	290	1,100
Total to date	257	33	—	290	1,100
Fort Steele—					
Total to 1950	31,287,472	2,006,789	9,704,778	42,999,039	166,468,348
1951–60	7,014,784	145,624	2,195,744	9,356,152	58,606,978
1961	619,828	14,698	200,190	834,716	5,979,805
1962	532,289	10,788	191,454	734,531	5,255,540
1963	557,939	17,089	191,879	766,907	5,454,401
1964	639,265	17,452	189,342	846,059	5,668,799
Total to date	40,651,577	2,212,440	12,673,387	55,537,404	247,433,871
Kamloops—					
Total to 1950	14,348	739	—	15,087	59,765
Total to date	14,348	739	—	15,087	59,765
Liard—					
Total to 1950	58,417	266	—	58,683	325,395
1951–60	36,083	20	—	36,103	333,461
1961	2,062	—	—	2,062	17,000
1962	1,389	—	—	1,389	12,501
1963	1,146	—	—	1,146	10,414
1964	50	—	—	50	750
Total to date	99,147	286	—	99,433	699,521
Nanaimo—					
Total to 1950	67,181,037	4,280,602	558,985	72,020,624	278,647,173
1951–60	1,951,075	11,071	—	1,962,146	19,134,499
1961	76,009	—	—	76,009	736,814
1962	83,534	—	—	83,534	801,294
1963	76,728	—	—	76,728	711,085
1964	58,382	—	—	58,382	588,622
Total to date	69,426,765	4,291,673	558,985	74,277,423	300,619,487
Nicola—					
Total to 1950	2,731,340	188,884	—	2,920,224	10,985,359
1951–60	9,016	—	—	9,016	91,725
1961	159	—	—	159	1,717
1962	125	—	—	125	1,375
1963	60	—	—	60	660
Total to date	2,740,700	188,884	—	2,929,584	11,080,836
Omineca—					
Total to 1950	214,126	4,095	—	218,221	1,034,134
1951–60	202,931	—	—	202,931	1,616,775
1961	5,850	—	—	5,850	64,024
1962	5,760	—	—	5,760	63,276
1963	5,700	—	—	5,700	61,437
1964	6,835	—	—	6,835	69,507
Total to date	441,107	4,095	—	445,297	2,909,153
Osoyoos—					
Total to 1950	1,122	—	—	1,122	5,008
Total to date	1,122	—	—	1,122	5,008
Similkameen—					
Total to 1950	4,055,080	349,235	—	4,404,315	18,426,725
1951–60	212,781	—	—	212,781	1,124,226
1961	346	—	—	346	2,774
Total to date	4,268,207	349,235	—	4,617,442	19,553,725
Skeena—					
Total to 1950	36	—	—	36	116
Total to date	36	—	—	36	116
Provincial totals—					
Total to 1950	105,543,235	6,830,643	10,263,763	122,637,641	475,953,123
1951–60	9,426,670	156,715	2,195,744	11,779,129	80,907,664
1961	704,254	14,698	200,190	919,142	6,802,134
1962	623,097	10,788	191,454	825,339	6,133,986
1963	641,573	17,089	191,879	850,541	6,237,997
1964	704,532	17,452	189,342	911,326	6,327,678
Total to date	117,643,266	7,047,385	13,232,372	137,923,118	582,362,582

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 this and preceding Annual Reports.

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.

TABLE IX.—COKE AND BY-PRODUCTS FOR YEARS 1895 TO 1925 AND BY YEARS 1926 TO 1964

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	6,556,142
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
1960	186,960	1,124,760			139,040	1,948,370			139,040	1,948,370		108,360		2,056,730
1961	200,190	1,201,140			153,843	2,232,690			153,843	2,232,690		115,291		2,347,981
1962	191,454	1,196,588			152,885	2,171,128			152,885	2,171,128		116,499		2,287,627
1963	191,879	1,247,214			154,844	2,203,689			154,844	2,203,689		120,468		2,324,157
1964	189,342	1,183,387			149,759	2,134,792			149,759	2,134,792		152,423		2,287,215
Totals	16,845,262	73,193,395	6,223,241	35,571,124	3,244,522	36,950,295	1,829,283	11,777,717	11,296,143	84,299,136	83,269,939	4,461,206	553,717	172,583,998

[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 X.—Dividends Paid by Mining Companies, 1897–1964

Dividends Paid during 1963 and 1964

	1963	1964
Bralorne Pioneer Mines Ltd.	$645,740	$645,740
Brynnor Mines Ltd.		3,220,000
Cassiar Asbestos Corporation Ltd.	2,376,000	2,376,000
Craigmont Mines Ltd.	4,084,480	5,139,166
Consolidated Mining and Smelting Co. of Canada, Ltd.	21,294,551	26,453,906
Crow's Nest Pass Coal Co. Ltd.	582,878	582,878
Giant Mascot Mines Ltd.	244,141	279,018
Nimpkish Iron Mines Ltd.	756,000	
Sheep Creek Mines Ltd.	225,000	225,600
Others	4,300	5,000
Totals	$30,213,090	$38,927,308

Dividends Paid Yearly, 1917 to 1964, Inclusive

Year	Amount Paid	Year	Amount Paid
1917	$3,269,494	1942	$13,627,104
1918	2,704,469	1943	11,860,159
1919	2,494,283	1944	11,367,732
1920	1,870,296	1945	10,487,395
1921	736,629	1946	15,566,047
1922	3,174,756	1947	27,940,213
1923	2,983,570	1948	37,672,319
1924	2,977,276	1949	33,651,096
1925	5,853,419	1950	34,399,330
1926	8,011,137	1951	40,921,238
1927	8,816,681	1952	32,603,956
1928	9,572,536	1953	22,323,089
1929	11,263,118	1954	25,368,262
1930	10,543,500	1955	35,071,583
1931	4,650,857	1956	36,262,682
1932	2,786,958	1957	24,247,420
1933	2,471,735	1958	14,996,123
1934	4,745,905	1959	16,444,281
1935	7,386,070	1960	20,595,943
1936	10,513,705	1961	20,720,239
1937	15,085,293	1962	24,394,297
1938	12,068,875	1963	30,213,090
1939	11,865,698	1964	38,927,308
1940	14,595,530		
1941	16,598,110	Total	$736,700,797

TABLE X.—DIVIDENDS PAID BY MINING COMPANIES, 1897–1964—*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	17,759,500
Bralorne Pioneer Mines Ltd.[2]	Bridge River	Gold	3,818,905
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.[6]	Sheep Creek	Gold	3,796,875[7]
Silbak Premier Mines Ltd.	Premier	Gold	2,425,000[5]
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			$81,920,775

[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 and subsequent years 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] Since March, 1956, company name is Sheep Creek Mines Ltd.

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

TABLE X.—DIVIDENDS PAID BY MINING COMPANIES, 1897–1964—*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	580,428,279[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	2,111,840
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	4,033,050
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	1,088,100
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			$613,644,076

[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 X.—DIVIDENDS PAID BY MINING COMPANIES, 1897–1964—*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
Craigmont Mines Ltd.	Merritt	Copper	10,117,618
Granby Cons. M.S. & P. Co.[2]	Phoenix, Anyox, 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			$60,088,265

[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 30, 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	19,702,477
Canadian Collieries Resources Ltd.	Nanaimo	Coal	828,271
Unsworth & Dunn	Nanaimo	Coal	7,065
Total, coal mines			$36,561,813

Aggregate of All Classes

Lode-gold mining	$81,920,775
Silver-lead-zinc mining and smelting	613,644,076
Copper-mining	60,088,265
Coal-mining	36,561,813
Miscellaneous, structural, and placer gold	27,112,084
Total	$819,327,013

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

Class	Salaries and Wages	Fuel and Electricity[1]	Process Supplies[1 2]
Lode-mining[3]	$50,270,379	$6,234,889	$19,782,555
Placer-mining	21,491	243	....
Fuel—coal, coke, and gas plant	2,787,760	289,221	35,284
„ petroleum and natural gas	1,225,144	173,521	1,278,074
Industrial minerals	2,962,052	880,017	2,659,036
Structural materials industry	6,357,733	2,627,970	3,875,004
Totals, 1964	**$63,624,559**	**$10,205,861**	**$27,629,953**
Totals, 1963	57,939,294	10,546,806	12,923,325
1962	55,522,171	9,505,559	14,024,799
1961	50,887,275	8,907,034	17,787,127
1960	52,694,818	7,834,728	21,496,912
1959	49,961,996	7,677,321	17,371,688
1958	48,933,560	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, 1935–64	$1,194,437,623	$202,959,830	$423,093,397

[1] In some cases prior to 1964 this detail is not available and is included in a total that contains expenditures on fixed assets plus cost of goods, materials, and supplies not chargeable to fixed assets.

[2] In previous years designated as "process supplies (except fuel)—explosives, flux, chemicals, drill steel, oxygen, acetylene, diamonds, etc." The forms used in collecting 1964 data for all minerals excepting fuels and sulphur read: "Process, operating, maintenance and repair supplies . . . used in the mine/mill operations; that is, explosives, chemicals, drill steel, bits, lubricants, electrical, etc., . . . not charged to Fixed Assets Account . . . provisions and supplies sold in any company operated cafeteria or commissary." The amount shown by 1964 returns is substantially greater than for any previous year, and because of the difference in specification is not comparable.

[3] Prior to 1962 this included data related to the principal lode metals as detailed in Table 1. The lode metals classed as miscellaneous metals in Table I were previously included under the heading "Miscellaneous Metals and Industrial Minerals."

TABLE XII.—AVERAGE NUMBER EMPLOYED IN THE MINING INDUSTRY,[1] 1901–64

Year	Placer-mining	Lode-mining			In Concentrators	In Smelters	Coal-mining			Structural Materials		Industrial	Total[2]
		Under	Above	Total			Under	Above	Total	Quarries and Pits	Plants		
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	827	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
1960	86	1,782	1,959	3,741	648	3,034	894	288	1,182	1,704	557	589	11,541
1961	74	1,785	1,582	3,367	626	3,118	705	237	942	1,828	508	571	11,034
1962	35	1,684	2,238	3,922	950	3,356	548	228	776	1,523	481	517	11,560
1963	[3] 43	1,752	2,423	4,175	850	3,239	501	247	748	909	460	528	10,952
1964	**5**	**1,839**	**2,739**	**4,578**	**822**	**3,281**	**446**	**267**	**713**	**1,293**	**444**	**509**	**11,645**

[1] Mining industry includes all branches of the mineral industry except petroleum and natural gas.

[2] 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.

[3] Includes estimated employment of 6 at Germansen Mines Ltd. and 35 at Wingdam and Lightning Creek Mining Co. Ltd.

Table XIII.—Lode-metal Mines—Tonnage, Number of Mines, Net and Gross Value,[1] 1901–64

Year	Tonnage[2]	Number of Shipping Mines	Number of Mines Shipping over 100 Tons	Gross Value as reported by Shippers[3]	Freight and Treatment[3]	Net Value to Shipper[4]	Value of Copper, Lead and Zinc[1]	Gross Value of Metals Produced[1] (Excluding Placer)
				$	$	$	$	$
1901	926,162	119	78	......	......	......	6,457,149	13,288,855
1902	1,009,016	124	75	......	......	......	4,275,123	11,090,421
1903	1,288,466	125	74	......	......	......	5,237,622	11,579,663
1904	1,461,609	142	76	......	......	......	5,999,911	12,309,455
1905	1,706,679	146	79	......	......	......	8,414,444	15,319,865
1906	1,963,872	154	77	......	......	......	10,973,243	17,501,202
1907	1,805,614	147	72	......	......	......	10,504,102	16,273,305
1908	2,083,606	108	59	......	......	......	7,972,344	14,580,991
1909	2,057,713	89	52	......	......	......	8,027,781	14,191,141
1910	2,216,428	83	50	......	......	......	6,450,335	13,228,731
1911	1,770,755	80	45	......	......	......	5,770,257	11,454,062
1912	2,688,532	86	51	......	......	......	10,530,279	17,662,766
1913	2,663,809	110	58	......	......	......	9,594,742	17,191,482
1914	2,175,971	98	56	......	......	......	8,239,321	15,225,727
1915	2,720,669	132	59	......	......	......	13,235,224	19,995,212
1916	3,229,942	169	81	......	......	......	24,835,941	31,512,148
1917	2,797,368	193	87	......	......	......	22,155,535	26,803,984
1918	2,912,516	175	80	......	......	......	20,970,596	27,637,302
1919	2,146,920	144	74	......	......	......	13,007,180	19,771,717
1920	2,215,445	121	60	......	......	......	13,726,993	19,465,932
1921	1,586,428	80	35	......	......	......	8,525,043	12,927,217
1922	1,592,163	98	33	......	......	......	10,587,382	19,236,601
1923	2,447,672	77	28	......	......	......	17,923,939	25,349,215
1924	3,413,912	86	37	......	......	......	25,125,528	35,538,816
1925	3,849,269	102	40	......	......	......	36,578,048	46,200,650
1926	4,775,327	138	55	......	......	38,558,613	40,668,566	51,512,289
1927	5,416,411	132	52	......	......	27,750,364	35,395,438	44,978,042
1928	6,241,672	110	49	......	......	29,070,075	38,211,267	48,496,950
1929	6,977,903	106	48	......	......	34,713,887	43,436,831	52,686,634
1930	6,804,276	68	32	......	......	21,977,688	33,645,669	41,633,145
1931	5,549,622	44	22	......	......	10,513,931	17,624,413	23,238,477
1932	4,354,904	75	29	......	......	7,075,393	13,176,965	19,734,327
1933	4,063,775	109	47	......	......	13,976,358	15,915,836	25,214,936
1934	5,141,744	145	69	......	......	20,243,278	19,729,720	34,462,793
1935	4,927,204	177	72	......	......	25,407,914	21,800,218	41,111,560
1936	4,381,173	168	70	......	......	30,051,207	25,283,229	44,640,004
1937	6,145,244	185	113	48,617,920	4,663,843	43,954,077	41,714,705	63,666,000
1938	7,377,117	211	92	40,222,237	4,943,754	35,278,483	29,541,421	54,288,698
1939	7,212,171	217	99	45,133,788	4,416,919	40,716,869	27,939,627	54,737,557
1940	7,949,736	216	92	50,004,909	6,334,611	43,670,298	34,203,578	63,095,238
1941	8,007,937	200	98	52,354,870	5,673,048	46,681,822	34,607,700	64,421,668
1942	6,894,844	126	76	50,494,041	5,294,637	45,199,404	35,313,546	62,584,368
1943	5,786,864	48	32	37,234,070	3,940,367	33,293,703	34,903,052	54,543,124
1944	4,879,851	51	31	29,327,114	2,877,706	26,449,408	29,494,325	41,733,036
1945	4,377,722	36	27	34,154,917	2,771,292	31,383,625	39,077,876	50,275,001
1946	3,705,594	50	32	48,920,971	2,904,130	46,016,841	47,006,285	58,359,386
1947	5,011,271	75	33	81,033,093	4,722,010	76,311,087	79,819,647	95,528,728
1948	5,762,321	97	51	118,713,859	18,585,183	100,128,727	105,005,155	123,505,044
1949	6,125,460	118	54	99,426,678	19,613,185	79,814,604	91,067,630	109,691,706
1950	6,802,482	112	58	108,864,792	22,113,431	86,751,361	94,711,755	116,566,320
1951	6,972,400	119	64	142,590,427	25,096,743	117,493,684	129,460,924	152,877,635
1952	9,174,617	95	58	140,070,389	30,444,575	106,601,451	118,181,241	147,360,895
1953	9,660,281	80	48	94,555,069	27,815,152	66,739,892	95,161,406	126,350,912
1954	8,513,865	63	40	106,223,833	29,135,673	77,088,160	94,887,953	123,594,282
1955	9,126,902	53	34	119,039,285	30,696,044	88,343,241	114,142,703	142,391,009
1956	8,827,037	70	40	125,043,590	31,933,681	93,110,262	120,889,292	149,331,373
1957	7,282,436	59	40	95,644,930	30,273,900	65,370,185	97,945,232	125,272,668
1958	6,402,198	57	28	83,023,111	28,068,396	54,955,069	80,826,443	104,093,241
1959	6,990,985	60	44	92,287,277	27,079,911	65,208,728	82,209,495	104,867,557
1960	8,242,703	67	31	114,852,061	29,505,158	85,346,903	98,902,362	130,196,595
1961	8,392,161	59	39	112,488,918	30,304,050	82,184,868	96,649,609	128,465,488
1962	11,212,106	64	45	137,759,188	34,274,698	103,484,490	119,103,045	159,530,089
1963	11,893,594	65	36	139,881,792	34,008,151	105,873,641	128,721,353	172,716,557
1964	**12,523,636**	**68**	**42**	**169,503,670**	**39,516,641**	**129,987,029**	**136,659,990**	**180,870,817**

[1] Gross value calculated by valuing gold, silver, copper, lead, zinc, mercury (1938–44, 1955), and nickel (1936–37, 1958–63) at yearly average prices, and iron (1901–03, 1907, 1918–23, 1928, 1948–63) and tungsten (1939–45, 1947–58) at values given by operators.

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

[3] Data not collected before 1937.

[4] 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."

Table XIV.—Lode-metal Production in 1964

Property or Operator	Location of Mine	Owner or Agent	Ore Shipped or Treated	Product Shipped	Gross Metal Contents: Gold	Silver	Copper	Lead	Zinc	Cadmium
Northern British Columbia			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Atlin Mining Division										
Nil										
Liard Mining Division										
Nil										
Central British Columbia										
Cariboo Mining Division										
Aurum	Wells	The Cariboo Gold Quartz Mining Co. Ltd., Vancouver	29,630	Bullion	19,867	3,816				
Clinton Mining Division										
Nil										
Omineca Mining Division										
Cronin	Smithers	New Cronin Babine Mines Ltd., Vancouver	500	Lead concentrates, 45 tons; zinc concentrates, 79 tons	8	5,473		60,957	91,696	1,049
French Peak	Smithers	S. Homenuke, Smithers	2	Crude ore		945		663	77	
Hudson Bay Mountain Silver	Smithers	Hudson Bay Mountain Silver Mines Ltd., Vancouver	1	Crude ore		104		1,461	157	
Coast and Islands										
Alberni Mining Division										
Brynnor	Kennedy Lake	Brynnor Mines Ltd., Vancouver	1,017,343	Iron concentrates, 753,732 tons						
Fandora	Tofino	New Hamil Silver Lead Mines Ltd., Vancouver	930	Concentrates	734	103	19	22		
F.L.	Zeballos	Zeballos Iron Mines Ltd., Vancouver	127,259	Iron concentrates, 92,727 tons						

			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Nanaimo Mining Division										
Baron	Quadra Island	New Ainsworth Base Metals Ltd., Vancouver	371	Crude ore	......	82	11,106	......	......	......
Merry Widow and Kingfisher	Benson Lake	Empire Development Co. Ltd., Vancouver	......	Iron concentrates, 18,397 tons	......	......	......	......	......	......
Old Sport	Benson Lake	Coast Copper Co. Ltd., Port McNeill	306,132	Copper concentrates, 20,529 tons; iron concentrates, 58,045 tons	12,191	31,328	11,868,309	......	......	......
Texada	Texada Island	Texada Mines Ltd., Vancouver	1,013,488	Iron concentrates, 576,962 tons; copper concentrates, 5,441 tons	1,477	32,424	2,369,067	......	......	......
New Westminster Mining Division										
Pride of Emory	Choate	Giant Mascot Mines Ltd., Vancouver	319,801	Nickel - copper concentrates, 19,100 tons; nickel content, 3,862,000 lb.	......	......	1,952,000	......	......	......
Skeena Mining Division										
Harriet Harbour	Jedway	Jedway Iron Ore Ltd., Vancouver	695,120	Iron concentrates, 429,239 tons	......	......	......	......	......	......
Silbak Premier	Premier	Silbak Premier Mines Ltd., Vancouver	2,712	Crude ore and precipitates, 14 tons	1,941	39,038	......	......	......	......
Vancouver Mining Division										
Britannia	Britannia Beach	The Anaconda Co. (Canada) Ltd., Britannia Beach	444,757	Copper concentrates and precipitates, 19,356 tons; zinc concentrates, 3,516 tons; tailings, 47,076 tons	8,854	45,249	11,983,236	114,217	4,236,654	20,984
Victoria Mining Division										
Lenora	Duncan	Mt. Sicker Mines Ltd.	167	Crude ore	17	378	......	10,158	......	......
SOUTH CENTRAL BRITISH COLUMBIA										
Greenwood Mining Division										
Albion	Paulson	Albion Mining Co. Ltd., Castlegar	25	Crude ore	7	23	......	50	50	......
Highland-Bell	Beaverdell	Mastodon-Highland Bell Mines Ltd., Vancouver	25,090	Lead concentrates, 1,578 tons; zinc concentrates, 573 tons; jig concentrates, 370 tons	491	809,819	......	605,154	764,025	5,600
Phoenix	Greenwood	The Granby Mining Co. Ltd., Phoenix Copper Division, Vancouver	686,267	Copper concentrates, 15,740 tons	12,835	79,863	7,634,599	......	......	......
Skomac	Rock Creek	Skomac Mines Ltd., Toronto	530	Crude ore	16	1,831	......	17,774	9,006	......
Kamloops Mining Division										
Bethlehem[1]	Ashcroft	Bethlehem Copper Corporation Ltd., Vancouver	1,379,429	Copper concentrates, 30,393 tons; molybdenite, 40 tons	3,654	141,047	25,643,219	......	......	......

[1] Reported for 1963 for fiscal year, 1963 calendar year ore treated: 1,046,901 tons; copper concentrates, 24,817 tons; gold, 2,346 oz.; silver, 89,599 oz.; copper, 19,578,739 lb.

Table XIV.—Lode-metal Production in 1964—*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
SOUTH CENTRAL BRITISH COLUMBIA—*Continued*			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Lillooet Mining Division										
Bralorne	Bridge River	Bralorne Pioneer Mines Ltd., Vancouver	153,080	Bullion	73,848	14,022	—	—	—	—
Silver Wing	Lillooet	W. P. Watson, Vancouver	30	Crude ore	—	676	302	—	—	—
Silverquick	Tyaughton Creek	Silverquick Development Co. (B.C.) Ltd., Vancouver	300	Mercury, 5,548 lb.	—	—	—	—	—	—
Nicola Mining Division										
Craigmont	Merritt	Craigmont Mines Ltd., Vancouver	1,839,058	Copper concentrates, 95,200 tons	—	—	55,167,450	—	—	—
Osoyoos Mining Division										
Susie	Oliver	K. G. Ewers, Okanagan Falls	1,211	Crude ore	126	2,475	—	4,436	2,540	—
Similkameen Mining Division										
Red Star	Princeton	Hendrickson and Hopkins, Princeton	28	Crude ore	1	74	4,632	—	—	—
Vernon Mining Division										
Nil	—	—	—	—	—	—	—	—	—	—
SOUTHEASTERN BRITISH COLUMBIA										
Fort Steele Mining Division										
Humbolt	Crawford Bay	D. J. Fulton, Cranbrook	6	Crude ore	—	126	—	3,679	1,731	—
Sullivan	Kimberley	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	2,722,775	Lead concentrates, 131,538 tons; zinc concentrates, 276,887 tons; zinc middlings, 4,470 tons; tin concentrates, 303 tons; iron sinter, 73,460 tons	325	2,897,873	578,800	212,342,800	272,830,400	740,959
Golden Mining Division										
Mineral King	Toby Creek	Sheep Creek Mines Ltd., Nelson	183,971	Lead concentrates, 3,467 tons; zinc concentrates, 12,019 tons	—	90,822	72,592	4,546,620	13,442,205	51,250

			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Nelson Mining Division										
Gold Belt	Salmo	A. Endersby, Fruitvale	115	Crude ore	67	41	—	305	305	—
H.B.	Salmo	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	477,800	Lead concentrates, 5,588 tons; zinc concentrates, 37,915 tons	—	68,017	—	6,294,600	41,881,400	344,035
Holmes	Taghum	W. L. H. Holmes, Nelson	107	Crude ore	1	139	—	2,569	6,619	—
Jersey	Salmo	Canadian Exploration Ltd., Vancouver	407,062	Lead concentrates, 7,119 tons; zinc concentrates, 22,223 tons	—	33,875	—	11,427,766	26,548,598	223,477
Kootenay Belle	Salmo	M. Arishenkoff, Trail	6,098	Crude ore	301	745	—	12,663	12,971	—
New Arlington	Erie	G. D. Fox, Trail	4,168	Siliceous ore	548	1,869	—	30,227	51,579	—
Queen	Salmo	A. Endersby, Fruitvale	42	Crude ore	26	13	—	423	85	—
Reeves MacDonald	Remac	Reeves MacDonald Mines Ltd., Vancouver	397,269	Lead concentrates, 6,019 tons; zinc concentrates, 23,514 tons	—	38,850	—	7,942,006	25,916,576	159,487
Revelstoke Mining Division										
Nil	—	—	—	—	—	—	—	—	—	—
Slocan Mining Division										
Anna	Slocan	Silver King Mines Ltd., Slocan	3	Siliceous ore	—	243	—	68	125	—
Antoine	Kaslo	L. N. Garland, Kaslo	9	Crude ore	—	1,180	—	6,669	4,546	—
Arlington	Slocan	Arlington Silver Mines Ltd., Vancouver	123	Crude ore	—	548	—	1,721	1,475	—
Black Diamond	Ainsworth	T. Lane, Ainsworth	6	Crude ore	—	311	—	3,041	814	—
Bluebell	Riondel	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	257,871	Lead concentrates, 14,629 tons; zinc concentrates, 28,016 tons	—	324,023	355,600	22,158,400	28,429,800	130,049
Cork Province	Kaslo	London Pride Silver Mines Ltd., Vancouver	5,432	Lead concentrates, 171 tons; zinc concentrates, 526 tons	4	8,981	—	234,361	567,524	4,901
Deadman	Sandon	L. Fried, New Denver	9	Crude ore	—	507	—	4,856	2,614	—
Elna	Kaslo	W. Turley, Nelson	—	Zinc concentrates, 6 tons	—	55	—	1,040	4,165	33
Freddy Fraction	Silverton	V. C. Hanson and H. Lyon, New Denver	16	Crude ore	2	994	—	197	131	—
Galena Farm	Silverton	F. Mills, Silverton	126	Lead concentrates, 1 ton; zinc concentrates, 24 tons	—	594	—	1,919	26,379	198
Hecla	Silverton	Johnsby Mines Ltd., Silverton, and lessees	3,046	Lead concentrates, 131 tons; zinc concentrates, 149 tons; crude ore, 5 tons	5	38,315	—	163,146	168,462	1,362
Hewitt	Silverton	F. Pho and J. Kelly, New Denver	1,372	Lead concentrates, 90 tons; zinc concentrates, 130 tons	6	35,374	—	105,100	155,878	1,601
Idaho	Three Forks	M. Tarnowski and J. A. Nesbitt, Silverton	3	Crude ore	—	228	—	2,589	647	—
Krao	Ainsworth	T. Lane, Ainsworth	45	Crude ore	—	287	—	8,028	7,482	—
Meteor	Slocan	Cultus Exploration Ltd., Edmonton, Alta.	1,890	Gold-silver concentrates, 38 tons	61	12,549	—	948	1,004	—

TABLE XIV.—LODE-METAL PRODUCTION IN 1964—*Continued*

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
			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
SOUTHEASTERN BRITISH COLUMBIA—*Continued*										
Slocan Mining Division—Continued										
Ottawa	Slocan	Ottawa Silver Mines Ltd., Spokane, Wash.	6,400	Silver concentrates, 41 tons	5	51,003	—	3,130	1,071	—
Richard First	Deanshaven	W. Turley, Nelson	32	Crude ore	—	73	—	6,427	6,173	—
Shady M.C.	Sandon	N. Sibilleau, Rossland	9	Crude ore	—	655	—	11,923	572	—
Sharon Group	Ainsworth	T. D. Logan, Nelson	3	Crude ore	—	31	—	1,540	146	—
Silversmith	Sandon	E. Perepolkin and L. Irwin, Hills	465	Lead concentrates, 30 tons; zinc concentrates, 49 tons; crude ore, 10 tons	2	3,923	—	40,143	58,577	386
Slocan Star	Sandon	L. Fried and E. De Rosa, New Denver	60	Lead concentrates, 3 tons; zinc concentrates, 17 tons; crude ore, 7 tons	—	830	—	7,994	21,269	136
Utica	Kaslo	Lamint Mining Corporation Ltd., Kaslo	1,590	Lead concentrates, 39 tons; zinc concentrates, 120 tons	6	12,104	—	29,589	133,932	800
Victor	Sandon	L. Fried and E. De Rosa, New Denver; J. Stewart and E. Anderson, New Denver	541	Lead concentrates, 57 tons; zinc concentrates, 102 tons; crude ore, 29 tons	13	17,958	—	121,025	122,423	776
Washington	Sandon	Larch Mining Ltd., Vancouver	40	Zinc concentrates, 2 tons	—	50	—	104	2,661	21
White Hope	Slocan	Western Standard Silver Mines Ltd., Slocan	18	Crude ore	—	163	—	72	36	—
Trail Creek Mining Division										
I.X.L.	Rossland	J. A. Ruelle and Associates, Rossland	0.11	High-grade ore	57	7	—	—	—	—
Sunset	Paterson	W. Crowe, Trail	7	Crude ore	—	80	—	993	3,341	—
Velvet	Rossland	Mid-West Mines Ltd., Vancouver, and L. J. Penny, Vernon	1,736	Copper concentrates, 35 tons; clean-up	39	272	15,769	59	20	—
W.D.	Trail	Columbia River Mines Ltd., Vancouver	110	Crude ore	71	22	—	220	220	—

TABLE XV.—LODE-METAL OPERATIONS, EMPLOYMENT DURING 1964[1]

Name of Mine or Operator	Days Operating		Tons		Average Number Employed	
	Mine	Mill	Mined	Milled	Mine	Mill
Shipping Mines						
Bethlehem Copper Corp. Ltd. (including Floods Mining and Aggregate Co.)	251	366	1,379,429	1,379,429	161	57
Bluebell (Cons. M. & S. Co. of Canada Ltd.)	366	366	257,871	257,871	207	15
Bralorne Pioneer Mines Ltd.	255	325	153,115	153,080	344	38
Britannia (The Anaconda Co. (Canada) Ltd.)	174	174	443,264	444,757	270	22
Brynnor Mines Ltd.	306	360	1,191,050	1,017,343	140	23
Canadian Exploration Ltd. (Jersey)	366	366	407,062	407,062	206	11
Cariboo Gold Quartz Mining Co. Ltd.	366	366	31,635	31,635	118	11
Coast Copper Co. Ltd.	366	366	306,132	306,132	218	10
Craigmont Mines Ltd. (including Pooley Bros.)	358	358	1,815,477	1,839,058	417	188
Empire Development Co. Ltd.	......	......	......	......	28	......
Giant Mascot Mines Ltd. (Pride of Emory)	366	366	319,801	319,801	136	20
Granby Mining Co. Ltd. (Phoenix)	265	366	681,179	686,267	92	18
H.B. (Cons. M. & S. Co. of Canada Ltd.)	255	363	477,800	477,800	101	19
Jedway Iron Ore Ltd.	366	366	693,907	695,120	85	65
Mastodon-Highland Bell Mines Ltd.	245	300	25,090	25,090	36	8
Mineral King (Sheep Creek Mines Ltd.)	308	360	183,971	183,971	87	12
Reeves MacDonald Mines Ltd.	250	346	402,632	397,269	102	17
Sullivan (Cons. M. & S. Co. of Canada Ltd.)	254	258	2,722,775	2,722,775	769	227
Texada Mines Ltd.	366	366	1,006,563	1,013,488	251	26
Zeballos Iron Mines Ltd.	81	127	102,566	127,259	1	40
Other mines	......	......	......	......	29	1
Development and Exploration[2]						
Anaconda American Brass	......	......	......	......	15	......
Canex Aerial Exploration Ltd.	......	......	......	......	62	......
Cons. M. & S. Co. of Canada Ltd.	......	......	......	......	25	......
Falconbridge Nickel Mines Ltd.	......	......	......	......	36	......
Giant Mascot Mines Ltd.	......	......	......	......	16	......
Granduc Mines Ltd.	......	......	......	......	52	......
Gunnex Ltd.	......	......	......	......	11	......
Newconex Canadian Exploration Ltd.	......	......	......	......	10	......
Newmont Mining Corp. of Canada Ltd.	......	......	......	......	14	......
Noranda Exploration Co. Ltd.	......	......	......	......	39	......
Noranda Mines Ltd. (Boss Mountain)	......	......	......	......	116	......
Phelps Dodge Corp. of Canada Ltd.	......	......	......	......	12	......
Silver Standard Mines Ltd.	......	......	......	......	13	......
Southwest Potash Corp.	......	......	......	......	39	......
Stikine Copper Ltd.	......	......	......	......	43	......
Sunshine Mining Co.	......	......	......	......	15	......
Western Mines Ltd.	......	......	......	......	62	......
Other companies	......	......	......	......	192	......

[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] May not include employees of contractors doing diamond drilling and other work.

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.

Gold Commissioners, Mining Recorders, and Sub-Mining Recorders, whose duties are laid down in the *Mineral Act* and *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 101, 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 59.

Central Records Offices (Victoria and Vancouver)

Transcripts of all recordings 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 101, 739 West Hastings Street. The approximate position of mineral claims held by record and of placer-mining leases are plotted from details supplied by locators. Late in 1963 a start was made toward converting the plotting of claims and leases to a map scheme based on the National Topographic system. This will result, ultimately, in the Province being completely covered with maps of the same scale (40 chains to 1 inch approximately) rather than a confusion of scales necessitated by maps based on the Lands Service branch of the Department of Lands, Forests, and Water Resources reference and mineral reference maps. It is expected the transition to the National Topographic system will occupy about two years' time.

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	D. P. Lancaster	D. P. Lancaster.
Cariboo	Quesnel	F. E. P. Hughes	F. E. P. Hughes.
Clinton	Clinton	R. H. Archibald	R. H. Archibald.
Fort Steele	Cranbrook	E. L. Hedley	E. L. Hedley.
Golden	Golden	W. G. Mundell	W. G. Mundell.
Greenwood	Grand Forks	R. Macgregor	R. Macgregor.
Kamloops	Kamloops	F. J. Sell	F. J. Sell.
Liard	Victoria	R. H. McCrimmon.	
Lillooet	Lillooet	B. J. H. Ryley	B. J. H. Ryley.
Nanaimo	Nanaimo	E. B. Offin	E. B. Offin.
Nelson	Nelson	G. L. Brodie	G. L. Brodie.
New Westminster	New Westminster	J. F. McDonald	E. W. Pedersen.
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	D. V. Drew	D. V. Drew.
Similkameen	Princeton	B. Kennelly	B. Kennelly.
Skeena	Prince Rupert	T. H. W. Harding	T. H. W. Harding.
Slocan	Kaslo	T. P. McKinnon	T. P. McKinnon.
Trail Creek	Rossland	W. L. Draper	W. L. Draper.
Vancouver	Vancouver	J. Egdell	Mrs. S. Jeannotte (Deputy).
Vernon	Vernon	W. T. McGruder	W. T. McGruder.
Victoria	Victoria	R. H. McCrimmon	E. J. Bowles.

Gold Commissioners' and Mining Recorders' Office Statistics, 1964

Mining Division	Free Miners' Certificates: Individual	Free Miners' Certificates: Company	Lode-mining: Mineral Claims	Lode-mining: Certificates of Work	Lode-mining: Cash in Lieu	Lode-mining: Certificates of Improvements	Lode-mining: Bills of Sale, etc.	Lode-mining: Leases	Placer-mining: Placer Claims	Placer-mining: Leases	Placer-mining: Certificates of Work	Placer-mining: Cash in Lieu	Placer-mining: Bills of Sale, etc.	Revenue: Free Miners' Certificates	Revenue: Mining Receipts	Revenue: Total
Alberni	118	1	743	1,075	$4,724.00	.....	80	4	1	1	10	.....	.....	$716.00	$14,543.75	$15,259.75
Atlin	123	2	819	534	7,544.00	.....	63	.....	1	.....	50	.....	7	765.00	17,598.75	18,363.75
Cariboo	793	16	2,563	794	1,900.00	.....	65	.....	2	40	484	$2,000.00	62	6,325.00	36,783.00	43,108.00
Clinton	102	.....	431	382	1,600.00	.....	19	.....	.....	14	2	.....	54	510.00	5,658.75	6,168.75
Fort Steele	210	3	487	299	800.00	.....	32	1	.....	34	31	500.00	20	1,460.00	8,092.25	9,552.25
Golden	124	1	287	411	1,972.00	.....	15	5	.....	2	.....	.....	.....	716.00	6,820.75	7,536.75
Greenwood	154	4	1,723	526	1,100.00	.....	77	49	.....	10	10	.....	.....	1,371.00	19,756.25	21,127.25
Kamloops	312	6	3,543	4,068	5,600.00	.....	229	5	.....	8	11	.....	3	2,562.00	42,545.25	45,107.25
Liard	247	2	4,009	3,409	4,360.00	.....	126	.....	.....	9	39	750.00	15	1,651.00	43,462.50	45,113.50
Lillooet	165	4	945	692	300.00	.....	112	5	.....	12	31	250.00	18	1,427.00	13,413.50	14,840.50
Nanaimo	164	2	490	1,935	7,000.00	.....	152	.....	.....	.....	3	.....	.....	1,020.00	16,812.50	17,832.50
Nelson	347	10	367	288	1,000.00	.....	35	13	.....	5	13	.....	4	3,350.00	6,795.50	10,145.50
New Westminster	394	8	909	788	6,300.00	.....	376	1	4	9	19	750.00	1	2,975.00	17,278.75	20,253.75
Nicola	107	1	1,445	2,370	2,100.00	.....	100	.....	.....	.....	.....	.....	.....	736.00	21,109.50	21,845.50
Omineca	417	3	4,403	6,050	14,000.00	13	286	20	1	37	124	250.00	99	2,379.00	82,309.80	84,688.80
Osoyoos	178	3	630	310	1,100.00	.....	39	4	.....	.....	.....	.....	.....	1,297.00	6,678.75	7,975.75
Revelstoke	80	2	424	766	4,000.00	.....	32	6	.....	5	37	.....	9	800.00	13,551.75	14,351.75
Similkameen	124	3	379	624	3,800.00	.....	68	9	.....	28	57	750.00	61	870.00	14,418.50	15,288.50
Skeena	158	2	1,737	4,074	18,556.00	.....	214	19	.....	2	6	.....	.....	1,095.00	49,279.00	50,374.00
Slocan	245	4	596	583	3,340.00	.....	81	24	.....	.....	.....	.....	.....	1,680.00	13,772.25	15,452.25
Trail Creek	120	2	413	272	100.00	.....	24	13	.....	.....	.....	.....	.....	1,000.00	5,066.25	6,066.25
Vancouver	1,972	310	569	817	4,500.00	.....	31	8	.....	.....	.....	.....	3	52,380.00	18,414.50	70,794.50
Vernon	212	4	311	330	100.00	.....	36	3	11	7	9	.....	3	1,513.00	4,527.00	6,040.00
Victoria	331	38	1,021	650	800.00	.....	53	3	.....	8	4	.....	1	7,345.00	8,823.90	16,168.90
Totals for 1964	7,197	431	29,244	32,047	$96,596.00	13	2,345	192	20	231	940	$5,250.00	360	$95,943.00	$487,512.70	$583,455.70
Totals for 1963	6,875	453	25,160	24,648	$62,080.00	4	2,194	150	12	353	860	$10,100.00	314	$68,965.00	$297,175.38	$366,140.38

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 and Petroleum Resources, 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 and Petroleum Resources, 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.

Coal Revenue, 1964

Licences—		
Fees	$650.00	
Rental	4,617.95	
		$5,267.95
Leases—		
Fees	———	
Rental	$94.50	
Cash in lieu	———	
		94.50
		$5,362.45

At the end of 1964, 34,727,862 acres, or approximately 54,262 square miles, of Crown petroleum and natural-gas rights, issued pursuant to the *Petroleum and Natural Gas Act*, were held in good standing. This acreage, held by operators ranging from small independent companies to major international ones, comprised:—

	Acreage
302 permits	22,417,836
1 natural-gas licence	9,669
19 drilling reservations	451,998
3,716 leases (all types)	11,848,359
	34,727,862

Petroleum and Natural-gas Revenue, 1964

Rentals and fees—		
Permits	$1,302,305	
Drilling reservations	64,800	
Natural-gas licences	———	
Petroleum, natural-gas, and petroleum and natural-gas leases	7,077,488	
Total rentals and fees		$8,444,593

Petroleum and Natural-gas Revenue, 1964—Continued

Sales of Crown reserves—		
Permits	$721,193	
Drilling reservations	1,541,685	
Leases	10,830,994	
Total Crown reserve sales		$13,093,872
Royalties—		
Gas	$1,583,292	
Oil	3,502,222	
Processed products	104,990	
Total royalties		$5,190,504
Miscellaneous fees		26,851
Total petroleum and natural-gas revenues		$26,755,820

ANALYTICAL AND ASSAY BRANCH

By S. W. Metcalfe, Chief Analyst and Assayer

Rock Samples

During 1964 the chemical laboratory in Victoria issued reports on 2,397 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)	1,995	1,977	5,160
Prospectors (grantees)	186	184	459
Departmental engineers	216	98	580
Totals	2,397	2,259	6,199

Samples submitted to the laboratory for identification are examined by the Mineralogical Branch of the Department. During the year 84 such samples were examined.

Petroleum and Natural-gas Samples

Reports were issued on 21 samples. Of this number, seven were samples of formation waters from wells being drilled for gas and oil in the Province, one was a sample of natural gas, one was a sample from a suspected oil seep, and one was a crude oil for specific gravity determination. Finally, a black material in 11 rock samples was examined by X-ray and found to be amorphous carbon.

* 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.

Coal Samples

Reports were issued on 35 samples of coal submitted by the Purchasing Commission, etc.

Miscellaneous Samples

Reports were issued on 341 samples of a miscellaneous nature. One hundred and fifty-six assays and 11 spectrographic analyses were reported in this category.

For the Purchasing Commission, spectrographic analyses were performed on three steel reinforcing rods.

For the Department of Agriculture, 11 samples of animal forage were analysed for copper, manganese, phosphorus, molybdenum, and sulphur; one marl sample and a calcareous waste product from a pulp-mill were also analysed.

For the Department of Highways, Materials Testing Branch, four materials used in the manufacture of concrete were spectrographed; three clay samples were analysed for sodium and calcium, and one for sodium alone; one crust from a tunnel was identified as calcium carbonate; a partial analysis was conducted upon a water sample, and the content of organic material in another water sample was determined; finally, a white material in a rock sample was identified as the hemihydrate of calcium sulphate (plaster of Paris).

For the Department of Mines and Petroleum Resources, for the Inspection Branch, four samples of diesel exhaust gas were analysed for oxides of nitrogen and two for aldehydes; elements in trace amounts were determined in two water samples, and two other water samples were examined for the presence of cyanide; finally, a proximate coal analysis was performed on a coal sample. For the Petroleum and Natural Gas Branch, a rock sample was analysed for its phosphorous pentoxide content.

For the Department of Lands, Forests, and Water Resources, Water Resources Service, four samples of water from the Nakusp Hot Springs were analysed, and partial analyses were performed on three other water samples.

For the City of Victoria, for smoke inspection, determination was made of the weight of residue collected in 285 bottles of water placed in various open locations in the city; for the city engineers' department, determination of specific gravity was made on four water samples.

For citizens of the Province, proximate analyses were performed on three coal samples, and a coal ash was examined for the presence of germanium; a sample of gypsum was analysed for sulphur, and a sample of limestone was analysed for lime and magnesia, these latter two samples having been referred to us by the Department of Agriculture.

X-ray Powder Diffraction Analyses

Sixty-five analyses of this type were performed for identification purposes.

Examination for Assayers

Two Provincial Government examinations for certificates of efficiency were held at Trail in May and December. In the May examination, eight candidates were granted licences to practise assaying in the Province, one was granted a supplemental in fire assaying, and one a supplemental in wet assaying. In the December examination, four candidates were granted licences to practise assaying, one was granted a supplemental in wet assaying, and one failed the entire examination.

INSPECTION BRANCH

Organization and Staff

Inspectors and Resident Engineers

J. W. Peck, Chief Inspector	Victoria
Robert B. Bonar, Deputy Chief Inspector of Mines	Victoria
L. Wardman, Senior Electrical Inspector of Mines	Victoria
E. R. Hughes, Senior Inspector of Mines	Victoria
R. J. Craig, Senior Inspector of Mines, Silicosis Control	Vancouver
S. Elias, Inspector, Silicosis Control	Vancouver
J. E. Merrett, Inspector and Resident Engineer	Vancouver
A. R. C. James, Inspector and Resident Engineer	Vancouver
D. R. Morgan, Inspector and Resident Engineer	Cranbrook
David Smith, Inspector and Resident Engineer	Kamloops
W. C. Robinson, Inspector and Resident Engineer	Kamloops
Harry Bapty, Inspector and Resident Engineer	Prince Rupert
P. E. Olson, Inspector and Resident Engineer	Nelson

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. The Silicosis Control Inspectors make dust and ventilation surveys at all mines and quarries. E. R. Hughes supervised the Department's roads and trails programme and prospectors' grub-stakes.

Instructors, Mine-rescue Stations

Arthur Williams	Fernie Station
W. H. Childress	Nanaimo Station
T. H. Robertson	Kamloops Station
G. J. Lee	Nelson Station

Staff Changes

There were no staff changes during 1964.

Board of Examiners for Coal-mine Officials

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

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 60 days between regular examinations.

Board of Examiners for Shiftbosses (Metalliferous Mines)

Robert B. Bonar, Chairman	Victoria
A. R. C. James, Member	Vancouver
J. E. Merrett, Member	Vancouver

The Board conducts written examinations in various mining centres for applicants for underground shiftboss certificates. The Board is also empowered to grant provisional certificates without examination under such conditions as the Board considers necessary.

MINERALOGICAL BRANCH

Field work by officers of the Mineralogical Branch includes geological mapping and examinations 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 Petroleum Resources and partly in a series of bulletins. Since March, 1964, a charge has been made for Annual Reports and 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 31, 1964, the professional staff included the following geologists, all stationed at Victoria:—

H. Sargent	Chief of the Branch
M. S. Hedley	Senior Geologist
Stuart S. Holland	Geologist
J. W. McCammon	Geologist
N. D. McKechnie	Geologist
G. E. P. Eastwood	Geologist
James T. Fyles	Geologist
A. Sutherland Brown	Geologist
J. M. Carr	Geologist
W. G. Jeffery	Geologist
A. F. Shepherd	Geologist
J. E. Hughes	Geologist
E. W. Grove	Geologist
N. C. Carter	Geologist

N. C. Carter joined the staff as geologist on March 1, 1964. R. V. Kirkham was employed for the field season, and in the autumn he returned to the University of Wisconsin to continue postgraduate studies in geology. N. Haimila, a postgraduate student in geology at Michigan State University, was employed for the field season under the general supervision of W. G. Jeffery. H. E. O. Neugebauer, a postgraduate student at the University of Oregon, was employed for the field season under the general supervision of N. D. McKechnie.

Technical editing of the Annual Report of the Minister of Mines and Petroleum Resources and of other publications was directed by M. S. Hedley. Copy for printing was prepared by and under the direction of 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, 1964 Season

A. Sutherland Brown made a reconnaissance geological study in the Port San Juan-Cowichan Lake area. He also made geological studies and property examinations at Britannia, Texada Mines, and at Skidegate Inlet, Jedway, Skonun Point, and Tasu, in the Queen Charlotte Islands.

J. M. Carr studied molybdenum deposits at Bone Lake, Whiting Creek, Huckleberry Mountain, and Endako, in the central Interior. The Endako project involved extensive studies on the surface and underground, including the examination of a representative series of diamond-drill holes. He also made property examinations in the Princeton-Merritt-Highland Valley-Spences Bridge area.

N. C. Carter made geological studies in the Alice Arm area, including a detailed study of the Lime Creek stock and associated molybdenum deposit, a less detailed study of the Lime Creek-Roundy Creek area, and property examinations in those sections, at the Tidewater molybdenum property, and silver properties on the upper Kitsault River.

G. E. P. Eastwood made detailed geological studies in the Giant Mascot nickel mine at Choate, and underground and surface studies at the Boss Mountain molybdenum mine.

James T. Fyles completed detailed mapping and studies of the structural features of the Ainsworth-Kaslo area, and began a study of the mineralized area at the Mount Copeland (King Fissure) property as a preliminary phase of a detailed study in the Jordan River area northwest of Revelstoke. Dr. Fyles also made examinations at the Big Ledge and Teddy Glacier properties.

E. W. Grove began working in the Stewart area. His work included geological mapping from Stewart to the Bell-Irving River, along the Stewart–Cassiar road, detailed geological mapping of the surface and some underground mapping at the Silbak-Premier mine, and of the area between Bear Ridge and the Salmon Glacier, from Stewart northerly toward Mitre Mountain.

M. S. Hedley made preliminary inspections of proposed dam-sites along the Grand Canyon of the Stikine River, and visited properties in the Stikine, Stewart, and Kootenay areas.

W. G. Jeffery, with a senior assistant and two junior assistants, completed geological mapping of an area west of Buttle Lake and extending south to the head of Great Central Lake, on Vancouver Island. Moderate use of a helicopter was made for observation and in setting out fly camps.

J. W. McCammon completed mapping magnesite deposits at Marysville and Brisco, in the East Kootenay district. He also examined deposits of quartz, kyanite, talc, and dolomite, in selected areas, and a deposit of mercury near the Bridge River area.

N. D. McKechnie, with a senior assistant, mapped the Old Tom and Shoemaker Formations in an area north of Keremeos. Mr. McKechnie also made property examinations in the Aspen Grove area, and at Hedley, Peachland, upper Similkameen River, Greenwood, Mabel Lake, and Westwold.

R. V. Kirkham continued geological mapping at Hudson Bay Mountain (Smithers) and examined properties there and the molybdenum prospect at Mount Thomlinson.

Air-borne Magnetometer Mapping

As a project financed jointly by the Geological Survey of Canada and the British Columbia Department of Mines and Petroleum Resources, the contractor, Spartan Air Services Ltd., did the field work for the production of four maps covering adjoining sheets at Revelstoke. Each sheet covers a quarter degree of latitude by a quarter degree of longitude.

PETROLEUM AND NATURAL GAS BRANCH

The Petroleum and Natural Gas Branch is responsible for the administration of the Regulations Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas, and the Regulations Establishing Gas-Oil Ratio Adjustment Factors, Oil Production Allowables, and Overproduction and Underproduction, made pursuant to the *Petroleum and Natural Gas Act*.

The first named regulations provide 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.

The regulations concerning gas-oil ratio factors, production allowables, and overproduction and underproduction provide for conservation of reservoir energy by limiting the volume of oil that can be produced during any day, month, or year from a well or pool in accordance with the schedule of gas-oil ratio adjustment factors. The factors are applicable against oil production when the average volume of gas produced with each barrel of oil exceeds a specified level, and, when applied, result in reduction of the producing rate. Overproduction and underproduction are adjusted on a monthly basis.

Every well location must be approved by the Branch before the well is drilled. All operations related to drilling and production are inspected frequently to ensure compliance with the provision of all regulations, including such features as facilities and practices used, adequate plugging of abandoned wells, surface restoration of well-sites, well testing and measurement procedures employed, disposal of produced water, protection of installations against fire, and general conservation.

Investigations are made of complaints of property damage resulting from drilling and producing operations, and from geophysical work programmes.

Comprehensive records of all drilling and producing operations are maintained at Victoria and are made available for study, or are published, for the use and benefit of anyone interested in oil or gas development in British Columbia. Samples of bit cuttings, as well as all core, obtained from every well drilled in the Province are collected and retained at the field office located at Charlie Lake, where they may be studied by interested persons. Charlie Lake is adjacent to the Alaska Highway about 5 miles northwest of Fort St. John.

Detailed reservoir engineering and geological studies are conducted on the basis of technical information submitted to the Branch from operating companies, as well as information acquired through field work by Branch personnel. Estimates of the reserves of oil and natural gas are made twice a year, at the end of June and December. Crown-owned oil and natural-gas rights are evaluated prior to being disposed of by public tender.

Administration

The Petroleum and Natural Gas Branch is subdivided for administrative purposes into three sections. The sections and the supervisors are as follows: Reservoir Engineering, R. R. McLeod; Development Engineering, W. L. Ingram; and Geology, S. S. Cosburn.

The field office at Charlie Lake, which includes the core and sample laboratory, is supervised by the District Engineer, G. E. Blue.

Staff

Headquarters, Victoria

J. D. Lineham .... Chief of Branch
R. R. McLeod .... Senior Reservoir Engineer and member of the Board of Arbitration
K. C. Gilbart .... Reservoir Engineer

G. V. Rehwald	Reservoir Engineer
P. K. Huus	Reservoir Assistant
W. L. Ingram	Senior Development Engineer
M. B. Hamersley	Development Assistant
J. F. Tomczak	Statistician
S. S. Cosburn	Senior Petroleum Geologist
D. L. Griffin	Petroleum Geologist
H. B. Fulton	Petroleum Geologist
D. M. Callan	Petroleum Geologist

The headquarters staff includes also one geological draughtsman, one clerk-stenographer, three clerks, and three clerk-typists.

Field Office, Charlie Lake

G. E. Blue	District Engineer
D. L. Johnson	Field Engineer
M. A. Churchill	Field Technician
D. A. Selby	Field Technician
G. T. Mohler	Field Technician

The field staff includes also three core and sample laboratory assistants, one clerk-stenographer, and one clerk.

Staff Changes

H. B. Fulton, petroleum geologist, was transferred from the field office to headquarters, effective June 30th.

Board of Arbitration

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

The Board of Arbitration is responsible to the Minister of Mines and Petroleum Resources, and is established under the authority of the *Petroleum and Natural Gas Act*. The Board grants right of entry by oil and gas companies upon alienated land and determines conditions of entry and compensation therefor. It also terminates the right of entry when the company has ceased to use the land.

The Board held one hearing in 1964, at which the two applications, carried over from 1963, were heard and settled by Board awards. No further applications were received during the year.

Conservation Committee

Chairman: P. J. Mulcahy, Deputy Minister of Mines and Petroleum Resources. Members: N. D. McKechnie, geologist, Department of Mines and Petroleum Resources; M. H. A. Glover, economist, Department of Industrial Development, Trade, and Commerce.

The Conservation Committee is responsible to the Minister of Mines and Petroleum Resources, and was established originally on October 11, 1957, under the authority of the *Petroleum and Natural Gas Act*. Its duties are as follows:—

(1) To act as an advisory committee to the Minister on such questions of conservation that the Minister, in writing, shall refer to the Committee for consideration and recommendation.

(2) To deal with such questions of conservation and production in the various fields of British Columbia as may arise between two or more operators in the same field or between operators and the Branch when appeals on such questions are made to the Minister and referred by him to the Committee.

The Conservation Committee did not meet in 1964.

GRUB-STAKING PROSPECTORS

Under authority of the *Prospectors' Grub-stake Act* the Department has provided grub-stakes each year since 1943 to a limited number of applicants able to qualify. The normal maximum grub-stake is $300, with an additional amount up to $200 for travelling expenses. A limited number of experienced prospectors of proven ability may be granted top priority grub-stakes of as much as $400, plus a maximum of $300 for travelling expenses, where prospecting is to be done in approved areas where air transportation is necessary. Items such as guns, fishing-gear, stoves, boats, and outboard motors are not a legitimate charge against the grant and must be provided by the applicant. Costly items such as geophysical survey equipment, mineralights, Geiger counters, berylometers, packsack diamond drills, two-way radios, horses, and packsaddles are not expendable in any one season and cannot be accepted at full cost against the grant, but a reasonable rental charge may be considered.

To qualify at the present time, the Department requires that the applicant shall be a bona fide prospector holding a free miner's certificate. He must be a British subject, between the ages of 18 and 70 years, and must have resided in British Columbia during the year preceding the date of application. He must be able to identify common rocks and minerals. He should have bush experience and be physically and mentally fit. He must agree to abide by the regulations which the Department may make. The grub-staked prospector is provided with maps, a current list of prices of metals and ores, and the latest Departmental information circulars on prospecting and related matters.

It is required that in order to obtain the maximum grub-stake, he agree to spend at least 60 days actually prospecting in the area of his choice in British Columbia considered favourably by officers of the Department. If he prospects a lesser time, the grant will be reduced proportionately. The grub-stakes are not intended for week-end prospecting or for short trips from a home base. The grant is usually made in two payments: the first at the beginning of the season, and the second after he has completed 60 days in the field and has submitted a diary. 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. A field engineer is employed, who contacts as many prospectors as he is able during the field season and gives advice and direction to those who need it. Grantees are permitted a reasonable number of free assays.

The grub-stakes are granted with the object of maintaining the search for mineral occurrences with mine-making possibilities. The grants are not intended for the purpose of exploring and developing occurrences already found, but one year is allowed to prospect ground that has been staked by a grantee while on the grub-stake. No interest is retained by the Government in any discovery made by a grantee, other than that which applies in common with all free miners. Time is not allowed for prospecting on old properties which have had work done on them, unless mineral deposits of present economic importance have been discovered on them for the first time. Grub-stakes are not given for prospecting for placer deposits or gem stones. The grantee must not accept pay from other sources for services rendered during the period credited to the grub-stake.

It is recognized that competent and experienced prospectors are capable of looking after themselves in wilderness areas. Nevertheless, experience has shown that less hazard may result when prospecting is done by two or three men in a team. A man working alone may be injured or be taken seriously ill and, if alone, he may have to endure extreme hardship and pain.

Grub-stake grantees are not working for the Government but are self-employed and are not covered under the provisions of the *Workmen's Compensation Act.* Therefore, it is recommended that prospectors make their own arrangements concerning insurance coverage to provide for medical and other expenditures that may be incurred in the event of an accident.

The grants are intended only to assist grantees to go out and prospect and are not intended for the support of dependents. Therefore, applicants who are married and have dependents are required to give assurance that their dependents will be adequately provided for during the time the applicant is absent in the field.

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
1960	28,115	50	358	241
1961	29,175	47	309	325
1962	26,730	52	233	189
1963	29,000	50	150	843
1964	31,751	53	213	351

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

Sixty-five applications were received in 1964, and 53 grub-stakes were authorized. Three grantees were unable to go out, and their initial payments were returned. Grantees who were unable to complete the terms and conditions of the grant received only partial payment. Seventeen prospectors were given grants for the first time. Six grantees proved to be unsatisfactory. Several grantees used aircraft for transportation to their prospecting areas. Two grantees were taken ill and were unable to continue prospecting.

D. H. Rae interviewed applicants in Vancouver and contacted 30 grantees in the field and gave advice and direction to those who needed it. 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.

Alberni Mining Division.—Some prospecting was done in the Bedwell River area, close to Mount Tom Taylor, where minor mineralization was found near a granite-porphyry contact.

Atlin Mining Division.—In the Squaw Creek-Rainy Hollow area, close to the British Columbia-Yukon boundary, further work was done on a large mineralized zone showing much chalcopyrite. Claim holdings in this area have interested several mining companies. Prospecting was also done west of the Haines road between Miles 71 and 87 on several mineral zones exposed in the area. Nothing of value was reported.

Cariboo Mining Division.—Near Philip Lakes, in the northern part of the mining division, some prospecting was done. Fifteen miles southwest of Prince George, prospecting was carried on in an area underlain mainly by andesite and limestone. One carbonate zone was investigated, and a small talc deposit was found. In the Willow River district a small area underlain by granite was prospected at La Pier Creek, and another near Giscome. A base camp was established at an unnamed lake 40 miles southwest of Vanderhoof and field work was done in the area; outcroppings of pyritized granite were examined. In the Snowshoe Creek-Harveys Creek area, slate and wide barren quartz veins were found. Some inconclusive work was done near Moorehead Lake, near Keithley Creek, where considerable quartz in slate was found, and near Kersley. Nothing of interest resulted from work done near Cariboo Lake, Beaver Creek, or Upper Hat Creek.

Clinton Mining Division.—Some prospecting was done near Canim Lake, where the underlying rocks are diorite, limestone, and some volcanic rocks. A base camp was established on Bluff Lake near Tatla Lake, and considerable work was done about that and nearby lakes. At Tatlayoko Lake one barren-looking quartz vein was investigated. In the vicinity of Taseko Lake, metamorphic rocks, shear zones, and numerous dykes were seen. In the valley of the Tchaikazan River the geology was reported to be complex, but the prospecting possibilities were reported to be better than average.

Fort Steele Mining Division.—Some work was done along the United States boundary on Monk Creek and Priest River—rusty quartz in dolomite, and a wide quartz vein containing minor lead and silver were reported.

Greenwood Mining Division.—At the headwaters of Kerr Creek, prospecting was done in the Wallace Creek valley, in the Granby River area where chalcopyrite was found in limestone, and Porter Creek where a 4-foot-wide quartz vein mineralized with chalcopyrite and pyrite was found. In the McCarren Creek area nothing new was reported.

Kamloops Mining Division.—Some prospecting was done in areas adjacent to Charcoal and Chase Creeks. In the Fly Hills area, several quartz veins and pegmatite dykes were prospected, and low metal values were found. In the Clearwater River area, minor occurrences of barite and molybdenite were reported. Close to Wallenstein Lake, copper stain over a fairly wide area was investigated. A small amount of work was done around Mahood Lake and close to Star Lake. In the Louis Creek area, narrow quartz veins in volcanics were found to contain minor amounts of galena. Some rhodonite was found near Barriere, and in the Barriere River area a mineralized zone containing galena, pyrrhotite, and arsenopyrite was prospected; values were low. Prospecting was done on both sides of Adams Lake. On the east side, nearly opposite Agate Bay, some interesting mineralized zones were found above the 2,500-foot level; some barite was found on the east side of the lake 6 miles north of Agate Bay. On Johnson Creek, in an area underlain mainly by schists and breccia, small amounts of galena in quartz were found. Near the headwaters of Tshinakin Creek, narrow quartz veins in argillite were prospected. On the north side of lower Shuswap Lake above Celista, arsenopyrite was found associated with quartz veins.

Liard Mining Division.—Prospecting was done 30 miles below the headwaters of Turnagain River in the general vicinity of Wheaton Creek and on King Mountain. Small amounts of chromite and some veins of asbestos were found in serpentine.

Some work was done in the Cold Fish Lake area and at Nation Peak. Northwest of Nation Peak, some barite stringers were examined. In the Mink Creek area, claims were staked on a showing of barite and galena. In the Dalton Creek valley, the lower slopes showed limestone, quartzite, and pyritized tuff. Near Gnat Creek, green copper stain and minor amounts of bornite were found near a contact zone of granite and volcanics. Close to the Three Sisters Range, narrow discontinuous stringers of bornite were noted. At Tanzilla River, serpentine, limestone, and outcrops of volcanics were observed. The Pitman River area received some attention; small pieces of chalcopyrite float were found in several places, but the source of these was not discovered.

Some inconclusive work was done on showings of both asbestos and molybdenite within 15 miles of the Cassiar Asbestos mine. Some prospecting was done in other parts of the area, but nothing of interest was reported.

Base camps were established on Nuttlude and Kakiddi Lakes, and considerable prospecting was done there and on the Klastline Plateau. Some narrow stringers of bornite were found along the Klappan River.

Some work was done from a base camp on Boulder Creek, an area underlain by serpentine, and where some good jade boulders have been found. West of King Mountain, occurrences of serpentine and schist were noted; along Wheaton Creek, sedimentary rocks, serpentine, andesite, and slate showing numerous quartz stringers were reported; along Ferry Creek, andesite and some occurrences of bog iron. On King Mountain, serpentine containing narrow asbestos fibres was observed, and along Faulkner Creek, granite with abundant quartz.

A considerable amount of prospecting was done in flat and swampy country, with numerous lakes and streams, at the southern edge of the Kawdy Plateau west of the Tuya River. Some sulphide minerals were found on and close to Nuthinaw Mountain.

About 10 miles northeast of Tootsie Lake, some prospecting was done on a mineralized zone containing molybdenite, and a number of mineral claims were staked.

Lillooet Mining Division.—Prospecting was done on Sallus Creek south of Pavilion and Mount Bren and Riley Creek south of Lillooet. Outcrops of nephrite jade on Ama Creek in the lower Bridge River received some attention, as well as chalcopyrite in a breccia zone. A short distance below the mouth of the Yalakom River a gold-bearing shear zone was discovered and staked. Work was done on Moon, Applespring, Antoine, and Camoo Creeks.

Work in the Marshall Creek area north of the Bridge River extended from Liza Lake to Bighorn Creek. A little copper mineralization was found, and stringers of asbestos fibre were investigated. Disseminated chalcopyrite was seen at Spider Creek south of Shalalth.

A large deposit of dolomite above the village of Lillooet was investigated and staked. Barren quartz veins in porphyry were seen near Jesmond. Quartz float showing gold was found in the area of Black Dome Mountain.

Nanaimo Mining Division.—A considerable amount of intensive prospecting was done on Quadra Island, from Granite Bay on the west side to Open Bay on the east side, and including a large area inland from these localities. No commercial ore exposures were found, but the whole area is interesting from the point of view of prospecting.

Nelson Mining Division.—A fair amount of work was done in areas southeast and north of Creston, including Sanca Creek, Corn Creek north of Boundary Creek (pyritized granite and some kyanite outcrops were reported), Dodge Creek, Goat

River valley, and the junction of Goat and Cameron Creeks. Nothing of immediate importance was discovered.

New Westminster Mining Division.—An intensive programme of prospecting was carried out in the Ashloo Creek valley, both above and below the old gold-mine camp. Both conventional and geochemical methods of prospecting were employed. Similar work was done in the upper Pitt Lake area. Some interesting preliminary results of this work were obtained.

Prospecting was done north of Ioco, at Widgeon Lake, Alouette Lake, east of Stake Lake, and in the Kanaka Creek area.

A great deal of prospecting in the form of surface trenching and diamond drilling was done on an occurrence of sericite-talcose schist close to the railway bridge over Ruby Creek (a few miles north of Agassiz). Nothing of commercial importance was reported in the Mahood Creek valley and also at Dog Mountain near Hope.

Nicola Mining Division.—Some prospecting was done in the Coldwater River valley near Juliet in an area mainly underlain by granite. Nothing of importance was reported from these areas.

Omineca Mining Division.—Some work was done near the centre of the eastern side of Babine Lake, but no mineralization of interest was reported. Near Francois Lake an area underlain by Topley granite and other rocks was investigated. Considerable work was done between Chuchi Lake and Witch Lake, southwest of Witch Lake, and in the Jean Marie Creek area. Some work was done on a mineralized zone on Tchentlo Lake, where disseminated low-grade showings of molybdenite had been found. A great deal of prospecting was done fairly close to the Manson River about 20 miles south of Manson Creek, where fairly good mineralization of molybdenite and narrow quartz veing containing chalcopyrite had been discovered. Near Gillis Mountain, granodiorite and quartzite showing some molybdenite and galena were reported. Some mineralization was seen on Boulder Creek. These various mineral zones appear to warrant further prospecting.

At and near Manson Creek, work was done at Government Gulch, on a low-grade copper showing at Skeleton Gulch, galena-bearing quartz stringers at Skeleton Creek, a quartz vein with tetrahedrite at Slate Creek. Work was done to the east on Blackjack Mountain, Lost Creek, and Jackfish Creek.

West of Germanson Lake, work was done on upper Twenty Mile Creek, where stibnite was found in a major fault. At Twin Creek and Groundhog Creek, tributaries of Kwanika Creek, some copper mineralization was seen. A wide carbonate zone was reported at Wasi Lake, south of the Osilinka River.

On the south side of Tsayta Lake at the head of Nation River, some narrow asbestos veins were found in serpentine. On Klawli Creek north of Nation Lake, some molybdenite was found in a large quartz vein near a granite-slate contact.

From camps on Stuart Lake, work was done at several localities. Near Pam Lake very fine blebs of cinnabar were found in argillite, and at Mount Nielsp narrow stringers of asbestos were seen in amphibolite.

At the extreme south of the mining division, considerable work was done on a large mineralized zone lying at a high elevation above Tesla Lake; chalcopyrite, bornite, and malachite in commercial amounts are found in this zone, which may develop into something of importance.

A little work was done south and southeast of Vanderhoof and to the southwest in the Fawnie and Nechako Hills region.

From a base camp established by helicopter on the top of Mount Loring on the westerly side of Morice Lake, intensive prospecting was done on copper mineralization scattered over a wide area, and sufficiently strong in several sections to be of importance. Copper minerals include chalcopyrite, chalcocite, and bornite, and a great deal of malachite and azurite. This area warrants further intensive prospecting. Near Sweeney Lake small quartz veins mineralized with chalcopyrite were found in volcanic rocks; no commercial material was reported.

Osoyoos Mining Division.—In the Peachland Creek valley, some work was done on a mineralized zone showing minor amounts of chalcopyrite and molybdenite in an area underlain by argillite and tuff. On the south slope of Mount Kathleen, high-grade copper float was found, but the source was not located. Some work was done along Shuttleworth Creek and in the Trout Creek area, where low values in copper were found in quartz-diorite. On Apex Mountain, low values in molybdenite were found in quartz-diorite and low copper values in chert.

Similkameen Mining Division.—Some further work was done in the Princeton area on Badger, McNulty, Hines, and Red Creeks; some low values in copper and molybdenite were reported. In Olivine Creek valley, some lenses of magnetite in basic rocks were found.

A limited amount of work was done on Nickel Plate Mountain. Some work was done from the old Summit camp in the upper Tulameen River, but nothing of interest was reported.

Skeena Mining Division.—On Banks Island, pyritic quartz veins were investigated near Banks Lake and in Colby Bay. Float was found in Porcher Inlet, and quartz veins were seen on Prescott and Stephens Islands. Nothing of importance was reported from any of these findings.

Prospecting was done at Lime Creek in Alice Arm area on quartz veins giving commercial assays in silver, lead, and zinc. In the Olh Creek valley in Hastings Arm, barren wide quartz veins were investigated. Some work was done northwest of Terrace in the Star Creek area. At Mitchell Inlet on the Queen Charlotte Islands, gold-bearing quartz veins received some attention.

A little work was done in the upper Bella Coola River valley, where serpentine containing short narrow stringers of asbestos fibre were reported. Work was also done near Hagensborg in the Salloomt and Nusatsum River valleys, North Bentinck Arm, and at the head of South Bentinck Arm.

Slocan Mining Division.—A considerable amount of work was done within reach of Burton, within the valleys of Caribou, Tyee, Independence, Slewiskin, Ice, and Woden Creeks, and on Silver Mountain. Nothing of economic value was reported. Some inconclusive work was done in the upper reaches of the Duncan River.

Vancouver Mining Division.—A short time was spent in the Squamish River area and some prospecting was reported to have been done in the Clowhom Lake area, in the Mount Murchison area, and close to Mount Roderick; no information is available on the results of this. Two prospectors were flown in and landed on a glacier in the Mount Waddington area; supplies for the season were air-dropped nearby. An excellent report on the work done has been submitted.

Work extended from Scimitar Glacier, Remote and Bell Mountains, Dorothy Creek, Fank Peak, Mount Geddes, and Twist Creek to Calwell Creek. Nothing of definite commercial importance was reported, but much valuable information was submitted, including the occurrence of gossans, shears, and copper mineralization.

Vernon Mining Division.—Work was done 5 miles above the junction of McCauley and Harris Creeks, near Nicklen Lake and in the Vidler Creek valley.

Victoria Mining Division.—Some work was done on a quartz vein in the Sooke Lake area; no information was submitted.

MINING ROADS AND TRAILS

Provision is made in the *Department of Mines and Petroleum Resources Act* whereby the Minister may, with the approval of the Lieutenant-Governor in Council, authorize the expenditure of public funds for the construction or repair of roads and trails into mining areas. Assistance on a half-cost basis may also be provided on roads and trails to individual properties.

Requests for road and trail assistance must be made to the Department before the commencement of work. The type of access upon which assistance may be given depends upon the value of the property, the stage of development, and the amount of work to be done. A trail is sometimes sufficient for initial exploration, and a tractor-road may be adequate for preliminary work. Subsequent development might warrant assistance on the construction of a trunk road. A carefully drawn sketch or plan of the location of the road is required to be submitted and, where warranted by the amount of assistance requested, a report on the property by a professional geological or mining engineer may be required. An engineer from the Department may be required to report on the property before a grant is made and to inspect the road after the work has been done.

Total mileages and disbursements under "Grants in Aid of Mining Roads and Trails" during the fiscal year ended March 31, 1965, were as follows:—

	Miles	Cost
Mining roads and trails—		
Construction and reconstruction	123.6	$194,846.80
Maintenance	189.0	35,567.53
Bridges—Construction and reconstruction		10,307.50
Total		$240,721.83

In addition to the above, work was continued on the Stewart–Cassiar road. This road is being constructed under the Roads to Resources Agreement between Canada and British Columbia. The construction is supervised by the Department of Highways on behalf of the Department of Mines and Petroleum Resources. At the north end of the road the 40.12-mile section from Eddontenajon Lake to Burrage River is 99 per cent completed. At the south end of the road the 31.87-mile section between Strohn Lake and the lower crossing of the Bell-Irving River is 91 per cent completed. A contract was let in October for clearing and grubbing on the 38.1-mile section from the south to the north crossings of the Bell-Irving River.

MUSEUMS

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

Specimens from the collection in Victoria, accumulated in a period of more than 60 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 Petroleum Resources 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 and Petroleum Resources, bulletins, and other publications of the Department, with prices charged for them, are listed in the Department of Mines and Petroleum Resources 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 use in the Department's library (Mineralogical Branch) at Victoria, in the reading-room of the office of the Geological Survey of Canada 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 approximate positions of mineral claims held by record and of placer-mining leases are shown on maps that may be inspected in the central records offices of the Department of Mines and Petroleum Resources in Victoria and in Vancouver. Copies of these maps may be obtained on request. The boundaries of surveyed claims and leases are shown on the reference maps and other maps of the British Columbia Department of Lands, Forests, and Water Resources.

OFFICES OF THE BRITISH COLUMBIA DEPARTMENT OF MINES AND PETROLEUM RESOURCES AND THE DEPARTMENT OF MINES AND TECHNICAL SURVEYS, CANADA.

The Provincial Inspectors of Mines and Resident Engineers for the Vancouver Island and Lower Mainland districts, the Silicosis Control Inspectors, and the Gold Commissioner and Mining Recorder for Vancouver Mining Division occupy offices at 739 West Hastings Street, Vancouver 1. Next door, at 326 Howe Street, officers of the Geological Survey of Canada are stationed, and a technical library is maintained.

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

Topographic Mapping and Air Photography

The Legal, Topographic, Air, and Geographic Divisions of the Surveys and Mapping Branch are responsible for the official surveys and mapping programme of the Province of British Columbia. A complete summary of the activities of the Surveys and Mapping Branch is published in the Annual Report of the British Columbia Lands Service, 1964.

In 1964 the Legal Surveys Division received 660 sets of field notes covering 910 lots surveyed under the *Land Act* and 78 under the *Mineral Act*. The 210 Departmental reference maps showing cadastral information were maintained, and four of them were renewed. Home-site subdivisions produced 66 lots at Port Hardy, 104 at the south end of Dease Lake, 46 at Windermere Lake, 46 at 70 Mile House, 11 at 150 Mile House, and 1 near Chetwynd. A total of 69 miles of highway right-of-way was surveyed on the Northern Trans-Provincial (Route No. 16), Southern Trans-Canada (No. 3), Kootenay–Columbia (No. 93), and Okanagan (No. 97) highways.

The Topographic Division conducted co-ordinate surveys and ran nearly 175 miles of levelling in Surrey Municipality. A control survey was made around the perimeter of Graham Island, while another field crew established control on the Peace River power project reservoir. At the request of the petroleum industry, 170 miles of levels were run and 48 bench-marks established north of Fort St. John.

Eight National Topographic map-sheets covering approximately 2,930 square miles were produced photogrammetrically, and 16 standard topographic manuscripts were draughted at 2-inches-to-1-mile scale.

The Air Division added interim sheets covering 3,200 square miles to its 20-chain (4 inches to 1 mile) scale programme. Interim mapping at 40-chain (2 inches to 1 mile) scale produced 13 full sheets and 12 partial sheets of the Esquimalt and Nanaimo Railway Company lands.

Aerial photographic block coverage totalled 20,390 square miles at 40-chain scale and 18,965 square miles at 20 chains. For the first time the entire Queen Charlotte Islands group was photographed, the area covered by 938 photos at 40-chain scale being 4,500 square miles. Other assignments included photography of sections of the Bridge, Fraser, Thompson, Salmon, and Similkameen Rivers.

The mining industry requisitioned 14,126 photographs by loan or reprint; this represented 27 per cent of the prints taken by the general public in 1964.

New maps issued by the Geographic Division included one sheet at 1-inch-to-2-miles scale, 82 G/NW-NE (Cranbrook), and three at 1:250,000 scale—namely, 93F (Nechako), 103I-J (Prince Rupert-Terrace), and 103P (Nass River). Also completed was map 1JPS (British Columbia, Physiographic Subdivisions). This sheet, at 1-inch-to-30-miles scale, was specially prepared at the request of the Department of Mines and Petroleum Resources to accompany its Bulletin No. 48, Landforms of British Columbia. A variation of map 1JPS without the overprint of physiographic subdivisions was issued separately as map 1JP (British Columbia, Physical).

Plans of 152 petroleum and natural-gas well sites surveyed under the *Petroleum and Natural Gas Act* were checked during 1964.

Ottawa agencies printed 38 Federal and two Provincial map-sheets at 1:50,000 scale and two at 1:250,000 scale. A list of place-name revisions and additions was sent to Ottawa for publication in a new Provincial Gazetteer. At the end of the year the Gazetteer of British Columbia, 1953, was virtually out of print.

Indexes showing the extent and types of aerial photography and map coverage are available from the Director, Surveys and Mapping Branch, Department of Lands, Forests, and Water Resources, Victoria, B.C.

Department of Mines and Technical Surveys

The Canadian Government Department of Mines and Technical Surveys performs many functions related to mining and the mineral industry in general. The Mines Branch, Geological Survey of Canada, Surveys and Mapping Branch, and Mineral Resources Division are services of the Department of direct interest to the mineral 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 notes on the Mines Branch and the Mineral Resources Division.

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 at Room 102, 326 Howe Street, Vancouver 1.

Field Work by Geological Survey of Canada in British Columbia, 1964

Geological mapping was done in the following map-sheets and major areas:—

A. J. Baer in the Bella Coola (93 D) map-area.

R. B. Campbell in the Canoe River West Half (83 D, W ½) map-area.

R. J. Fulton on the surficial geology of the Vernon West Half (82 L, W ½) map-area.

E. C. Halstead on the surficial geology of southeast Vancouver Island.

W. W. Hutchison in the Prince Rupert East Half (103 J, E ½) and Terrace West Half (103 I, W ½) map-areas.

H. W. Little and R. I. Thorpe in the Greenwood (82 E/2) map-area.

J. E. Muller in the Alberni (92 F) map-area.

G. C. Taylor, E. W. Bamber, R. T. Bell, B. S. Norford, and D. F. Stott on Operation Liard in northeastern British Columbia.

H. W. Tipper and R. B. Campbell in the Bonaparte River East Half (92 P, E ½) map-area.

H. W. Tipper in the Bonaparte River West Half (92 P, W ½) map-area.

H. W. Tipper in the Taseko Lakes (92 O) map-area.

J. O. Wheeler in the Big Bend (82 M, E ½) map-area.

G. B. Leech in the Kananaskis Lakes West Half (82 J, W ½) map-area extending into Alberta.

The following special studies and mapping projects were carried out:—

E. W. Bamber studied the stratigraphy of Permo-Carboniferous rocks in conjunction with Operation Liard.

D. J. T. Carson commenced a metallogenic study of metal-bearing deposits on Vancouver Island.

J. Coates made structural studies in and near Manning Park.

Raymond Cox studied the biostratigraphy of the Sooke and Carmanah Formations.

J. A. Jeletzky studied Upper Jurassic and Lower Cretaceous rocks in the Taseko Lakes map-area.

S. F. Leaming completed a study of sand and gravel deposits in south central British Columbia.

B. S. Norford studied Ordovician and Silurian biostratigraphy in the Rocky Mountains.

Peter B. Read studied the eastern contact area of the Kuskanax batholith, Lardeau district.

J. E. Reesor studied the Thor-Odin gneiss dome west of Upper Arrow Lake.

J. V. Ross conducted structural studies in the Mount Revelstoke area.

D. F. Stott studied the Cretaceous stratigraphy of northeastern British Columbia.

H. P. Trettin studied limestones in the Marble Range.

E. D. Kindle studied copper deposits in Yukon and northern British Columbia.

D. K. Norris made lithostratigraphic studies in the southeastern Cordillera in British Columbia and Alberta.

R. A. Price studied Tectonic fabrics in the southeastern Cordillera of British Columbia and Alberta.

Publications of the Geological Survey

A total of 32 publications of the Geological Survey of Canada relating to British Columbia was received by the British Columbia Department of Mines and Petroleum Resources in 1964.

MINES BRANCH

The Mines Branch has branches dealing with mineral dressing and process metallurgy, physical metallurgy, radioactivity, and fuels and explosives. A total of 23 publications of the Mines Branch pertaining to British Columbia was received in 1964 by the British Columbia Department of Mines and Petroleum Resources. 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 publishes studies on mineral resources, mineral economics, mineral legislation, mineral taxation, mining technology, and other miscellaneous mineral-industry subjects. A total of five publications published by this Division was received by the library.

LODE METALS

CONTENTS

NOTES ON METAL MINES—*Continued*

NOTES ON METAL MINES—*Continued*

GENERAL REVIEW

The average Canadian prices paid in 1964 for silver and the base metals were well up. The price for silver, $1.3946 per ounce, was an all-time high; the prices for copper and lead were the highest since 1956, and the price for zinc was the highest since 1952. The New York silver price was constant throughout 1964, and most of the increase in base-metal prices took place in the second half of the year. The values for gold and for iron concentrates were essentially unchanged from 1963.

The total quantity of ore mined at all lode mines amounted to 12,523,636 tons and came from 65 mines, of which 43 produced 100 tons or more. The average number employed in the lode-mining industry in 1964, including mines, mills, and smelters, was 8,681.

In 1964, 30 mills were operated, 17 of them throughout the year. Of the others, five were new, two reopened, one closed, and five operated for part of the year. The new mills were those at the Silbak Premier and Mount Washington properties and small plants at the Ottawa, Meteor, and Washington properties in the Slocan. The Cork Province mill reopened after a closure of 12 years. The Britannia operation closed. Four mills treated gold ore, including the Silbak Premier and the small Fandora mill. Nine mills treated copper ore, two in association with iron ore, one made a bulk nickel-copper concentrate, and one produced a molybdenite by-product. Five mills produced magnetic iron concentrates. Fourteen mills treated silver-lead-zinc ores, including two that accepted custom ore and three small plants. The Bethlehem capacity was increased from about 3,500 to 6,000 tons per day, and for the first time a molybdenum concentrate was produced.

The Trail smelter recorded custom receipts from British Columbia properties of 12,741 tons of ore, 1,177 tons of lead concentrates, and 17,370 tons of zinc concentrates. The ore was from 30 properties, of which three produced 90 per cent of the total; a number received a bonus for the silica content. The lead concentrates came from 11 properties, one of which contributed 52 per cent of the total. The zinc concentrates came from 14 properties, one of which contributed 82 per cent of the total. In addition, the smelter treated considerable amounts of lead and zinc concentrates and ores from out-of-Province sources. Lead concentrates exported to American smelters totalled 20,121 tons, and zinc concentrates, 43,489 tons. Of the copper concentrates, 154,357 tons went to Japanese smelters and 26,761 tons went to the Tacoma smelter. Copper matte from the Trail smelter, amounting to 971 tons, went to the Tacoma smelter. Nickel-copper bulk concentrates, amounting to 19,100 tons, were shipped to Japan. All iron-ore concentrates, a total of 1,929,102 tons, were shipped under contract to Japan.

The promise of future production from several recently developed ore zones and the high level of exploration activity make the present one of the brightest periods in British Columbia's history. Commitments have been made to proceed to production at Endako and Boss Mountain in 1965 with very substantial output of molybdenum concentrates. The Granisle and Granduc copper deposits are to produce by 1966 and 1968 respectively. The Tasu mine will produce copper as well as iron concentrates, and the Western Mines Lynx property will produce copper and zinc as well as gold and silver.

The total value of all metals produced in 1964 was $180,926,329, setting a new record approximately $8,000,000 above the total for 1963. The increase in value was due entirely to increase in metal prices in the past year, since the quantities of all the more abundant metals were down. The value of zinc was at an eight-year high, although the quantity produced was close to the average figure for the same length of time. The production of lead was the lowest since 1949 and was almost 15 per cent below that for 1963, yet the value was 4 per cent higher than in 1963. The value of cadmium was at a record high of $6,040,186, placing that metal in sixth place, below silver and above gold.

The production of gold continued to drop, reaching the lowest point since 1946. Reduced production from Bralorne and Coast Copper was largely responsible. Milling at Silbak Premier took place too late in the year to affect the total substantially.

The situation with regard to silver, lead, and zinc was not greatly changed. The higher price for zinc had no apparent effect on production of that metal. A sharp drop in lead production took place at the Sullivan and, on the average, at other lead-producing mines as well. While the output of lead from the Sullivan was down, the Trail smelter accepted more custom lead concentrates from outside the Province than has been usual. Silver production, naturally, fell with that of lead. The high price of silver was reflected by little more than customary activity in the Slocan, where three small mills were put into operation; they did not greatly affect the over-all picture. At Alice Arm several old silver properties were under investigation but, in general, search for new deposits of silver, lead, and zinc was not very active. The Western Mines property at Buttle Lake, slated for production in 1966, will contribute a considerable amount of zinc.

Copper production was down from the record year of 1963, although the output still exceeded 115,000,000 pounds. There were three reasons for this drop. Cowichan Copper was inoperative, Britannia was closed late in 1964 through labour-management dispute, and a slide in the Craigmont open pit curtailed production and necessitated the drawing of ore from the low-grade stockpile. On the other hand, the Phoenix operation had its most productive year, and Coast Copper increased its output substantially in its second full year of operation. The new mill at Mount Washington was opened in December, although no shipments were made in 1964.

The future for copper is good. The announced intentions of Granduc Mines Limited to bring its property into production in 1968 at a rate of 7,500 tons per day and that of Granisle Copper Company (1964) Limited to bring its property into production in 1966 at a rate of 5,000 tons per day are of major importance. At the same time, the copper produced by the projected Tasu and Western Mines operations will be substantial. It seems certain that at the end of 1968 the rate of copper production will be twice that at the end of 1964. Other copper deposits still in the exploration stage will probably make mines in the reasonably near future.

There was no great change in the volume of production of iron concentrates, but there were some interesting developments. The magnetic circuit installed in the Coast Copper mill produced for the first time in 1964. Wesfrob Mines Limited announced an early start on bringing the Tasu major iron-copper deposit into production. The Texada mine was fully converted from an open pit to an underground operation, becoming the second largest underground mine in the Province. An 800-foot production shaft was sunk at the Brynnor mine to develop the deeper part of the ore zone. The F.L. property at Zeballos resumed operation as an underground mine. Underground development was continued at the Empire property.

Between 1914 and 1960 the Province produced several small lots of molybdenum concentrates, totalling 31,303 pounds of metal. In 1964, 28,245 pounds of molybdenum in concentrates was a by-product of the Bethlehem mill. British

Columbia is on the eve of becoming an important producer, with major molybdenum deposits at Endako and Boss Mountain being brought into production. A number of other interesting deposits are being actively investigated in widely scattered situations, including one in the old Rossland camp. The interest is a result of the improved market for molybdenum, but it stems also from appreciation of the wide distribution of the mineral molybdenite and from realization of the possible low mining costs obtainable in such large low-grade deposits as Endako.

Claim staking was at a new high. A total of 29,244 mineral claims was recorded, some 3,000 more than the previous high of 1956, when there was a staking boom in the Kamloops Mining Division. In 1964 many claims were staked in the Kamloops region, but more in the Omineca and Liard Mining Divisions. The full length of the western half of the Province was under investigation for deposits of copper and molybdenum, and such has been the competition that large claim groups have been staked on indications of mineral or in strategic situations. However, low-grade deposits are long and costly to evaluate, and much surface investigation of showings has been done and will continue to be done for many years to come.

The Stikine River region attracted most attention, with Galore Creek as centre. Stikine Copper Limited diamond drilled 45,000 feet of holes in six months, employing 11 drills and two helicopters. This was a model of intensive exploration in difficult terrane. Other work in the region included surface investigation of all kinds.

More mining companies, large and small, were active in British Columbia than ever before. There was, moreover, more interest shown in mining and mine exploration by the oil companies and by those whose capital was derived from oil than in past years, when it was commoner for mining companies to spread into the oilfields. The extent and diversity of exploration activity have made that activity hard to measure, particularly as air transportation enables a crew to whip into an isolated situation, do a considerable amount of work, and whip out in the space of a few weeks, outside the knowledge of most mining people. The mass staking of claims, the abandonments, the regroupings and changes in ownership or control, and the different phases of exploration by different aggregates make the record a confusing one to maintain. At the same time, there is more need for those who are concerned with the future development of the country to keep well informed and to maintain a suitable record. This Annual Report, it is feared, has not maintained the record as well as it might during the last few years, and there is need for change in the method of collecting information and preserving it for the use of the industry as a whole. Gone is the time when a road or a horse-trail provided access to every property under exploration, and an individual could keep track of all significant developments in the Province.

It will be recalled that the decision to put Bethlehem into production, made in 1961, was looked upon with skepticism by some engineers. The Endako deposit was considered by many to be prohibitively low in grade until comparatively recently. Production is now a fact at one mine and assured at the other, while the Granisle deposit is committed for production at the announced grade of 0.53 per cent copper. British Columbians are revising their concepts of costs, and have tended to overlook the fact that the Phoenix Copper operation during the past three-year period has mined, at an average rate of about 1,700 tons per calendar day, ore that has averaged approximately 12½ pounds of copper per ton and approximately 90 cents in gold and silver. The mining of iron ore underground at the Texada, Zeballos, and Empire mines and presently at Brynnor shows excellent cost figures involving a low-grade product.

The unfortunate incident at the Cowichan Copper Sunloch mine on December 5, 1963, when ground caved and the Jordan River flowed into the mine, prevented production throughout 1964. An unforeseen effect was that the rush of water through the haulage adit took out timber and caused caving at several places. Water under pressure in the caved adit then escaped through fissures in the rock, with the result that a serious washout of overburden took place and a land slip of considerable size was threatened (*see* pp. 169 and 170). Such a set of circumstances may never be repeated, but the power of water under pressure underground was amply demonstrated.

NOTES ON METAL MINES

ATLIN

Tin

Silver Diamond (The Consolidated Mining and Smelting Company of Canada, Limited)*

(59° 133° N.E.) Western district exploration office, 1150 Bay Avenue, Trail. Twenty recorded claims are held by option on Boulder Creek, approximately 16 road miles northeast of Atlin. Work commenced on July 10th and was completed on July 17th by a small crew under the direction of D. W. Heddle. During this time 115 feet of diamond drilling was done in five holes on a tin showing in a pyrrhotite-fluorite skarn zone. One mile of four-wheel-drive road connects the showing with the Boulder Creek road. The property was not visited.

Copper

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

(59° 134° S.E.) Western district exploration office, 1150 Bay Avenue, Trail. The company holds 44 recorded mineral claims and holds options on three Crown-granted claims on this old property on the west side of Hoboe Creek, at the southwest end of Willison Bay on Atlin Lake. A work programme was carried on intermittently during the period of March to August, 1964, by a small crew under the direction of R. G. Gifford and M. R. Wolfhard. Magnetometer and geological surveys were made of the area and 505 feet of diamond drilling was done in five holes. Copper mineralization occurs in a magnetite-bearing skarn in sedimentary rocks. The property was reached by float-equipped plane from Atlin to a small nearby unnamed lake near the showings. The property was not visited (*see* Annual Report, 1918, p. 93).

Molybdenum

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

(59° 134° S.E.) Western district exploration office, 1150 Bay Avenue, Trail. Fifty mineral claims are held by record on the north slope of Mount Caprice, at the southwest end of Willison Bay on Atlin Lake. A small crew worked from June 9th until October 28th under the direction of W. J. McMillan and M. R. Wolfhard. Geological mapping, a magnetometer survey, trenching, trail-building, line-cutting, and 1,200 feet of BX diamond drilling were done. Molybdenite was found as disseminations and fracture fillings, with minor pyrite and chalcopyrite in sheared and brecciated biotite-rich granite. Transportation was by float-equipped plane from Atlin to the camp on the shore of Willison Bay. The property was not visited.

TAKU RIVER

Silver-Lead-Zinc

Potlatch-Banker (New Taku Mines Ltd.)*

(58° 133° N.W.) Registered office, 25 King Street West, Toronto; company office, 1033 Davie Street, Vancouver 5. W. B. Milner, president; L. G. White, engineer in charge. The company holds the NT group of 36 recorded claims and 75 Crown-granted claims of the Polaris Taku property, for

* By H. Bapty.

the most part on the east side of the Tulsequah River about 2.5 miles above its junction with the Taku River. A good gravel road is maintained for 6 miles on the west side of the Tulsequah River from docking facilities on the Taku River. A small airport is also maintained along this road. The 1964 field season lasted from July 1st until September 15th. X-ray diamond drilling footage was 403 feet in 14 holes, done by an average crew of five men. Transportation was by river boat and helicopter. The property was not visited.

Zohini (New Taku Mines Ltd.)*

(58° 133° N.W.) Registered office, 25 King Street West, Toronto; company office, 1033 Davie Street, Vancouver 5. W. B. Milner, president; L. G. White, engineer in charge. The company holds the Zohini group of 60 recorded claims, 8 miles north of Tulsequah, on the south slope of Mount Lester Jones on the north side of Zohini Creek. Map 931A accompanying Geological Survey of Canada Memoir 248 shows the area underlain by rocks of the Inklin Group of Lower Cretaceous age. A shear zone exposed on the upper end for a width of 35 feet between well-defined walls was traced for 300 feet of slope distance, and showed two mineralized sections of massive lead-zinc-antimony sulphides. The 1964 field season commenced July 1st and was completed by September 15th, during which time 11 open cuts were dug by a crew of five men. Transportation was by helicopter. The property was not visited.

Sil (Ericksen-Ashby Mines Ltd.)*

(58° 133° N.W.) Company office, 1030 West Georgia Street, Vancouver 5. J. M. Powelson, president. Newconex Canadian Exploration Limited, 525 Seymour Street, Vancouver 2, has agreed to manage all the mining work to be performed on the property. The company holds 34 recorded claims near the top of Ericksen Mountain on the south side of the Taku River, 4 miles east of Tulsequah. Mapping during 1963 indicated two general areas of mineralization—one at 4,000 feet elevation and the other at 3,200 feet elevation. Evidence of mineralization occurs along a strike length of 3,000 feet. A new discovery of silver-lead-zinc mineralization was made at an elevation of 2,500 feet in a heavily covered area to the northeast of the portal, but because of the overburden and the folding and faulting, the zone lengths and widths were difficult to estimate. A crosscut adit was driven 500 feet at 3,200 feet elevation. This encountered two silver-lead-zinc zones. One of these was in the crosscut and the other at the end of the adit. A large diamond-drill station was slashed out 465 feet from the portal, and from it nine AX diamond-drill holes were drilled a total length of 1,762 feet. Work commenced in June and was completed by the 26th of August, and was done by a crew of 10 men under the supervision of G. A. Russell, engineer. Transportation of supplies was by barge on the Taku River and by helicopter to the camp-site. The property was not visited.

ALASKA HIGHWAY

Tootsee River (59° 130° N.W.)

Silver-Lead-Zinc

Amy 3 (Rancheria Mining Co. Ltd.)†

Company office, 106, 19 Melinda Street, Toronto 1. W. S. Kennedy, president; D. A. Campbell, engineer in charge of property. The company holds 158 recorded claims about 2 miles west of Tootsee Lake and 22 miles by road from

* By H. Bapty.
† By W. C. Robinson.

Mile 701 on the Alaska Highway. The showings consist of galena and sphalerite mineralization in limestone, approximately 1,000 feet from a granite contact.

Work in 1964, which was carried out by an average crew of eight men, commenced on April 15th and was suspended on September 15th. Initial work consisted of road construction. This was followed by 220 feet of crosscutting and 80 feet of drifting. Galena and sphalerite mineralization, similar to the surface showings exposed in trenches, was encountered in the drift. It has been reported that other work consisted of geophysical and geochemical surveying.

DEADWOOD LAKE

Lead-Zinc

Hidden Valley (The Consolidated Mining and Smelting Company of Canada, Limited)*

(59° 128° S.E.) Western district exploration office, 1150 Bay Avenue, Trail. The company holds the Vale group of 140 mineral claims by record and 9 other claims by option. The property is between Sandpile Lake and the head of Hidden Valley Creek, approximately 80 air miles south of Watson Lake and 65 air miles east of Cassiar. Geological mapping, electromagnetic surveys, minor trenching, and 185 feet of diamond drilling in three holes were done during the month of June by a small crew of men under the direction of A. B. Mawer and S. A. Jackson. Mineralization is reported to consist of massive pyrite, marcasite, sphalerite, galena, and barite fracture fillings in sheared and brecciated dolomite, quartzite, slate, and greenstones. Transportation was by float-equipped plane from Watson Lake and by a newly built foot-trail from Sandpile Lake. The property was not visited.

CASSIAR

Molybdenum

Storie†

(59° 129° S.W.) New Jersey Zinc Exploration Company (Canada) Ltd., 905, 525 Seymour Street, Vancouver 2, holds 10 claims by option agreement and 15 claims by record. The property is east of Limestone Peak and is about 4 miles south of Cassiar. Access is by truck-road up Granite Creek. The main molybdenite mineralization occurs in granite about 1,000 feet south of a limestone contact. Work in 1964 commenced in June and was terminated in September. An average crew of nine men was employed under the direction of Peter Crone. Work included mapping, trenching, and 3,947 feet of diamond drilling with BX wire-line equipment.

Gold

Hanna Gold Mines Ltd.†

(59° 129° S.W.) Head office, 401, 470 Granville Street, Vancouver 2; mine office, Cassiar. J. B. Frosst, president; W. C. Hood, Jr., managing director. The property, which was originally known as the Cornucopia group, is on the east slope of Quartzrock Creek valley, 2 to 3 miles north of McDame Lake. The showings have been described in previous Annual Reports (*see* 1947, pp. 70–72).

During 1964 Newconex Canadian Exploration Limited, of Toronto, optioned the property. Work, which was carried out by an average crew of 12 men under the direction of J. S. Ives, commenced on May 1st and was suspended on October 31st. Development of the 3600 level continued and comprised 595 feet of drifting and crosscutting. Other work included diamond drilling six holes underground, totalling 715 feet, trenching, sampling, and geological mapping. The property is serviced by the Cassiar–Stewart road.

* By H. Bapty.
† By W. C. Robinson.

Silver-Lead-Zinc

McDame Belle, Bar (Ventures Mining Ltd.)*

(59° 129° S.E.) Company office, 850 West Hastings Street, Vancouver 1. H. A. Briden, managing director; R. G. Hawley, engineer in charge of property. This property is located on McDame Creek, approximately 20 miles by road east of Cassiar. The company holds 149 claims by record and 5 claims by option agreement. Work in 1964, which was carried out by an average crew of eight men, commenced on May 1st and was suspended on December 15th. Fourteen diamond-drill holes, totalling 3,154 feet, were drilled from surface with BX wire-line equipment. Other work included trenching and road construction.

It has been reported that the mineralization consists of galena, sphalerite, and pyrite, with minor pyrrhotite and chalcopyrite, generally associated with argillite bands in limestone and dolomite. The property was not visited.

DEASE LAKE

Copper

Joy (Kennco Explorations (Western) Limited)†

(58° 129° S.E.) Company office, 1111, 1030 West Georgia Street, Vancouver 5. C. J. Sullivan, president. The company holds the Snowdrift prospect, consisting of the 32 recorded Joy claims lying 33 miles east of Dease Lake and from 5 to 7 miles southeast of Eaglehead Lake. Copper mineralization occurs in sheared granitic rocks along a contact zone with greywacke, at the west side of the Cassiar batholith. Work commenced on July 15th and terminated on August 30th, with a crew of eight men under the supervision of G. Rayner, engineer. An induced potential survey was employed to explore a large geochemical anomaly. A fixed-wing aircraft flew supplies to Eaglehead Lake, and from there helicopter and packhorses were used for transportation. The property was not visited.

TRAPPER LAKE

Copper-Gold-Silver

Thorn, Club, Kay (Julian Mining Co. Ltd.)†

(58° 132° N.W.) Company office, 409 Granville Street, Vancouver 2; field office, 1396 Fifth Avenue, Prince George. B. G. Gore, president; R. Macrae, engineer in charge. The Thorn group of 22 recorded claims is on a tributary of the Sutlahine River, about 13 miles southeast of King Salmon Lake and northwest of Trapper Lake. The Club group of 66 recorded claims and the Kay group of 44 recorded claims are in the same general grouping as the Thorn. Some hand-trenching, commenced in June, was completed in September by a crew of 12 men under the direction of M. O. Hampton. Geological mapping, geochemical sampling, and an induced potential survey were done. Transportation was by fixed-wing aircraft and helicopter. The property was not visited.

SHESLAY RIVER

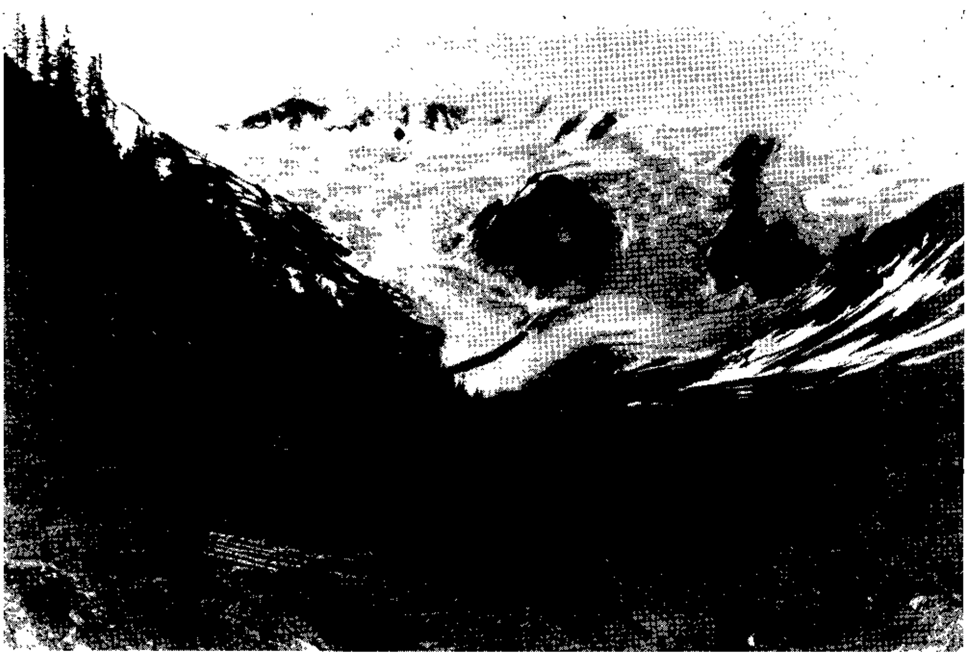
Copper

Bing (Newmont Mining Corporation of Canada Limited)†

(58° 132° S.E.) Registered office, 25 King Street West, Toronto; Vancouver office, 744 West Hastings Street. J. Drybrough, president; G. Gutrath, engineer in charge. This is a group of 84 recorded claims, 45 miles north of Telegraph Creek on the west side of Samotua River and east of Tatsamenie Lake. Outcrops of altered volcanic and sedimen-

* By W. C. Robinson.
† By H. Bapty.

On the GJ claim group, Klastline Plateau.



Helicopter pad at drill-site, Galore Creek.

tary rocks show finely disseminated pyrite, chalcopyrite, and sparse molybdenite. Work, continuous from July until September, was done by a crew of nine men and consisted of geological mapping, geochemical sampling, and geophysical surveying. Transportation to the property was by fixed-wing aircraft and helicopter. The property was not visited.

STIKINE RIVER

Copper

BIK, BUD* (57° 130° S.W.–57° 131° S.E., N.W.) Seven groups, totalling 272 recorded claims, are held under an agreement between Silver Standard Mines Limited, 602 West Hastings Street, Vancouver 2, and American Smelting and Refining Co., 1112 West Pender Street, Vancouver 1. W. St. C. Dunn and P. I. Conley were engineers for the respective companies. The claims were located early in 1964, partly as relocations of ground held by Silver Standard in past years.

The groups are as follows: South Scud (BIK 87–116), 5 miles southeast of the big bend in the Scud River; Middle Scud (BIK 117–136), 3 miles east of the toe of Scud Glacier; North Scud (BIK 137–160), west side of Scud Glacier; Mess Creek (BIK 161–196), upper Mess Creek, 5 miles southwest of Arctic Lake; Conover Creek (BIK 197–220), west side of the Chutine River, 3 miles from its mouth; East and North Stikine (BIK 221–269, BIK Fractions 1–3), mostly east of Galore Creek and lying east and north of the Galore Creek property of Stikine Copper; BUD 1–28, on the east side of upper Schaft Creek, south of the Bird group.

Work was carried out from mid-June to mid-September by a crew of 14 men. Geological mapping was done on all groups and a magnetometer survey was made on the Stikine East and Stikine North ground. Prospecting and regional geochemical sampling were done. Transportation was by river boat to the mouth of the Anuk River, and thence by helicopter. These properties were not visited.

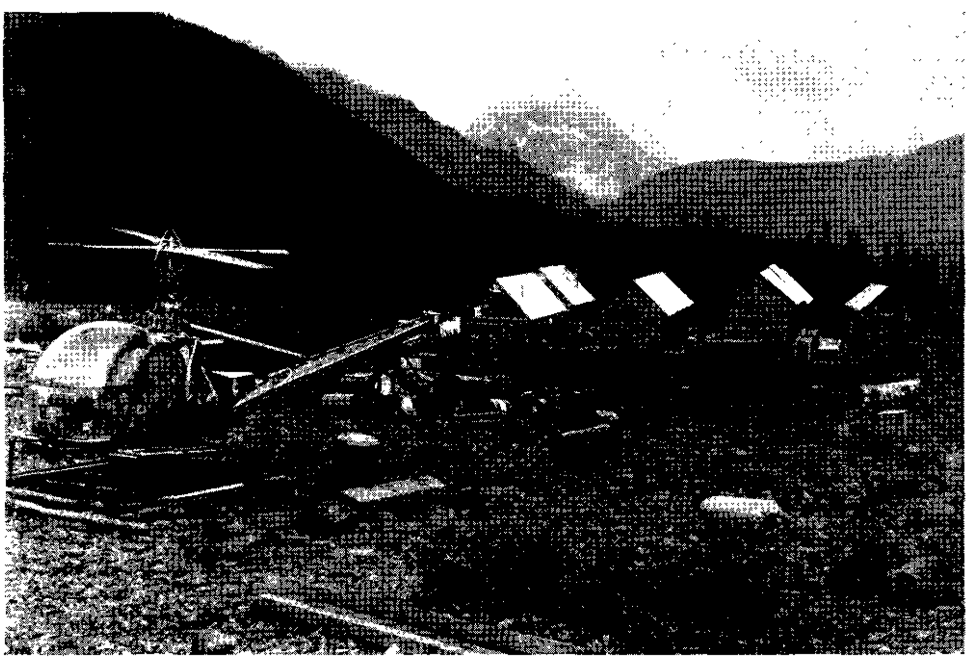
COS (Skeena Silver Mines Ltd.)* (57° 131° S.W.) Registered office, Suite 901, Vancouver Block, Vancouver 3; Vancouver office, 844 West Hastings Street, Vancouver 1. F. A. McGonigle, president; H. L. Hill and F. L. C. Price, consulting engineers. The company holds 16 recorded claims situated on the south side of Cone Mountain, commencing 2,000 feet north of the Scud River. Stringers mineralized with bornite and chalcopyrite were reported on a limestone-granite contact. The prospecting was done by a crew of seven men during August. Transportation was by fixed-wing float plane and helicopter. The property was not visited.

CW, PH, NH (Conwest Exploration Company Limited)* (57° 131° S.E.) Registered office, 85 Richmond Street West, Toronto 1; Vancouver office, 901, 675 West Hastings Street, Vancouver 2. F. M. Connell, president; G. Grant, geologist, supervised geological mapping on the CW, PH, and NH groups. The work was done by a group of six men from June 8th until September 20th. All properties were geologically mapped at a scale of 1 inch to 1,320 feet. Some geochemical sampling was done and mineral showings were sampled. Minor amounts of copper were found in the volcanic rocks.

The CW group contains 281 recorded claims and adjoins the Stikine Copper Limited property on the north and west.

* By H. Bapty.

Stikine Copper Limited. Galore Creek camp.



Stikine Copper Limited. Core examination and assay buildings left, core shacks right.

The PH group contains 84 recorded claims and adjoins the Stikine Copper Limited property on the southeast.

The NH group of 97 recorded claims is at the head of Sphaler Creek and adjoins the Goat and Kim groups on the east and south.

These properties were not visited.

Galore Creek (Stikine Copper Limited)*

(57° 131° S.E.) Company office, 1111, 1030 West Georgia Street, Vancouver 5. C. H. Burgess, president; D. A. Barr, engineer in charge at property. This company holds 289 recorded claims (270 GC, 9 HAB, and 10 BUY claims), all in the headwaters of Galore Creek and Anuk River. Copper mineralization occurs in syenite porphyry in several zones within an area of 8 square miles. The largest deposit developed to date, the Central Zone, has been traced by diamond drilling for a length of 6,500 feet. Work commenced in late April and continued until November 5th. An average crew of 85 men was employed during that time. A total of 44,994 feet of diamond drilling was completed in 61 holes. Additional work included claim surveying, geological mapping, 7½ miles of road construction, and the completion of two airstrips. Supplies were barged up the Stikine River to the Anuk River and from there flown by Sikorsky and Hiller helicopters into the property. The property was also serviced by fixed-wing aircraft landing on the Stikine River and on an airstrip at the property. Additional core-storage sheds were constructed. An assay-crusher building, office, and core-logging building were constructed on the property, and a warehouse at a staging point at the mouth of the Anuk River.

The diamond drilling was done with 11 machines, and in almost all cases the drillers were transported twice daily by helicopter. Approximately 96,000 feet of diamond drilling has now been done on this property. Two chartered helicopters serviced the drills and brought in supplies over the Anuk summit or, when visibility was limited, by way of the Scud River. A bulldozer tractor and a four-wheel drive vehicle were flown in, and roads were built in the upper basin and down the west side of Galore Creek valley. A watchman remained in camp for the winter.

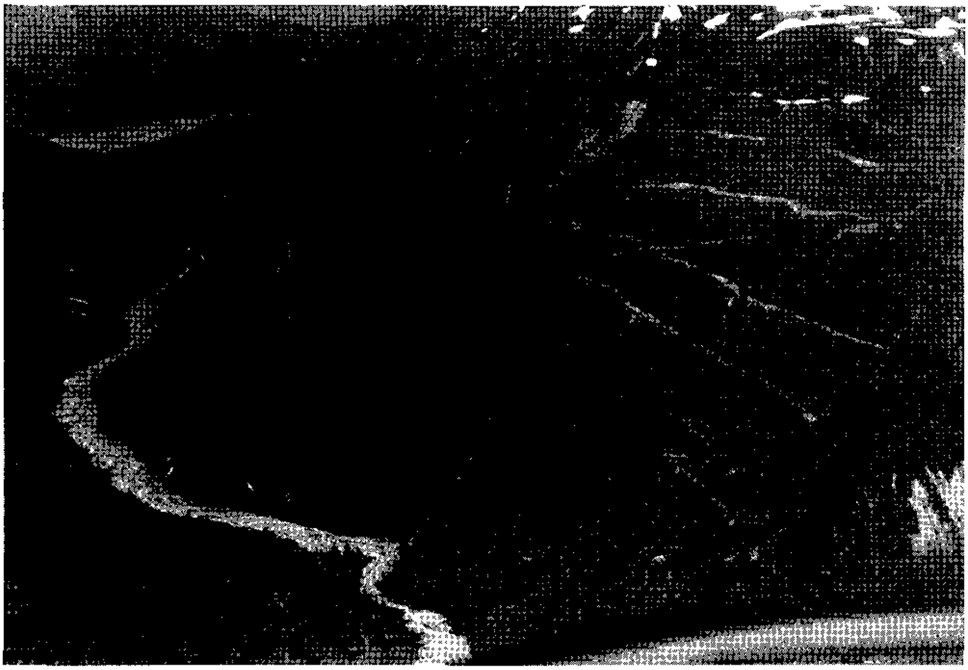
Penny (Racicot Syndicate)†

(57° 131° S.E.) The Racicot Syndicate is composed of Silver Standard Mines Limited, 808, 602 West Hastings Street, Vancouver 2; Magnum Consolidated Mining Co. Ltd., 700, 1030 West Georgia Street, Vancouver 5; and Keevil Mining Group Ltd., 11 Adelaide Street West, Toronto 1. Responsibility for the work was under the direction of W. St. C. Dunn for Silver Standard Mines Limited. The Penny 1 to 34 are recorded claims on the east fork of Galore Creek, lying south and east of the Copper Canyon property of eight claims. Copper mineralization occurs in a syenite intrusive. Work commenced June 16th and stopped August 24th with a crew of six men. Work included geological mapping, a magnetometer survey, and the digging of 18 trenches with a total length of 1,462 feet. Transportation was by river boat from Wrangel, Alaska, to the Anuk River and thence by helicopter.

Ann, Su (Julian Mining Co. Ltd.)†

(57° 131° S.W.) Company office, 409 Granville Street, Vancouver 2; field office, 1396 Fifth Avenue, Prince George. B. G. Gore, president; R. Macrae, engineer in charge. This company controls a large group of recorded

* By H. Bapty and M. S. Hedley.
† By H. Bapty.



Julian Mining Co. Ltd. Bulldozer trenches and geophysical lines on Ann property.
Split Creek, tributary of Porcupine River.

Headwaters of Split Creek from high trench on Ann property.

claims including the Ann 1–144 and the Su 1–11 on Split Creek. The property includes the upper basin of Split Creek and extends south nearly to the Porcupine River. Work was commenced by a crew of 12 men on July 1st and continued until the end of August, under the direction of R. S. Adamson. Geological mapping, geochemical sampling, an induced potential survey, and a magnetic survey were undertaken. A buldozer tractor was taken from the Stikine River into the property, and trenching was done on the flank of Mount Scotsimpson. The property was served by fixed-wing float plane and helicopter. The property was not visited.

Goat, Kim (Kennco Explorations (Western) Limited)* (57° 131° S.E.) Company office, 1111, 1030 West Georgia Street, Vancouver 5. C. J. Sullivan, president. The company holds the Goat group of 48 recorded claims on Sphaler Creek, 16 miles east of the junction of the Porcupine and Stikine Rivers. Work, which was undertaken by a crew of six men, was commenced in June and completed by September 15. The following was done under agreement with Silver Standard Mines Limited, owner of the adjoining Kim group of 10 claims: Mapping, sampling, several hundred feet of shallow trenching, several miles of trail work, and two X-ray diamond-drill holes were sunk a total of 126 feet. The showings consist of disseminated copper minerals in altered and brecciated volcanic rocks with minor monzonite intrusives. Several areas are under investigation along a northeast-trending zone on either side of Sphaler Creek. Transportation is by river boat to the mouth of the Porcupine River and thence by helicopter. The property was not visited.

MESS CREEK

Copper

MESS, MEST, JET, DELL (Skeena Silver Mines Ltd.)* (57° 131° S.E.) Company office, 844 West Hastings Street, Vancouver 1. F. A. McGonigle, president; H. L. Hill and F. L. C. Price, consulting engineers. The company holds three groups of mineral claims by record in the Mess Creek area. A crew of seven men in August did work on this ground. Transportation was by fixed-wing float plane and helicopter. The properties were not visited.

The MESS 1–12 and MEST 1–34 claims are on the southwest side of Mess Lake, about one-half mile from the shore.

The JET 1–16 claims are on the ridge between Mess Creek and Schaft Creek, south of the Bird group and about 9 miles southwest of Mess Lake. Prospecting uncovered a lightly mineralized outcrop 30 feet wide.

The DELL 1–32 claims lie west of Schaft Creek, about 9 miles southwest of Mess Lake. A geochemical survey showed indications of copper, but prospecting failed to reveal copper mineralization.

SNO, Bird* (57° 130° S.W.) This group of 20 recorded claims is held under an agreement between Silver Standard Mines Limited, 602 West Pender Street, Vancouver 2; McIntyre Porcupine Mines Limited; Kerr-Addison Gold Mines Limited; and Dalhousie Oil Company Limited. It is in a saddle on the ridge between Schaft Creek and Mess Creek, 7 miles southwest of Mess Lake. Trenching had been done on the Bird claims in past years. On the SNO claims four men under W. St. C. Dunn did 900 feet of trenching between August 20th and September 11th. Geological mapping was also done. Transportation was by helicopter. The property was not visited.

* By H. Bapty.

Bam (Hudson Bay Exploration and Development Company Limited)*

(57° 130° S.W.) Head office, 333 Broadway Avenue, Winnipeg 1. E. S. Austin, president; R. A. Freberg, assistant chief geologist in exploration. The Bam group of 21 recorded claims lies on the east side of upper Mess Creek about 2 miles southwest of Arctic Lake. Rock types in the mineralized area consist of fractured arkose lying unconformably above dolomite. Minerals of interest are tetrahedrite and secondary malachite and azurite in the arkose. Disseminated tetrahedrite is also present in shattered dolomite. Mineralized zones appear to dip 10 degrees to the southwest. The showings were located and sampled in September, 1963, and diamond drilling was done between August 11 and September 3, 1964. Four drillers and assistants worked under the direction of the engineer, G. C. Camsell. Three EX diamond-drill holes were drilled with a footage of 736 feet. A float-equipped aircraft was used to bring supplies to Arctic Lake, whence a helicopter serviced the property. The property was not visited.

ISKUT RIVER

Iron-Zinc-Copper

Shan (Newmont Mining Corporation of Canada Limited)*

(56° 130° N.W.) Vancouver office, 744 West Hastings Street, Vancouver 1. J. Drybrough, president; G. W. H. Norman, engineer in charge. This group of 20 recorded claims lies approximately 4 miles south of the Iskut River and 2 miles east of Snippacker Creek. The showings consist of skarnified limestone and volcanics sporadically mineralized with magnetite, sphalerite, and chalcopyrite. The skarn zone parallels and is adjacent to an east-west trending monzonite contact. Three men were employed in geological mapping. The work commenced in July and was completed by August. Transportation was by helicopter. The property was not visited. (*See* Annual Report, 1963, p. 9.)

UNUK RIVER

Copper

Granduc (Granduc Mines Limited)†

(56° 130° S.E.) Company office, 626, 744 West Hastings Street, Vancouver 1. J. Drybrough, president; R. D. Baker, general manager. The Granduc mine, at the head of the Leduc River, 25 miles north-northwest of Stewart, comprises 64 Crown-granted and 153 recorded mineral claims. Considerable work was conducted on the property starting in February, with an exploration development programme of 893 feet of crosscutting, 591 feet of raising, and 7,529 feet of diamond drilling. This exploration programme was completed in May.

Financial arrangements were completed in July to bring the property into production, and work was started in August to establish a 140-man camp at the Leduc end of the proposed 11.6-mile drainage and access tunnel. At the Leduc end an 8-foot pilot tunnel was driven a distance of 260 feet and a storage drift 200 feet long was also completed. The camp at Leduc consists of four bunkhouses, dining hall, recreation hall, auditorium, office, dry, and power-house.

The construction of a 140-man camp at the Tide Lake end of the tunnel was started. This camp, when completed, will have facilities similar to the Leduc camp. The portal at the Tide Lake end was started and oil-storage facilities installed. Eighty mineral claims were recorded in the Tide Lake area. During the year the work force averaged 40 to 50 men under the supervision of H. M. Fowler.

* By H. Bapty.
† By H. Bapty and E. W. Grove.

During August and September 150 tons of ore was air freighted to Stewart and then transhipped by boat to Lakefield, Ont., for bulk grinding tests.

An airstrip was prepared on the North Leduc Glacier and a gravel strip at Tide Lake. These airstrips are used for handling deliveries of freight to the sites by C-46 and Otter aircraft. Personnel are transported by helicopter. Freight was also hauled from Stewart and delivered to the two camp-sites by means of a Nodwell carrier and " cat " trains.

The construction of the 29-mile access road from Stewart to the Tide Lake area was started September 15th.

Ted-Ray.—This group of 64 recorded claims is held by Granduc Mines Limited. An airborne magnetometer survey was carried out during the early summer.

Max.—This is another Granduc Mines Limited holding of 84 recorded claims (*see* Annual Report, 1962, p. 8).

The present Granduc mine showings were apparently located in 1931 by W. Dawson and W. Fromholz, of Ketchikan, Alaska. These prospectors first made an aerial reconnaissance of the area and were later serviced at their Leduc camp by air-dropped supplies. They reported finding numerous pegmatite dykes along the Coast Range Batholith contact as well as abundant float containing chalcopyrite, pyrite, molybdenite, and galena along the river bottom. They staked their claims 3 to 5 miles easterly of the Alaska-British Columbia boundary on exposed quartz sulphide and disseminated sulphide mineralization occurring in northeasterly trending schists, slates, and porphyries. However, the claims were allowed to lapse.

The mineralization was rediscovered in 1948, and was located in 1951 for Helicopter Exploration Co. Ltd. In 1953 Newmont Mining Corporation of Canada Limited and the Granby Consolidated Mining, Smelting and Power Company Limited joined in providing funds for the exploration of the deposit by Granduc Mines Limited. Exploration and development continued until March, 1958, when all operations ceased. Geological and geophysical surveys, supervised by G. W. H. Norman, were conducted through 1959, 1960, and 1961. Base camps were re-established at the mine-site in 1961, when development work on the deposit was resumed.

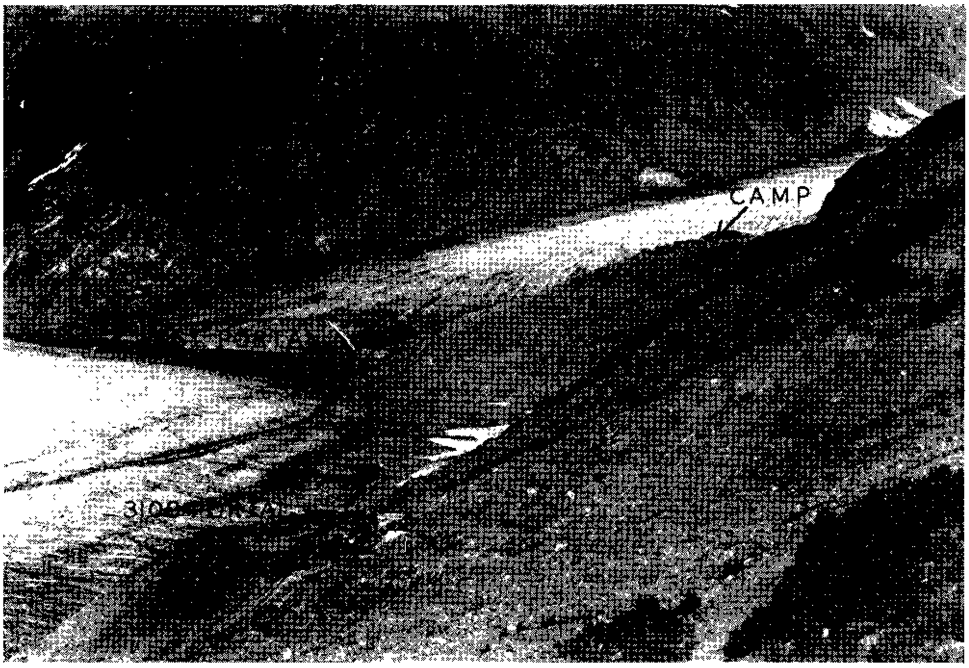
Underground workings at the mine presently include four main levels and one internal shaft. Recently published ore-reserve figures disclose a potential 32,500,000 tons grading 1.93 per cent copper.

The mineralization has been outlined by diamond drilling and appears to occur as isolated and converging in echelon lenses or zones striking slightly east of north and dipping steeply west. Grossly, the ore zones are conformable within metasediments of the mine series. In more detail the zones are comprised of interbanded massive ore minerals, disseminated ore minerals within banded country rock, and barren country rock. The main ore mineral is chalcopyrite with associated pyrite, pyrrhotite, magnetite, and minor arsenopyrite.

The rocks in the mine area, the mine series, are commonly fine grained, finely laminated, and conspicuously layered and are generally marked by fine biotite. The series appears to consist mainly of mylonitized and variably recrystallized rocks, including thin-bedded limestones, argillites, and greywackes as well as sill-like feldspar porphyries. To the east these rocks are succeeded by a mixed volcanic-sediment sequence. West of the ore zones the rocks grade into thinly laminated greenish amphibole bearing metasediments.

[References: Bacon, W. R., *B.C. Dept. of Mines*, Preliminary Map, Granduc Area, B.C., 1956; *Minister of Mines, B.C.*, Ann. Repts., 1953–1963; Norman, G. W. H., Faults and Folds across Cordilleran Trends at the Headwaters of Leduc

River, Northern British Columbia, *Geol. Soc. Amer.*, Buddington Volume, 1962, pp. 313–326.]



Granduc mine at fork of the Leduc glacier.

Gold-Silver-Lead-Zinc

Kay (Canex Aerial Exploration Ltd.)*

(56° 130° N.E.) Company office, 700 Burrard Building, Vancouver 5. L. Adie, in charge of exploration. An option was acquired on the 36-claim Kay group from Western Resources Limited. These claims lie 3 miles east of Tom MacKay Lake. Work was conducted during the period August 23rd to October 4th by 10 men under geologist W. D. Tompson. Gold, silver, lead, and zinc minerals occur in a bed of volcanic breccia. Vein widths are up to 12–13 feet. The mineralized area was tested by probing six underground diamond-drill holes (size AXK) for a total length of 737 feet. Drift walls were sampled. The temporary tent camp was serviced by helicopter. Supplies were delivered to camp from an airstrip on the Unuk River 15 miles south of camp, and from Tom MacKay Lake. The property was not visited. (*See* Annual Report, 1963, p. 10.)

Zinc-Lead

Ted, Ray (Newmont Mining Corporation of Canada Limited)*

(56° 130° N.E.) Vancouver office, 744 West Hastings Street, Vancouver 1. J. Drybrough, president. A group of 52 recorded claims is located on the east side of Sulphurets Creek above its confluence with Mitchell Creek. Showings consist of concentrations of sphalerite, galena, and sparse tetrahedrite in highly pyritized and silicified mica schist. Trenching and sampling were done between July 1st and 15th and September 1st and 15th by a crew of two men under the charge of S. W. Barclay. Transportation was by helicopter. The property was not visited.

* By H. Bapty.

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. H. Hill & L. Starck & Associates Ltd., consulting engineers. In 1964 work was carried out by a crew of 12 men under the supervision of mine manager D. McLeod. This included regrading and resurfacing the road from No. 6 level portal to the glory-hole, and the completion of an ore and waste dump at the glory-hole. At No. 6 level, elevation 773 feet, a 75-tons-per-day cyanidation plant was constructed and put into operation in mid-September. Approximately 3,500 tons of ore was milled prior to the mill closure December 27th, when the ore stockpile was depleted.

High-grade gold and silver ore, first discovered in the Portland Canal area in 1910, led to the subsequent underground development on the Cascade No. 8 claim in 1916. The mining of bonanza ore from the near surface Premier workings sparked a prolonged period of intensive mining interest in the region.

The present holdings of Silbak Premier Mines Limited, which cover an area of about 5 square miles, are the result of the amalgamation of several adjoining properties. In 1936 Premier Gold Mining Company, Ltd., B.C. Silver Mines, Ltd., and Sebakwe and District Mines, Ltd., were consolidated to form Silbak Premier Mines Limited. In terms of comparative production, the Premier camp places second to the Sullivan mine in silver, and to the Bralorne mine in gold. It is also one of the important lead-zinc producers in British Columbia.

In 1953 low base-metal prices forced Silbak Premier to close operations. After remaining idle for two years, development work was resumed in 1955 under the direction of Henry L. Hill & Associates. In 1956 the property was rehabilitated, but fire destroyed the mill and surface buildings at the No. 4 level portal after only a few months' operation. At this time, underground work was concentrated on the 790, 940, and 1060 levels. Low metal prices in 1957 again forced closure of the property except for geological studies.

In 1959 Silbak Premier granted a one-year lease on the upper levels of the mine to Bermah Mines Ltd. The lessees mined the upper part of a small high-grade ore lens found on the south side of the abandoned glory-hole. This oreshoot was discovered after waste rock had sloughed from the pit wall and exposed silver-gold mineralization. At the termination of the one-year lease, Silbak Premier completed mining the lower part of the high-grade sulphide lens during parts of 1960, 1961, and 1962. Production from this one lens amounted to roughly 2,736 tons of ore containing 18,595 ounces of gold, 394,933 ounces of silver, 16,258 pounds of copper, 215,999 pounds of lead, and 322,118 pounds of zinc. Stimulated by this plum of bonanza ore, the company reviewed the potential of the property, but work at the mine was severely hampered when in November, 1961, the Salmon River section of the Stewart–Premier road was washed out by overflow of water from the Summit-Tide Lake area. The washed-out section of the road, entirely within Alaska, was largely rebuilt by Silbak Premier.

In 1963 work was initiated on a loading-trestle and ore-bin at the open pit and on the excavation of a mill-site at No. 6 level portal. A new camp was also erected at No. 6 level. Loading facilities at the open pit were completed and a new mill constructed and put into operation in 1964 to handle broken ore reserves from the open pit.

* By E. W. Grove.

The occurrence and geological environment of the Silbak Premier ores have aroused considerable discussion since the initial discovery. Mine development and exploration in the entire Salmon River district have been largely guided by what has been understood of ore controls at Premier. The country rock at the property consists of schistose intercalated green to purple volcanic agglomerates, tuffs, and porphyries cut by several varieties of dyke rocks. In general, ore-grade mineralization appears to be concentrated at or near sheared contacts between fragmental volcanics and feldspar porphyries (Premier porphyry) along two major intersecting fracture zones. Locally these are termed the Northwest and Northeast fracture systems. To date, only two such intersecting zones—the Premier and the Northern Light areas—have yielded substantial commercial mineralization.

In general it can be noted that the ore occurs as irregularly spaced sulphide-rich lenses within silicified-pyritized country rock. Lenses of ore-grade mineralization in the known zones extended from the surface downward over a vertical range of about 1,300 feet. The ore lenses consisted mainly of banded pyrite, galena, and sphalerite with minor chalcopyrite, enveloped in pyritic quartz gangue. Tetrahedrite, electrum, native silver, polybasite, argentite, and other silver-bearing minerals have been most abundant between surface and No. 3 level.

During the various processes that have led to the formation of the Premier ore deposits, the Northwest and Northeast fracture systems have remained the locus of rock alteration, ore deposition, dyke emplacement, and late faulting. The relatively small size and scattered nature of the ore lenses complicate the search for hidden mineralization even within the known zones. Exploration targets in the mine area include sheared contacts between fragmental volcanic and porphyry, cut by northwest and northeast fractures which possibly are indicated by dykes.

Published Silbak Premier ore reserves include about 20,000 tons of broken ore in the old glory-hole left from earlier operations, as well as 75,200 tons broken, measured, and indicated ore below No. 3 level averaging: Gold, 0.28 ounce per ton; silver, 2.8 ounces per ton; lead, 1.8 per cent; and zinc, 2.7 per cent. Ore reserves at and below No. 6 level consist mainly of lead-zinc mineralization estimated at 74,146 tons averaging: 4.25 per cent lead; 6.36 per cent zinc; with 0.07 ounce gold and 1.98 ounces silver. Total reserves as of 1961 were estimated at 169,346 tons.

Bear River (55° 129° N.W.)

Gold-Silver-Lead-Zinc

Dunwell (Silver Arrow Mines Limited)*

Company office, 800, 789 West Pender Street, Vancouver 1. Ardin Sovdi, president; A. C. Skerl, consulting geologist. The company is registered holder of six Crown-granted mineral claims, all situated 4½ miles north of Stewart on the Bear River and Glacier Creek. Access to the property is by a good road which joins the Stewart–Cassiar highway near the mouth of Glacier Creek. Work in 1964, which commenced in May and terminated in October, consisted of rehabilitating the Dunwell road, clearing trails, surface prospecting, and sampling. (*See* Annual Report, 1937, pp. 7–12.)

Silver-Lead-Zinc

Porter Idaho (Cassiar Consolidated Mines Limited)*

Company office, 1500 Marine Building, 355 Burrard Street, Vancouver 1. W. R. Wheeler, president; A. C. Skerl, consulting geologist. The property consists of 99 Crown-granted claims south of Stewart. Work on the property commenced in August and continued until the end of November. An

* By E. W. Grove.

underground programme of rehabilitating the winze to the " I " tunnel was undertaken by a crew of four men under the supervision of J. MacBeth. Access to the property was by helicopter.

[Reference: *Geol. Surv., Canada,* Mem. 175, 1935, p. 135.]

Bear River Pass

Silver-Gold

Goat (Noradco Mines Limited)* (56° 129° S.E.) Company office, Suite 8, 425 Howe Street, Vancouver 1. D. N. Cameron, manager. The property is located on the second west branch of Surprise Creek north of Bear River Pass and consists of 80 claims held by record. Access to the showings was by helicopter from a base camp on a new road constructed 3½ miles north from the 33-mile point on the Stewart–Cassiar highway.

Work on the property during 1964 consisted of surface prospecting, trenching, sampling, and drilling three diamond-drill holes totalling 408 feet. It was supervised by George Vooro.

The property was originally located in 1960 for Newmont Mining Corporation of Canada Limited and The Granby Mining Company Limited. The original Goat group was acquired under agreement by Noradco Mines in 1963, and during 1964 the holdings were increased to a total of 80 claims.

The Goat group is on the crest of a knife-edged east-trending ridge 3 miles northeast of the Bear River Pass glacier and 7 miles west of Meziadin Lake. The showings are at present easily accessible only by helicopter. The ridge crest is sparsely covered by scrub balsam and minor talus, so that the mineralization is almost entirely visible. The main vein has been traced from about 4,370 to 4,600 feet elevation at the top of the steep ridge.

The original showing consists of a narrow lenticular sulphide-carbonate vein trending northward and dipping from 35 to 80 degrees west, apparently controlled by a prominent fracture system. The vein has an average width of about 6 inches and consists of medium-grained thinly banded vuggy pyrite, dark-brown sphalerite, tetrahedrite, minor galena, and scheelite with a predominantly siderite gangue. The surface vein material is weathered brown to blue-black, and blends into the over-all rock coloration at a distance. Down dip the vein has been broken by a narrow north-trending nearly vertical shear zone, west of which the vein pinches out in massive green agglomerates. A second subparallel vein was found late in the 1964 field season near the ridge-top, 8 to 10 feet in the hangingwall side above the main mineralization.

Channel sampling by Newmont Mining Corporation in August, 1962, indicated the following lengths and average values for the main vein:—

South side of ridge: 133 feet long, 4.37 inches wide, 0.70 ounce gold, and 242.07 ounces silver per ton.

North side of ridge: 100 feet long, 7.4 inches wide, 0.486 ounce gold, and 191.47 ounces silver per ton.

The mineralization was resampled in August, 1964, by the present operators.

The main mineralization is apparently confined to fractures at and near the contact between a thin sill-like lens of feldspar porphyry and the enclosing fragmental volcanics. The porphyry has been saussuritized, partly replaced by quartz-epidote along fractures, and subsequently irregularly replaced by siderite and sulphide vein material. Fine-grained arsenopyrite needles were noted disseminated through the carbonized porphyry but not in the main sulphide lenses.

* By E. W. Grove.

Exploration camp, Alice molybdenum property, Lime Creek.

ALICE ARM

Geology of the Lime Creek Area*

Introduction

This report deals with an area of about 15 square miles extending north and west of the Alice molybdenum deposit, which is on the southeast fork of Lime Creek approximately 5 miles south of Alice Arm. The map-area includes the contact of the Coast Intrusions with the older sedimentary and volcanic rocks on the west and Widdzech (Table) Mountain, a flat-lying volcanic formation of Tertiary age, on the east. The map-area extends from 1 mile south of the Alice deposit northwest to include the Tidewater molybdenum deposit on the north shore of Alice Arm.

Alice Arm, a small village at the head of Alice Arm of Observatory Inlet, is 100 miles north of Prince Rupert. Transportation to Alice Arm is afforded by weekly steamship service from Prince Rupert and Vancouver and by aircraft from Prince Rupert or Terrace.

Transportation within the map-area is difficult. No roads other than the Kitsault River road exist, although trails in fair to good condition lead to the major mineral occurrence in the area.

Prospecting within the map-area has been carried out since the early part of the century. The molybdenum deposit on Lime Creek was investigated as early as 1912, as were other occurrences of silver, lead, and zinc. A number of trails were constructed south from Alice Arm, but the majority of them are overgrown. Mining within the map-area has been confined to the Tidewater molybdenum property, with limited production between the years 1916 and 1931. Bodies of barren quartz at the Macy mine, near tidewater one-half mile west of Roundy Creek,

* By N. C. Carter.

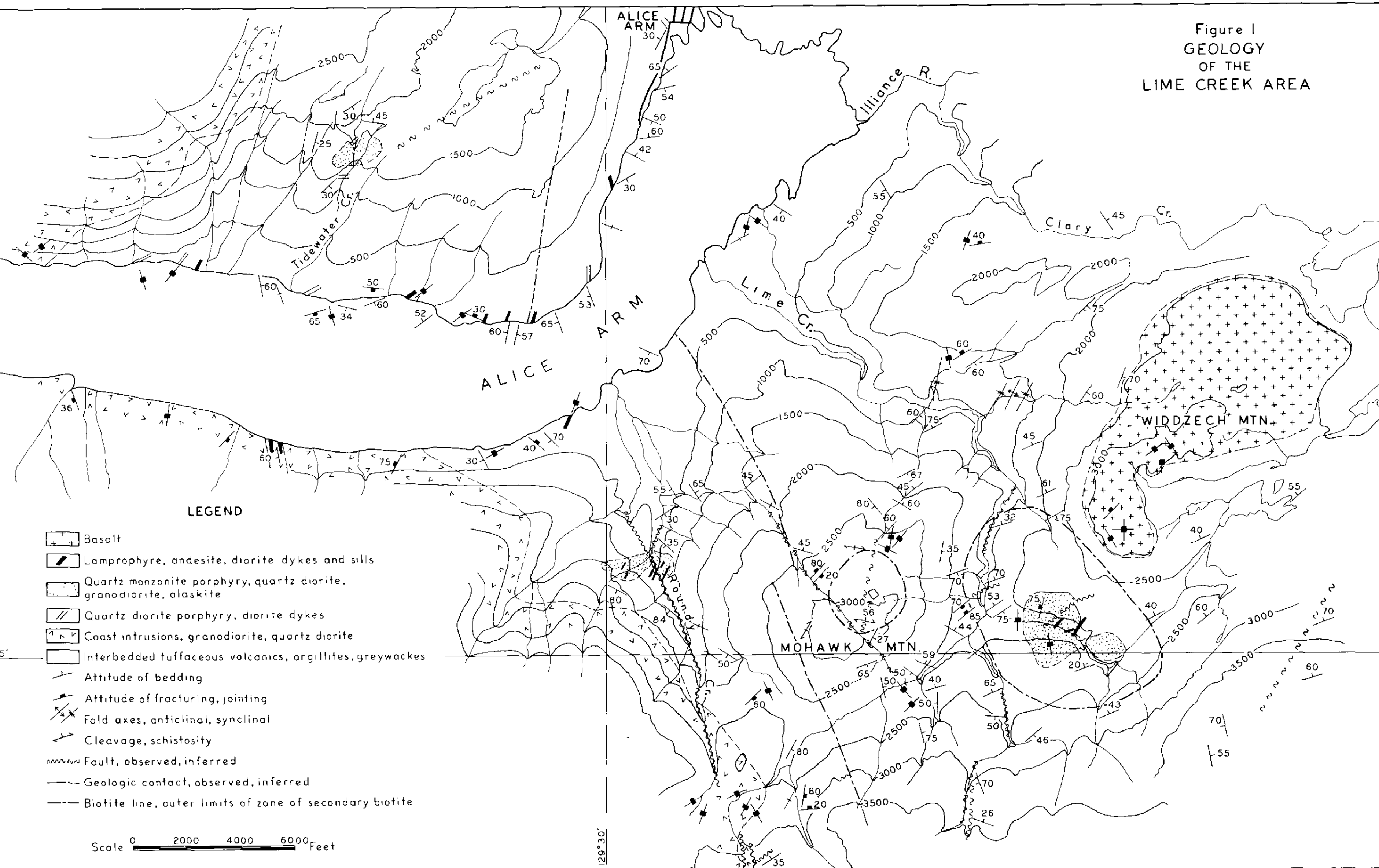


Figure 1
GEOLOGY
OF THE
LIME CREEK AREA

were mined for flux for the smelter at Anyox. Prospecting was done on numerous claim groups within the map-area in the 1920's, including the Keystone, Last Chance, Theda Bara and Bebe Daniels, Mohawk, Sunset, Verona, and Beverley groups. In most cases these occurrences consisted of quartz veins bearing values in lead, zinc, and silver and were localized in fractures in the sedimentary rocks.

The topography is fairly rugged, with deeply incised canyons along Clary, Lime, and Roundy Creeks. Elevations range from sea-level to 3,800 feet in the southern part of the map-area. The dominant topographic feature is expressed by Widdzech (Table) Mountain, made up of flat-lying lava flows and bounded by steep cliffs, particularly along the western side. It extends in an easterly direction for 1½ miles, ranging in elevation from 2,750 to 3,300 feet. Creeks and tributary streams have steep gradients, with numerous waterfalls and box canyons. Heavy timber and thick underbrush from sea-level to 3,000 feet is the general rule for most of the area, making foot travel arduous. Above 3,000 feet, fairly rolling topography is found with numerous open meadows to tree-line at 4,000 feet.

The topography in the southern part of the area, accentuated by the courses of the eastern and western branches of Lime Creek, reflects the major structural trend of north 60 degrees east. Large faults and fractures govern the direction of flow of many of the creeks, most notably Roundy Creek and the creek flowing north-west off Mohawk Mountain. The dominant directions of flow of Lime and Roundy Creeks are broken by the presence of small intrusive bodies.

Climate is typical of that of the northern British Columbia coast, with cool summers and plentiful rainfall in June and July. Heavy winter snowfall in the Portland Canal region is general, with the snow usually gone from the 2,500-foot elevation in early June.

Glacial deposits consisting of gravel and clay overlie most of the area, and as a result most good rock exposures are confined to Creek valleys and to higher elevations, such as Mohawk Mountain, Widdzech Mountain, and the southeast corner of the map-area.

Due to the lack of good exposures in much of the area and the difficulty encountered in running pace and compass traverses through the dense forest growth, the majority of traverses were confined to the creeks, using air photographs and an altimeter for control. A base map at a scale of 1 inch to 1,000 feet and with a contour interval of 50 feet was made up from British Columbia Government air photographs and used for initial plotting.

Mineral occurrences of current interest in the area include three molybdenum deposits, of which the Alice deposit on Lime Creek has undergone the most thorough investigation. The others include the Roundy Creek occurrence, 1¼ miles from the mouth of Roundy Creek, and the Tidewater molybdenum deposit, situated on the north side of Alice Arm 1 mile from sea-level. The molybdenite mineralization on both Lime and Roundy Creeks is associated with small intrusive bodies of quartz monzonite porphyry of probable Tertiary age. Previous mining operations at the Tidewater property were carried out on fairly wide, irregular quartz veins in sedimentary and volcanic rocks immediately south of a small intrusive body of quartz monzonite porphyry.

The oldest rocks, sedimentary and volcanic rocks of Upper Jurassic-Lower Cretaceous age, underlie the greater part of the map-area. Intrusive into them are the Coast Intrusions, including granodiorites and quartz diorites and associated diorite dykes, and small granitoid bodies of Tertiary age. Cutting all rocks in the area, with the exception of the flat-lying lava flows with which they may be related, are dykes and sills of lamprophyre and andesite. The flat-lying Tertiary lava flows of Widdzech Mountain overlie the sedimentary succession unconformably.

Sedimentary and Volcanic Rocks

These rocks, the oldest in the area, occur in two distinct assemblages—a sedimentary-volcanic one on the north side of Alice Arm, and a predominantly sedimentary one to the south.

The southern sedimentary rocks comprise a monotonous succession of interbedded argillites, siltstones, microgreywackes, greywackes, pebble conglomerates, and minor chert. Medium-grained greywacke is the most common rock type, being a massive competent rock with little indication of original bedding. The greywackes are light to medium grey in colour and exhibit a poorly sorted clastic texture with subangular grains of quartz and feldspar in a finer-grained matrix of quartz, feldspar, and argillaceous material. Interbedded with the greywackes are dark-brown to black colour banded argilltes, siltstones, and microgreywackes. These often have good slaty cleavage, which is particularly evident on the south shore of Alice Arm. They are very fine grained and medium bedded with alternating light-grey, buff, brown, and purple banding. Microbanding, with alternating bands of fine- and coarse-grained material, is a common feature of these rocks, as is the presence of disseminated pyrite, which imparts a brown iron-stained weathered surface in most exposures. Pebble conglomerates occur in a number of localities, most notably on the northeast side of Mohawk Mountain. The rock consists of subrounded elongated pebbles of quartz and argillite, one-eighth by one-half inch in size, set in a fine-grained schistose matrix of angular quartz, feldspar, argillaceous material, and carbonate. Pebbles make up 60 per cent of the rock. Beds of banded chert were noted in only a few localities.

The assemblage on the north side of Alice Arm differs from that on the south side by the presence of siliceous and tuffaceous volcanic rocks interbedded with the argillites and greywackes and by having a greater degree of crystallinity, particularly near the contact with the Coast Intrusions. The tuffs are light grey to black in colour and are typified by angular fragments of quartz ranging in size to 2 millimetres. A highly silicified crystal tuff occurs on the north shore of Alice Arm, near the mouth of Tidewater Creek. This is a leucocratic pink to white rock consisting of quartz, feldspar, and sericite with angular fragments of quartz and sodic feldspar. A schistose rock of similar type was noted just north of the old Tidewater workings.

Coast Intrusions

Granodiorites and quartz diorites of the Coast Intrusions occur along the western boundary of the map-area, and related quartz diorite porphyry dykes were noted as far as 4 miles away from the contact. The rocks are medium- to coarse-grained equigranular holocrystalline and are generally massive. A typical specimen is composed of 12 per cent quartz, commonly stained, 49 per cent plagioclase (An_{25}) exhibiting normal zoning, 17 per cent potash feldspar including both orthoclase and perthitic microcline, and 17 per cent chloritized biotite and hornblende, with the remainder made up of muscovite and minor pyrite, epidote, apatite, and sphene. Biotite-rich xenoliths were noted locally in the granodiorites along the south shore of Alice Arm, as were scattered porphyroblasts of pink potash feldspar ranging in size to one-half inch. A paragneiss consisting of half-inch alternating light and dark bands of quartzofeldspathic material and biotite was noted near the contact on the north shore of Alice Arm. The Coast Intrusions are commonly cut by 1-foot-wide andesite dykes.

The contact between the intrusions and the sedimentary and volcanic rock is fairly sharp and is vertical, or nearly so, south of Alice Arm. Some flattening of the contact is evident to the north. A large inclusion of sedimentary rocks cut by andesite dykes was noted on the southern shore of Alice Arm a mile west of the contact.

Quartz diorite porphyry dykes which cut the sedimentary and volcanic rocks on the north side of Alice Arm are up to 25 feet wide and are fine- to medium-grained light-grey to green rocks characterized by subhedral phenocrysts of plagioclase (An_{40}) 3 millimetres in size, set in a matrix of quartz, plagioclase, brown biotite, and laths of partially chloritized green hornblende. A hornblende diorite, exposed near the village of Alice Arm and consisting essentially of laths of brown hornblende and zoned plagioclase (An_{45}), may be related to a phase of the Coast Intrusions.

Quartz Monzonite Porphyry

Three bodies of quartz monzonite porphyry are known in the map-area. That on Lime Creek occurs as a small stock, while the structural relationships of the Roundy Creek and Tidewater intrusive bodies are not completely known. Information obtained from drilling suggests that the Roundy Creek quartz monzonite porphyry may be a relatively thin body in part. Contacts with the country rocks are generally sharp at all three localities.

The quartz monzonite porphyries at Roundy Creek and north of the Tidewater workings are markedly similar in appearance and composition. They are white to pink medium-grained leucocratic porphyries consisting essentially of 3-millimetre phenocrysts of euhedral quartz, plagioclase, and potash feldspar in a matrix of quartz, feldspar, and minor sericite. Mafic minerals are generally lacking, except for a border zone with a fair percentage of biotite in the western part of the Roundy Creek porphyry.

The Lime Creek stock displays a wide variety of rock types exhibiting a fair degree of alteration. The classic stock outline is broken by the presence of a small appendage or extension on the east side of the main stock. The main stock is elliptical in outline and oriented with its long axis in a north-south direction. A central zone of quartz monzonite porphyry grades outward to a quartz diorite phase that forms the east and west rims of the stock and the eastern appendage. The quartz monzonite porphyry is a medium-grained leucocratic rock, and in the central part of the stock it is composed almost entirely of quartz and potash feldspar.

Phenocrysts of quartz and feldspar are subhedral to anhedral in crystal outline, and argillic, sericitic, and potash feldspar alteration within the northern half of the stock has produced a rock type quite dissimilar to those in the Roundy Creek and Tidewater stocks. The quartz diorites are equigranular and differ from the quartz monzonite porphyries in having much less potash feldspar, a more calcic plagioclase, and a greater percentage of mafic minerals, including abundant secondary biotite.

A common rock at Lime Creek and Roundy Creek but not seen at the Tidewater stock is a fine- to medium-grained leucocratic quartzofeldspathic rock having the composition of alaskite. It is intrusive into the porphyries and occurs in dykes and irregularly shaped bodies.

Localized along the eastern and western borders and particularly the northern contact of the Lime Creek stock are fine-grained intrusive porphyries and breccias having the composition of granodiorites and quartz monzonites. A quartz-feldspar porphyry similar in texture and composition to the porphyries at Roundy Creek and Tidewater occurs at depth in a few drill-holes in the northern half of the Lime Creek stock. This rock may be later than the main quartz monzonite porphyry seen on surface or it may be a less altered phase at depth.

The three quartz monzonite porphyry bodies are host to molybdenite mineralization in varying amounts. All are intruded by basic dykes which follow late tension fractures.

Dykes and Sills

Basic dykes and sills are common throughout the area and intrude all rocks, with the exception of the flat-lying Tertiary lava flows. They range from a few feet to 25 feet in width and are of varying compositions. They consist essentially of lamprophyres, andesites, and diorites.

Lamprophyre dykes and sills occur mainly in the vicinity of the Lime Creek stock, where they are found cutting both the sediments and porphyries. They occur in swarms near the eastern contact of the stock. The lamprophyres are fine- to medium-grained dark-green rocks consisting of euhedral grains of clinopyroxene and plagioclase (An_{46-50}), which make up 20 and 60 per cent of the rock respectively. Minor hornblende is present, and amygdaloidal varieties feature calcite rimmed by chlorite. Minor amounts of green chlorite, brown biotite, and accessory magnetite, epidote, and sphene are also present. Sharp, chilled contacts are a common feature of these rocks.

Fine-grained green chloritized dyke rocks were noted to the north and west of the Lime Creek stock, particularly along Roundy Creek and the shoreline. These rocks have the composition and texture of andesites and consist of 57 per cent sericitized plagioclase and 20 per cent euhedral grains of poikilitic brown hornblende partially altered to green fibrous chlorite; the remainder includes abundant disseminated magnetite and minor olivine and calcite. Directly north of the Lime Creek stock, the same rock type occurs in dykes 2 to 4 feet wide and is composed essentially of sericitized plagioclase and chlorite.

Diorite dykes and sills similar in composition to the andesitic types but coarser grained occur in swarms in the old Tidewater molybdenum workings, where they follow zones of weakness adjacent to and between large molybdenite-bearing quartz veins. The diorites have chilled contacts and are equigranular to porphyritic, with phenocrysts of subhedral plagioclase (An_{50}) making up 55 per cent of the rock. The remainder of the rock consists of hornblende and pyroxene largely altered to chlorite, secondary brown biotite, and accessory magnetite, epidote, and sphene. Carbonate alteration of the diorites is extreme.

Some of the basic dykes, particularly the lamprophyres in and near the Lime Creek stock, may have acted as feeders for the flat-lying lava flows immediately to the northeast.

Lava Flows

Lava flows of Tertiary age cap Widdzech (Table) Mountain, which is the most westerly of four flat-lying remnants that extend 5½ miles in an easterly direction south of the Illiance River. The flows occur in horizontal beds up to 50 feet thick, as shown in terraces along the northern contact. Columnar jointing is a dominant feature on the western cliff face of the mountain. The rock is dense, fine grained, and dark green in colour with local amygdaloidal and porphyritic phases. It has a basaltic composition and consists essentially of calcic plagioclase and clinopyroxene with occasional amygdules of iron rich olivine. The porphyritic phase is characterized by phenocrysts of normally zoned plagioclase to 4 millimetres, which make up 25 per cent of the rock.

Large erratics of volcanic agglomerate, measuring 15 feet in diameter, were noted midway along the northern side of the mountain. These rocks are made up of 2- to 5-inch bombs in a scoriaceous matrix. The rounded bombs have the same composition as the basaltic lava flows.

The basaltic lava flows overlie the sedimentary succession unconformably and appear to be the youngest rocks in the area.

Pleistocene and Recent

Clay and gravel cover most of the area. Gravel terraces were noted at an elevation of 300 feet near the mouth of Lime Creek. Sand and gravel deltas are found at the mouths of the larger creeks, and a large tidal flat at the head of Alice Arm is composed of silt deposited by the Kitsault and Illiance Rivers.

Glacial striæ parallel the shoreline of Alice Arm.

Metamorphism

Sedimentary and volcanic rocks have been subjected to low-grade regional metamorphism of the greenschist facies caused by intrusive activity associated with the Coast granitic complex. More important within the boundaries of the map-area are zones of contact metamorphism surrounding the quartz monzonite porphyries and the Coast Intrusions.

A well-developed biotite zone of metamorphism exists around the Lime Creek stock, extending outward a distance of 1,000 to 4,000 feet to a biotite line or isograd where the first appearance of secondary biotite was noted in the sedimentary rocks. The biotite content increases with proximity to the stock, with a biotite-hornfels zone roughly 500 feet in width rimming the stock. Biotite zones surrounding the intrusive bodies at Roundy Creek and Tidewater Creek have been superimposed on the metamorphic effects developed in the sedimentary and volcanic rocks by the Coast Intrusions. Both these intrusive bodies are rimmed by a biotite-hornfels zone similar to that at Lime Creek.

On the south side of Alice Arm, a biotite line appears at a distance of 2,000 to 8,000 feet away from the contact between the Coast Intrusives and the sedimentary sequence. This variation in distance between the biotite isograd and the contact is probably due to the intrusion of the Roundy Creek stock. On the north side of Alice Arm, the biotite line appears almost 3 miles east of the contact and suggests a shallow dipping contact between the Coast granodiorites and the sedimentary-volcanic sequence in this area.

An anomalous zone of secondary biotite occurs on the top of Mohawk Mountain between the biotite lines of the Lime Creek stock and the Coast granitic rocks.

Structure

The dominant structural trend in the area south of Alice Arm is northeast, as expressed by the topography and drainage pattern. In the extreme northern part of the map-area, the sedimentary rocks strike roughly north 60 degrees east with moderate to steep dips to the northwest. In the vicinity of the Lime Creek stock and to the northwest, fairly tight folding was noted, with distance between folds in the range of 500 to 1,000 feet.

The northeasterly sedimentary trend is contorted locally, particularly near the granitic contact along Roundy Creek and the western slope of Mohawk Mountain. Close to this contact the strike is northwest, with steep dips to the south. The contortion appears to lessen in an easterly direction.

The sedimentary-volcanic rocks on the north side of Alice Arm exhibit a somewhat different trend, striking in a northerly direction roughly parallel to the granitic contact. This may represent cross-folding of an easterly trend, which is evident to some degree along the northern shore of Alice Arm.

The main direction of jointing is northeasterly, with a complementary northwest set. Many of these joints are filled with quartz and carbonate and are closely spaced, often obscuring any trace of bedding. Slaty cleavage, not uncommon in the argillites, appears to bear little relation to major structure.

Major faults and shear zones are common throughout the area, as indicated by the alignment of topographic features and displacements of rock contacts. Many of these trend northeastward, signifying movement along major joint sets. A fault along Roundy Creek has displaced both the contact of the Coast Intrusions and the quartz monzonite porphyry stock.

[References: *Minister of Mines, B.C.*, Ann. Rept., 1916, pp. K 57–K 82; *Geol. Surv., Canada*, Sum. Rept., 1922, Pt. A, pp. 35A–50A; *Geol. Surv., Canada*, Sum. Rept., 1928, Pt. A, pp. 27A–49A; *Geol. Surv., Canada*, Mem. 175, 1935.]

Molybdenum

Alice (British Columbia Molybdenum Ltd.)*

(55° 129° S.E.) Company office, 1030 West Georgia Street, Vancouver 5. C. H. Burgess, president. This property, consisting of 72 full and fractional recorded claims, is situated on the southeast fork of Lime Creek approximately 5 miles south of Alice Arm. A pack-trail in fair condition leads to the property from the site of Silver City, just east of the mouth of Lime Creek.

Since 1959, 43,152 feet of diamond drilling, including an initial 1,021 feet of packsack drilling, has been carried out. In addition, some 300 lineal feet of open cutting and trenching has been done. Records of earlier work are contained in Annual Reports dating back to 1916. The property has been known variously as the Cariboo group and the Lynx group. Small adits were driven on the molybdenite showings and along small quartz veins bearing values in lead and zinc immediately east of the zone of molybdenite mineralization. All have since caved.

Molybdenite mineralization is associated with a small elliptical stock of quartz monzonite-quartz diorite composition. A feature of the stock is the presence of an eastern appendage or extension which is connected to the main stock at the midpoint of the eastern side. The stock, of Tertiary age, intrudes Upper Jurassic-Lower Cretaceous argillites and greywackes which have been contact metamorphosed to biotite hornfels bordering the stock.

The main part of the stock, elongated in a north-south direction, measures 2,000 by 2,800 feet, while the eastern appendage measures 1,000 by 1,500 feet. The stock is bisected by the southeast fork of Lime Creek, flowing in a westerly direction. Elevations in the stock area range from 1,730 feet in Lime Creek to

* By N. C. Carter.

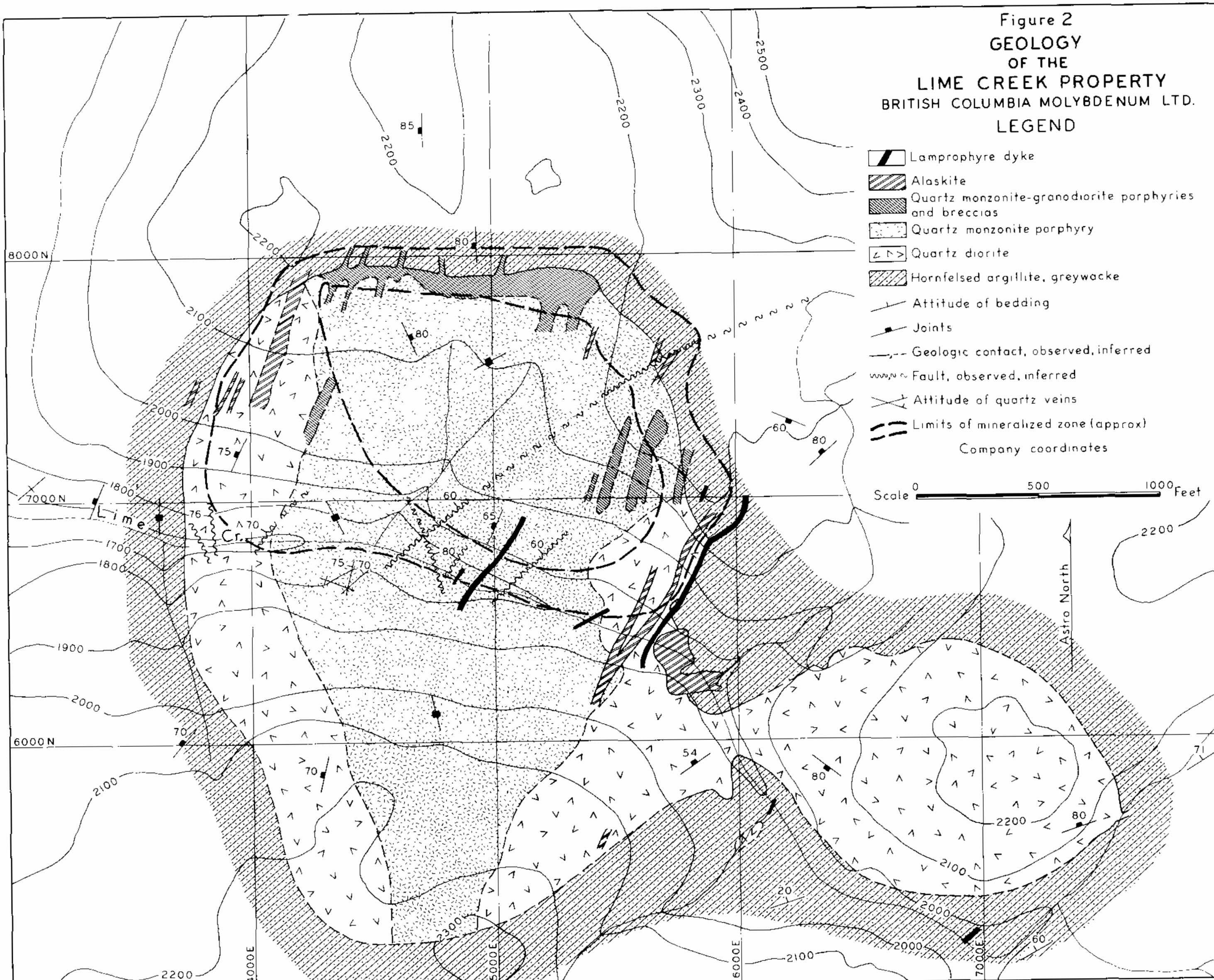


Figure 2
GEOLOGY
OF THE
LIME CREEK PROPERTY
BRITISH COLUMBIA MOLYBDENUM LTD.
LEGEND
Lamprophyre dyke
Alaskite
Quartz monzonite-granodiorite porphyries and breccias
Quartz monzonite porphyry
Quartz diorite
Hornfelsed argillite, greywacke
Attitude of bedding
Joints
Geologic contact, observed, inferred
Fault, observed, inferred
Attitude of quartz veins
Limits of mineralized zone (approx)
Company coordinates
Scale 0 500 1000 Feet
Astro North
Lime Cr.
8000 N
7000 N
6000 N
4000 E
5000 E
6000 E
7000 E

2,250 feet along the northern and southern contact areas. Extensive swamp cover obscures bedrock in the northern half of the stock while some rocky ridges are present in the southern half. Good exposures are confined to small creek valleys and to the southeast fork of Lime Creek, which affords a good cross-section of the stock.

An annular zone of molybdenite mineralization is situated around the borders of the northern half of the stock, with finely disseminated molybdenite contained in small quartz veins arranged in a stockwork pattern. This quartz-vein stockwork is also present inside the mineralized zone, with sporadic amounts of molybdenite grading inward from the ring-like ore zone to a central barren zone some 800 feet in diameter.

A base map at a scale of 100 feet to the inch was furnished by the company. The following account of the geology is based on a study of surface exposures and examination of drill core at the property.

General Geology

The stock is made up of granitoid rocks of several types and ages, with a central zone of quartz monzonite porphyry grading to a quartz diorite on the western and southeastern sides. These rocks appear to have formed contemporaneously and exhibit varying degrees of alteration. They are cut by later dykes and irregular bodies.

Three types of quartz monzonite porphyry exist within the stock: a relatively unaltered type confined to the southern half of the stock, the host rock in the ring-like mineralized zone, and a quartz monzonite porphyry making up the barren zone within the mineralized zone. The three types are distinguished by degree of alteration.

The quartz monzonite porphyry of the southern part of the stock is a relatively unaltered medium-grained leucocratic rock, with euhedral to subhedral 4-millimetre phenocrysts of normally zoned plagioclase (oligoclase-andesine) and poikilitic potash feldspar making up a fair percentage of the rock volume. The original mafic minerals, including hornblende and biotite, have been largely altered to chlorite, and the feldspars exhibit slight sericite alteration. This rock is not unlike the quartz diorites of the southwestern part of the stock in that it is characterized by ragged plates of secondary brown biotite and contains a fair amount of disseminated pyrite that imparts a brown iron stain to weathered surfaces.

The grey to pink quartz monzonite porphyry in the zone of molybdenite mineralization is characterized by a high degree of potash feldspar metasomatism which has produced rounded porphyroblasts of potash feldspar in the rock matrix and along the margins of numerous small mineralized quartz veins arranged in a stockwork pattern. The potash feldspar, generally orthoclase, replaces plagioclase, and perthitic and graphic intergrowths are common. Sericite, clay minerals, and carbonate are common alteration products of normally zoned plagioclase which occurs both in the matrix and in the form of subhedral phenocrysts up to 4 millimetres in size. Mafic minerals include primary biotite largely altered to green fibrous chlorite and secondary brown biotite. Disseminated pyrite occurs both in the rock matrix and within the quartz veins.

The quartz monzonite occupying that part of the stock within the annular mineralized zone is a medium- to coarse-grained pink leucocratic quartzose rock, porphyritic near the mineralized zone and equigranular in the central barren zone. Here the rock has undergone the greatest degree of alteration and consists of 60 per cent quartz and 40 per cent potash feldspar, with traces of sericite and pyrite. Potash feldspar metasomatism has been extreme, the areas between the numerous quartz veins in a stockwork pattern being made up almost entirely of potash feldspar. Toward the mineralized zone the rock becomes porphyritic with a lessening of potash feldspar content and contains 3- to 4-millimetre anhedral phenocrysts of potash feldspar and normally zoned plagioclase exhibiting a high degree of sericitic and argillic alteration. Secondary biotite is common, and the quartz veins contain a fair amount of carbonate.

The quartz diorites on the western and eastern sides of the stock are gradational through granodiorite to quartz monzonite porphyry with the addition of potash feldspar, an increase in sodic content of the plagioclase, and a lessening in the amount of primary mafic minerals, including hornblende and biotite partly altered to chlorite. The quartz diorites are medium-grained white to grey massive rocks with sparse phenocrysts of plagioclase to 5 millimetres. Potash feldspar metasomatism in these rocks is found generally along quartz veins within the mineralized zones, with only occasional grains of pink feldspar in the matrix. Disseminated pyrite and abundant secondary biotite are common in the quartz diorites. Irregular lenses and dykes of quartz diorite occur in the hornfelsed sedimentary rocks around the eastern contact area.

The quartz diorite of the southeastern part of the main stock, and the eastern extension, differs from that along the western side by a darker grey colour, a greater percentage of primary mafic minerals, and a more calcic plagioclase. Porphyritic phases are not uncommon along the southern contact of the eastern extension, with phenocrysts of normally zoned plagioclase making up 25 per cent of the rock. Ragged laths of hornblende partly altered to chlorite are common in the eastern quartz diorite, and there is sericite and clay mineral alteration of feldspar.

The quartz diorite along the western boundary has a fresher more leucocratic appearance and is coarser grained in part than that on the eastern side. Secondary reddish brown biotite is the dominant mafic mineral, and alteration of feldspar is slight.

Intrusive into both the quartz monzonite porphyries and the quartz diorites, and apparently confined to the northern half of the stock, are irregular lenses and dykes of a fine-grained quartz monzonite-granodiorite porphyry. These intrusions occur along the margins of the stock, particularly along the northern contact, and are characterized by distinct euhedral phenocrysts of sericitized plagioclase 2 millimetres in size. Approaching the northern contact, the rock grades through a type with protoclastic texture to an intrusive breccia containing sharply angular blocks of hornfels ranging in size to 5 inches in a granulated matrix. Inclusions of the main quartz monzonite porphyry to 1 foot in size were also noted along the northern contact. These porphyries and breccias are light grey to green in colour and have sharp contacts with the rocks they intrude. Outcrops of this type are poor, and most information concerning their position has been obtained from drill core. A few small exposures exist along the northern contact where the intrusive breccia occurs as small parallel dykes intruding both the quartz monzonite porphyry and hornfels. In thin-section, phenocrysts of subrounded crackled quartz and feldspar constitute 20 to 40 per cent of the rock. Bent albite twin lamellæ and curved biotite plates indicate a granulated texture, as does the very fine-grained crushed matrix of quartz and feldspar largely replaced by carbonate.

Occurring as dykes and irregular bodies intrusive into all of the above-mentioned rock types is a fine- to medium-grained holocrystalline white to pink rock with the composition of alaskite. The alaskites consist almost entirely of anhedral quartz and potash feldspar, including both orthoclase and microcline with perthitic and graphic intergrowths. The alaskite most commonly occurs near the contact areas of the stock, particularly near the eastern margins, where inclusions of quartz diorite to 5 feet in size were noted. It intrudes both hornfels and quartz diorite near the northwestern contact. The rock is characterized by numerous one-eighth to one-quarter inch quartz veins arranged in a stockwork pattern and has a brownish colour on weathered surfaces due to the presence of abundant disseminated pyrite.

A quartz feldspar porphyry is situated below the 1,600-foot level in the northern half of the stock, beneath the barren central zone and beneath the northeast part of the stock. This rock type, having the composition of a quartz monzonite, was encountered in only a few drill-holes, and age relationships are obscure. It may in part be post-mineralization in age, although some parts are mineralized slightly. A relatively unaltered phase of the quartz feldspar porphyry occurs in the northeastern part of the stock, with distinct euhedral phenocrysts of quartz and plagioclase feldspar making up 50 per cent of the rock. Plates of brown biotite are only partly chloritized, and feldspars show only minor sericite alteration. To the southwest, underlying the central part of the stock, the quartz feldspar porphyry contains more potash feldspar and exhibits a greater degree of sericite and clay mineral alteration but generally maintains distinct euhedral phenocrysts, including plagioclase, potash feldspar, and quartz. The rock is more quartzose and leucocratic than that occurring under the northeast part of the stock and has finely disseminated biotite.

Cutting all rocks in the stock, including the quartz feldspar porphyry, are lamprophyre dykes varying in width from 2 to 30 feet. These fine- to medium-grained dark-green rocks consist essentially of euhedral calcic plagioclase and clinopyroxene commonly altered to hornblende and chlorite. Amygdaloidal varieties feature calcite rimmed by chlorite. The lamprophyres have sharp, chilled contacts and occur in swarms near the eastern contact, where they have a northeasterly trend, following major joint directions. They are later than the period of mineralization, as mineralized quartz veins end abruptly at the lamprophyre contacts.

Argillites and greywackes of the sedimentary sequence adjacent to the stock have been thermally metamorphosed to hornfelses forming a roughly circular zone 200 to 500 feet in width. Two types of hornfels exist—a quartz-biotite-chlorite hornfels occupying the outer parts of the zone and an inner quartz-muscovite hornfels immediately adjacent to the stock. The quartz-biotite-chlorite hornfels derived from greywacke is a brown granoblastic to porphyroblastic rock with 1-millimetre quartz porphyroblasts in a very fine-grained quartz-feldspar-biotite matrix. That derived from argillites is distinguished by having a greater amount of biotite and a crude brown and green colour banding. The quartz-muscovite hornfels, occurring in various places along the stock contact, is a buff-coloured siliceous rock consisting almost entirely of quartz and sodic feldspar with minor muscovite, chlorite, and pyrite.

The hornfelsed sediments are massive competent rocks grading outward to the original sedimentary types. They contain numerous quartz-carbonate hairline fractures, many of which are mineralized adjacent to the stock contacts. In addition, the quartz-vein stockwork pattern, so common along the margins of the stock, partially extends into the hornfelsed rocks. Contacts with the stock porphyries are sharp, with a few inclusions of hornfels within the porphyries.

Metamorphism and Alteration

Contact metamorphic processes involving the addition of quartz and the formation of secondary biotite have converted the sedimentary rocks adjacent to the stock to a biotite hornfels. The biotite content is greatest in a zone extending 200 to 500 feet outward from the stock where the hornfelsed rocks grade into the characteristic argillites and greywackes of the area. Minor amounts of secondary biotite are present within the sedimentary rocks in a zone 1,000 to 4,000 feet outward from the stock.

There are several types of alteration of the granitoid rocks. Much of the alteration is due to hydrothermal activity associated with the period of mineralization, and as such is confined to the northern half of the stock, both within the zone of molybdenite mineralization and the central barren zone. An exception is the widespread occurrence of unaltered, secondary biotite, present in all the granitoid rocks. Chlorite alteration of original mafic minerals may be earlier than the main period of hydrothermal alteration.

Potash feldspar metasomatism is found rimming both mineralized and non-mineralized quartz veins a distance of 2 inches outward from the veins, and large grains of pink orthoclase to 5 millimetres in size replace plagioclase in the rock matrix. Potash feldspar metasomatism in the central barren zone of the northern half of the stock has been so great as to obliterate all traces of the original rock, converting it to an equigranular type composed essentially of quartz and pink orthoclase.

Argillic and sericitic alteration of plagioclase feldspar is widespread throughout the northern half of the stock in and near the mineralized zone. Large sections of a soft, grey, friable rock made up almost entirely of sericite and clay minerals are common adjacent to shear zones which contain abundant chlorite on slip surfaces.

Carbonate alteration is characterized by extensive leached zones with vuggy surfaces, and is widespread in the fine-grained porphyries. Minor silicification has taken place adjacent to quartz veins, in some cases extending outward a fraction of an inch from the veins.

Structure

The attitudes of the contact are fairly well known for the northern half of the stock. The western contact is nearly vertical, and the eastern contact, with local variations, dips at an angle of 75 degrees to the east. The northern contact dips between 65 and 82 degrees to the north. Attitudes of the southern stock contact and of the eastern extension of the stock are imperfectly known. The easternmost contact of the eastern extension dips steeply to the northeast.

Rocks within and outside the stock are transected by numerous joints. A major joint set strikes northeast and is vertical or dips steeply to the northwest. A complementary vertical set trends northwest.

Numerous large shear zones were noted along the southeast fork of Lime Creek, where they have the same trends as the joint pattern. In addition, numerous gouge zones are present in much of the drill core, particularly in that from the northeast part of the stock where the contact has been offset by numerous shears and thrust faults. A major shear zone which offsets the stock contact by 50 feet on surface in this area is probably an extension of major shear zones along Lime Creek. Some of these shears may be pre-mineralization in age, but slickensiding on lenses of molybdenite contained in many of the gouge zones indicates later movement along them.

Country rocks west of the stock show a change in structural trend effected by the intrusion of the stock. Away from the western contact, the rocks show the regional northeast structural trend. Approaching the contact, strikes change to nearly due north with vertical dips, conforming to the contact. This feature is not apparent along the eastern contact of the stock.

Lamprophyre dykes fill late northeasterly tension fractures.

Mineralization

The zone of molybdenite mineralization is a ring structure, elliptical in outline and elongated in an east-west direction, and is confined to the northern half of the stock. It measures 2,850 by 1,850 feet and is between 100 and 600 feet wide. The outer boundaries of the mineralized zone conform roughly to the north, east, and west contacts of the stock both on surface and at depth, while the southern extremity of the zone cuts across the stock at its mid-point and dips steeply to the north. The molybdenite content fades out toward the centre of the zone, with a central barren zone containing little or no molybdenite. Within the mineralized zone, higher-grade shoots of molybdenite mineralization occur.

Molybdenite mineralization occurs in small quartz veins arranged in a closely spaced stockwork pattern with one vein per half inch. The individual veins generally are not more than one-half inch wide and commonly are one-eighth to one-quarter inch wide. Molybdenite occurs along the boundaries of the quartz veins and to a lesser extent is finely disseminated within the veins. Mineralized veins one-half inch or larger exhibit a banded appearance, with molybdenite filling hairline fractures parallel to the vein walls. The largest molybdenite-bearing quartz vein noted was 1 foot wide and showed good banding. Hairline fractures in hornfels and alaskites within the mineralized zone consist almost entirely of molybdenite. Molybdenite is found to a lesser degree coating slip planes representing movement along pre-existing fractures. Molybdenite disseminated within rock matrixes is found only in the alaskites, and in these some rosettes of molybdenite one-quarter inch in size are found.

The quartz veins are closely spaced and randomly oriented in a stockwork pattern, but as a general rule molybdenite-bearing quartz veins strike north 15 degrees east with steep westerly dips. A second stage of molybdenite-bearing quartz veins, apparently not as numerous as the first stage, strike north 50 degrees east.

Initial molybdenite-bearing quartz veins are cut by white milky quartz veins up to 3 feet wide and striking north 70 degrees west with vertical dips. These later veins are barren of molybdenite but contain minor amounts of pyrite, galena, sphalerite, cosalite, and scheelite with some fluorite. Minor chalcopyrite, tetrahedrite, pyrrhotite, and gypsum were also noted in these veins, and carbonate-filled fractures are common.

Disseminated pyrite, some of which may be contemporaneous with the initial stage of molybdenite mineralization, is widespread in the quartz veins and rock matrixes both within and outside the ring zone of molybdenite mineralization. Disseminated pyrite is contained in all the rocks making up the stock and to a lesser extent is found within the biotite hornfels zone.

Controls for the localization of molybdenite mineralization are obscure. The quartz-vein stockwork is found throughout the northern half of the stock and in adjacent hornfelses, although molybdenite mineralization decreases sharply inward from the ring zone. Along the outer margins of the mineralized ring, the quartz veins decrease in number and assume a sub-parallel arrangement. The stock contact undoubtedly acted as a locus for intense fracturing in both the hornfels and the margins of the stock during its emplacement. In addition, the hornfelsed zone may have acted as a trap for the mineralizing solutions. The southern limit of the mineralized zone which crosses the middle of the stock may be due to a pressure-temperature effect outward from a central source, in this case the central barren zone of extreme hydrothermal alteration.

Higher grades of molybdenite mineralization occur in areas of intense fracturing and faulting, particularly in the northeast corner of the stock where a major fault has offset the stock contact and numerous smaller faults offset the stock contact at depth. Higher-grade oreshoots with unknown orientation are numerous in this zone.

Alaskites appear to be the most favourable host rock, commonly containing much molybdenite both in numerous veins and hairline fractures and as disseminations in the matrix.

Near the southern contact of the eastern quartz diorite extension a small adit was driven years ago on a 10-inch-wide quartz vein containing galena, sphalerite, and pyrite. A sample taken across the vein assayed: Gold, trace; silver, 3.0 ounces per ton; copper, 0.03 per cent; lead, 1.34 per cent; zinc, 1.2 per cent; molybdenum, 0.01 per cent.

Three chip samples were taken within the ore zone with the results tabulated below:—

Sample No.	Location	Lead	Zinc	MoS_2	Tungsten	Bismuth
		Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
1	West part of zone near creek	0.02	....	0.21	Trace	Trace
2	Northeast part of zone	Trace	....	0.36	....	....
3	Southeast part of zone	Trace	....	0.19	—	....

[References: *Minister of Mines, B.C.,* Ann. Repts., 1916, p. K 66; 1959, p. 10; 1960, p. 10; 1961, p. 10; 1963, p. 12; Hanson, G., 1923, *Geol. Surv., Canada,* Sum. Rept., Pt. A, p. 48A; Hanson, G., 1935, *Geol. Surv., Canada,* Mem. 175, p. 71.]

Roundy Creek* (55° 129° S.E.) This group of 40 full and fractional recorded claims is owned by Gunn Fiva, of Alice Arm. In 1960 the property was under option to Southwest Potash Corporation, during which time geological mapping and 2,500 feet of drilling were carried out.

The claim group, extending both east and west of Roundy Creek, includes a small stock-like body of quartz monzonite porphyry located on the creek 1¼ miles from tidewater. Molybdenite mineralization occurs in a poorly developed stockwork of quartz veins and as disseminations in alaskite-type rocks. A small lens of alaskite with high-grade molybdenite mineralization occurs in the western part of the porphyry body.

The quartz monzonite porphyry intrudes westerly dipping argillaceous sedimentary rocks, and while the greater part of the body is stock-like in form, it is a relatively thin lens in part. Roundy Creek follows the trace of a major north-trending fault zone which offsets the granitic contact near the head of the creek (*see* Fig. 3). This same fault zone has separated the porphyry body into eastern and western parts with an intervening wedge of hornfelsed sedimentary rocks. The eastern part is roughly circular and measures 800 feet in diameter, while the western part measures 1,800 by 800 feet in a westerly direction.

The quartz monzonite porphyry is a medium-grained pink to white leucocratic rock with 3-millimetre phenocrysts of glassy quartz, euhedral plagioclase, and potash

* By N. C. Carter.

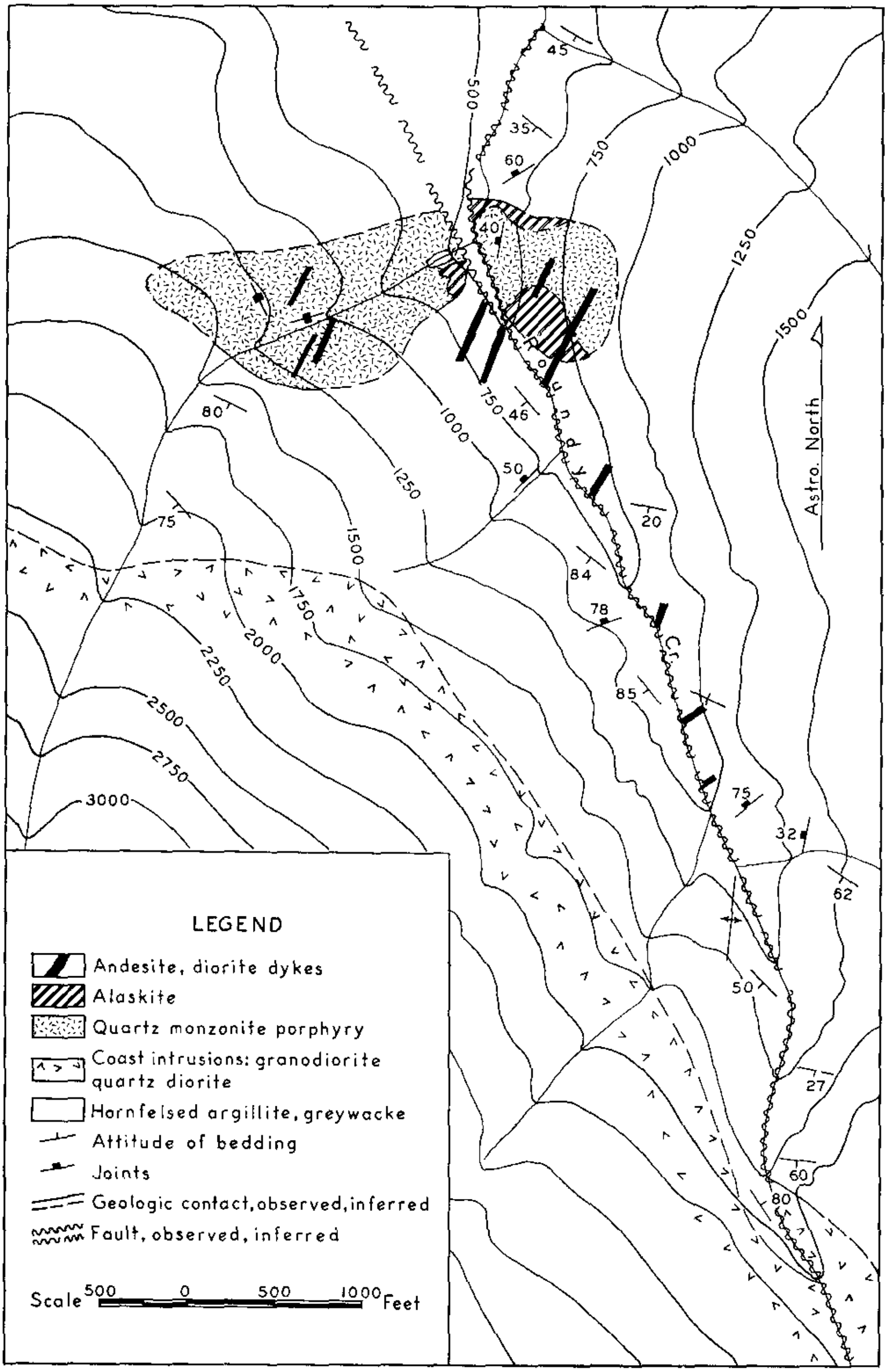


Figure 3. Geology of Roundy Creek stock and vicinity.

feldspar making up half the rock. Muscovite in minor amounts is the dominant mafic mineral with only minor chlorite and biotite. A zone relatively rich in biotite and crudely foliated in part occurs near the western boundary of the western body. Disseminated pyrite is common in these rocks, and 1-inch pyrite-rich xenoliths were noted in the eastern body along the creek. Moderate argillic and sericitic alteration of feldspar is the rule; however, clay, sericite, and chlorite alteration of the porphyry in large gouge zones was noted in the drill core. The quartz monzonite porphyry resembles the quartz-feldspar porphyry encountered at depth in the Lime Creek stock.

Intruded as dykes and irregular bodies in the quartz monzonite porphyry is an alaskite similar to the type present in the Lime Creek stock. It is localized near the boundaries of the stock and is particularly extensive in the southern part of the eastern porphyry mass. The rock is fine to medium grained and consists almost entirely of quartz and potash feldspar exhibiting micrographic intergrowths. Minor amounts of myrmekite and sericite are also present. The rock is cut by numerous one-sixteenth to one-quarter inch quartz veins and hairline fractures commonly bearing molybdenite.

Later than both the quartz monzonite porphyry and the alaskites are several varieties of basic dykes trending northeastward with vertical to steep westerly dips. The dykes are commonly less than 10 feet in width and include andesites, diorites, and lamprophyres. Dykes of andesitic composition occur in swarms in the eastern part, while a large diorite dyke was noted in drill core from the western part of the stock.

Sedimentary rocks have been contact metamorphosed to hornfels in a zone roughly 200 feet wide surrounding the stock. The most common type is a colour banded light to dark brown to green biotite-rich rock exhibiting a characteristic granoblastic texture. Reddish-brown biotite, minor muscovite, and chlorite impart a foliation to the rock parallel to original bedding. In general, the rock consists of 65 per cent quartz and minor feldspar, the remainder being biotite, muscovite, chlorite, and disseminated pyrite. A green phyllitic hornfelsed rock occupying the area between the eastern and western portions of the stock consists of alternating bands of biotite and quartz and very fine-grained black argillaceous material with distinct 1-millimetre porphyroblasts of muscovite and biotite.

Structural relationships of the intrusion are imperfectly known. Drilling evidence indicates nearly vertical contacts along the northern and southern boundaries of the stock. A vertical hole drilled near the mid-point of the eastern part encountered hornsfelsed sediments at a depth of 300 feet, suggesting that the eastern part may be a relatively thin body dipping eastward. A zone of hornfels, 200 feet long and located near the eastern edge of the western part of the stock, may be a window in the porphyry, supporting the view that the " stock " is a relatively thin lens in the eastern part.

Joint sets within the porphyry trend north 40 degrees east and north 20 degrees west and are vertical or nearly so.

The eastern part of the stock contains more widespread molybdenite mineralization than the western part, occurring in one-eighth to one-quarter inch quartz veins in a poorly developed stockwork pattern in the quartz monzonite porphyry and in hairline fractures and as disseminations in the alaskite. A selected chip sample of mineralized alaskite assayed 0.32 per cent MoS_2, while two similar samples from the quartz monzonite porphyry assayed 0.12 and 1.18 per cent MoS_2.

The western part of the stock is nearly barren of molybdenite mineralization, with the exception of an isolated lens of alaskite with relatively high values in molybdenite. This zone is exposed in the northeasterly flowing tributary to Roundy Creek at an elevation of 1,100 feet. The well-mineralized lens is 60 feet in length along the creek and 25 feet wide with an exposed thickness of 20 feet. Large northeast-trending fractures bound the zone on the east and west. A drill-hole driven under the zone indicates that it is shallow and flat lying. Mineralization averaging 6 per cent MoS_2 occurs as irregular blebs and patches and in closely spaced parallel one-quarter inch quartz veins giving a banded appearance to the rock. The individual veins, composed of 40 per cent quartz and 60 per cent molybdenite, have sharp boundaries with the intervening alaskite. More massive mineralized zones exhibit a replacement texture, with molybdenite-quartz lenses replacing medium-grained alaskite along fractures.

That part of the quartz-monzonite porphyry that surrounds the alaskite lens has a fairly well-developed quartz vein stockwork, but the veins are barren of molybdenite.

Tidewater* (55° 129° S.W.) This group, consisting of 2 Crown-granted claims and 89 claims held by record, is owned by Morris Black, of Vancouver. Under an agreement, Canex Aerial Exploration Ltd. carried out exploratory work on the property during 1964. The claim group includes the old Tidewater workings, from which 13,022 pounds of molybdenite was recovered from sporadic production between the years 1916 and 1931. A trail in fair condition leads from the beach to the old workings at an elevation of 1,000 feet.

Original mining was carried out in 1916, during which time 383 tons having an average grade of 1.60 per cent MoS_2 was shipped to Renfrew, Ont. The property lay dormant until 1930, when the Dalhousie Mining Co. Ltd. undertook mining operations in two adits. Work stopped the following year, when a sample of 2,700 pounds was shipped to the Department of Mines Ore Dressing and Metallurgical Laboratories in Ottawa. During the operations an aerial tramway connected the mine workings with a 100-ton flotation plant on the beach.

Two adits, at elevations of 1,015 and 1,121 feet and still in fair condition, follow northeasterly trending quartz veins with varying amounts of molybdenite mineralization. Extensions of these veins can be traced for a distance northward in the creek in the direction of a small stock of quartz monzonite porphyry located 900 feet north of the underground workings.

The quartz veins, up to 15 feet wide, are well exposed in the two adits. They follow northeasterly trending shears and fractures having a steep northwesterly dip, which occur in a northeasterly trending succession of interbedded brown to black to green argillites, greywackes, and fine-grained siliceous crystal tuffs. The sedimentary-volcanic rocks are intruded by quartz diorite porphyry dykes probably related to a phase of the Coast Intrusions. Intruded along the same zones of weakness as the quartz veins are fine- to medium-grained dark-green dykes of dioritic composition, thus causing the quartz veins to vary greatly in width along strike and in vertical continuity. The dykes are commonly 10 to 15 feet wide with chilled borders adjacent to the quartz veins. They are characterized by having extreme carbonate alteration and occasional subhedral phenocrysts of plagioclase. Some later shearing has taken place along the contacts of the veins and dykes.

Molybdenite mineralization in the quartz veins occurs in seams parallel to the vein walls, giving a banded appearance. According to Stevenson (1940), the best grade of molybdenite mineralization on the property occurs in the old stope off the upper adit, where sampling across a width of 4.1 feet and a length of 12 feet aver-

* By N. C. Carter.

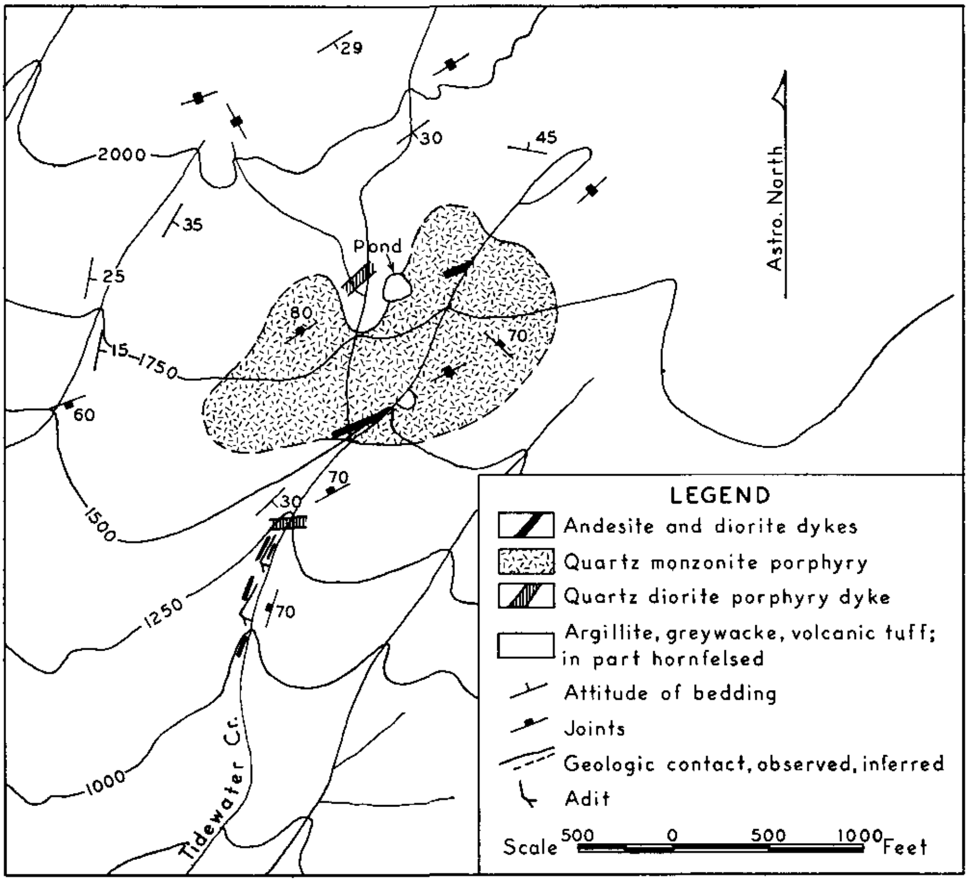


Figure 4. Geology of Tidewater molybdenite property.

aged 2.65 per cent MoS_2. In the lower adit, the best grade indicated was 1.05 per cent MoS_2 over a width of 3.9 feet and a length of 78 feet.

The quartz monzonite porphyry stock measures 2,000 by 1,500 feet and is irregular in outline. Contact relationships are obscure, except along the southern contact, which appears to be nearly vertical to steeply south dipping. The southern contact is fairly sharp, with only a few stringers of porphyry projecting into the wallrocks. The quartz monzonite porphyry is a medium-grained leucocratic pink to white rock with one-quarter inch phenocrysts of quartz and feldspar. The porphyry differs little in texture and composition from that exposed at Roundy Creek.

Andesite dykes up to 15 feet wide intrude the quartz monzonite porphyry. A hornfels inclusion 70 feet in length occurs near the southern contact. The hornfelsed zone of sediments and volcanics is not as readily apparent as the zone developed around the Lime and Roundy Creek intrusive bodies.

Minor amounts of molybdenite mineralization occur near the southern contact of the stock, suggesting that it may have been the source of molybdenite mineralization in the quartz veins to the south. Two small zones not more than 3 feet in size were noted, one of which assayed 1.39 per cent MoS_2, the molybdenite being contained in quartz-filled fractures. The second small zone consists of molybdenite disseminated in the rock matrix and has an average grade of 8.77 per cent MoS_2.

Work done in 1964 consisted of a geochemical survey, geological mapping, and 1,795 feet of diamond drilling carried out from the old underground workings. An average crew of seven men was employed under the direction of L. Adie between the months of July and November.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1916, pp. 66–68; 1930, pp. 83–86; Hanson, G., 1935, *Geol. Surv., Canada,* Mem. 175, pp. 37–38; Stevenson, J. S., 1940, Molybdenum Deposits of British Columbia; *B.C. Dept. of Mines,* Bull. 9, pp. 61–67.]

Silver

Wolf (Dolly Varden Mines Ltd.)* (55° 129° N.W.) Company office, 837 West Hastings Street, Vancouver 1. F. C. Buckland, president. This property, consisting of four Crown-granted claims, is on the east side of the Kitsault River 19½ miles north of Alice Arm. Transportation to the property is by good truck-road connecting Alice Arm with the old Torbrit camp 17 miles to the north, and from there by 2½ miles of road suitable for four-wheel-drive vehicles.

Three quartz-barite-jasper-pyrite replacement deposits, vein-like in form, follow large fractures and shear zones in tuffs and agglomerates. Varying amounts of silver, lead, and zinc minerals occur in small veins and irregular lenses within these replacement deposits, which have been opened up on four levels.

The country rocks are massive fragmental volcanic types, overlying shales and argillites which are exposed along the road a short distance south of the main workings. The volcanic rocks are fine to medium grained, grey to green in colour, with rounded fragments one-quarter inch in size. The fragments are often not readily discernible as they differ little in composition from the matrix, being composed of angular quartz and feldspar grains with interstitial chlorite and carbonate. A zone of volcanic agglomerate with rounded fragments 2 inches to 2 feet in diameter was noted in the easterly trending 1201 crosscut on the 1200 level.

The replacement deposits are 10 to 90 feet wide, trend north-northeast, and dip steeply to the east and west. In general, the contacts with the volcanic rocks are sharply defined, some movement having occurred along the contacts after the emplacement of the deposits. Near the portal of the 1200 level (*see* Fig. 5), where the Number 2 replacement deposit is widest, large inclusions of country rock are found within it. The most westerly, or Number 3, body has poorly defined contacts and appears to grade into the fragmental volcanic rocks. These quartz-barite-jasper-pyrite replacements exhibit a brecciated appearance, with subrounded fragments of quartz in a matrix of finer-grained quartz, barite, jasper, and carbonate. Pyrite is the most widespread metallic mineral, and varying amounts of galena, sphalerite, magnetite, hematite, and silver-bearing minerals occur in small fractures in zones of fine-grained crushed quartz interstitial to the larger quartz fragments. The silver-bearing minerals include pyrargyrite, tetrahedrite, and native silver; they occur in varying amounts throughout the deposits, and the richer shoots bear little relation to known structures. Galena also occurs in small irregular quartz veins within the replacement deposits. Brown manganese oxide stain is a common surface weathering product.

Narrow fine-grained green dykes of andesitic composition intrude both the fragmental volcanic rocks and the replacement deposits. They range in width from 6 inches to 5 feet and follow the dominant north-northeast fracture pattern.

* By N. C. Carter.

Closely spaced north-northeast trending joints are common in the volcanic rocks, the joint planes being coated with chlorite. Northwesterly striking shear zones cut the Number 2 replacement deposit in the 1200 level drift. Near the end of the main drift, this deposit has been cut off by a northeast-striking southerly dipping fault.

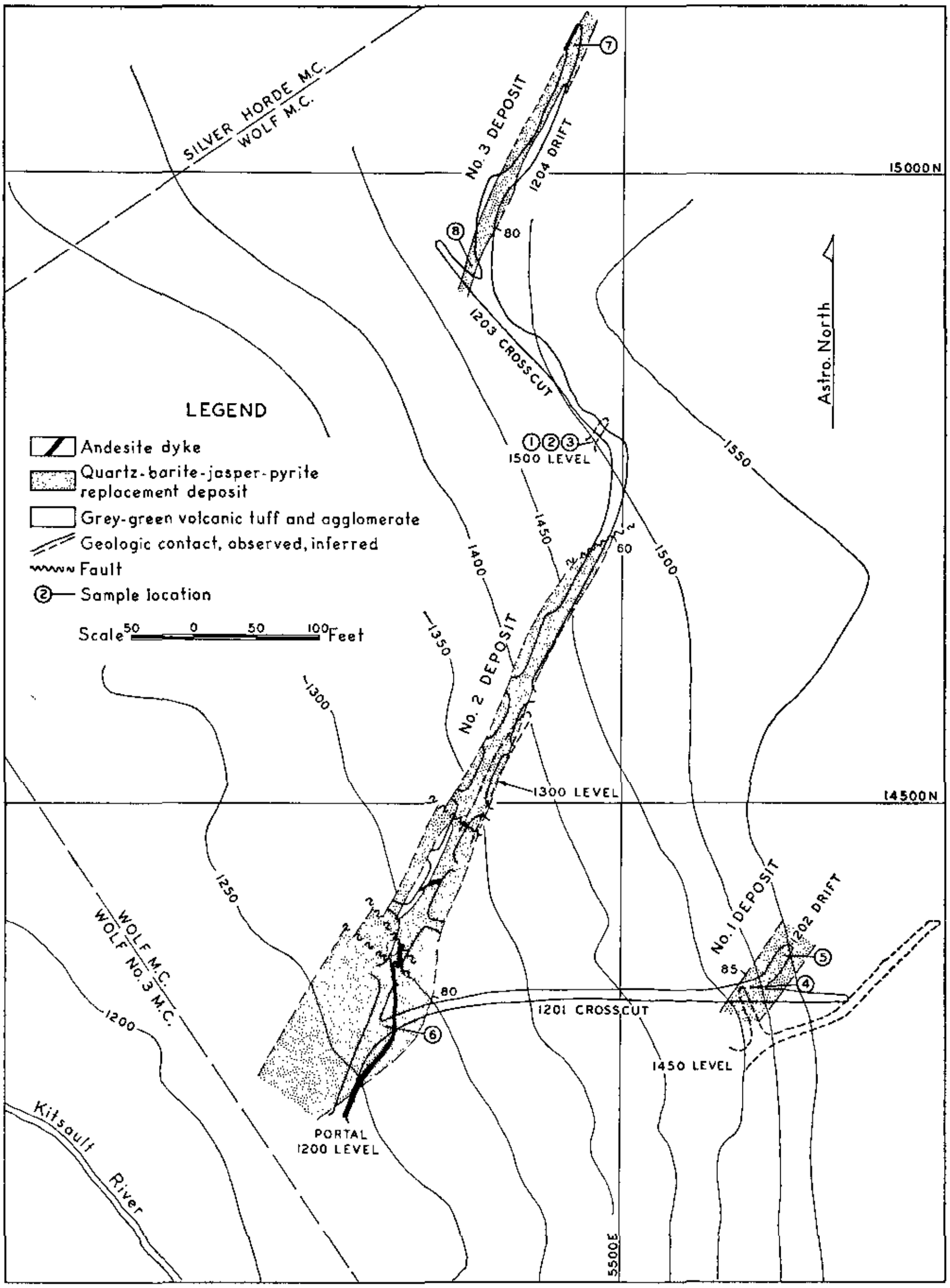


Figure 5. Dolly Varden Mines Ltd. Plan of Wolf workings.

Samples were taken at various points along the three replacement bodies. The results are tabulated below:—

Sample No.	Location	Width	Silver	Copper	Lead	Zinc
		Ft.	Oz. per Ton	Per Cent	Per Cent	Per Cent
1	Dump—1500 level portal	....	12.9	0.24	8.56	1.14
2	1500 level portal	1.5	30.7	0.40	3.62	0.22
3	1500 level portal	5.0	8.6	0.16	0.60	0.40
4	1450 level—northwest crosscut face	4.0	4.4	0.01	0.14	0.19
5	1200 level—1202 drift face	5.0	0.8	Trace	0.75	0.21
6	1200 level — junction, main drift and 1201 crosscut	5.0	6.1	0.03	0.76	0.30
7	1200 level—1204 drift	3.0	0.4	Trace	2.76	0.30
8	1200 level — junction, 1204 drift and 1203 crosscut	10.0	0.2	0.02	0.56	1.40

During 1964, Sunshine Mining Company, of Spokane, Wash., took up an option on the holdings of Dolly Varden Mines Limited and proceeded to carry out 1,020 feet of drifting and crosscutting on the 1200 level of the Wolf property. In addition, 10,295 feet of diamond drilling was done both on surface and underground. An average crew of 17 men was employed under the direction of H. W. Schulze from May 1st to October 18th.

[Reference: *Minister of Mines, B.C.,* Ann. Rept., 1951, pp. 97–98.]

Silver

Victory (Sirmac Mines Limited)* (55° 129° N.W.) Registered office, Suite 1326, 76 Yonge Street, Toronto. D. H. Baird, president. This property, of 1 mineral lease and 11 recorded claims, is on the east side of the Kitsault River, 22 miles north of Alice Arm. A jeep-road on the east side of the river passes within 1½ miles of the property. A trail in good condition leads from the road to the surface showings, situated on an easterly trending ridge at an elevation of 2,700 feet.

Silver mineralization was discovered before 1918, and the claims were originally known as the Last Chance and Chance group. Early work included open cutting, and in 1919 some drilling was done. A crosscut adit, 800 feet southwest of the surface showings, was driven west of north 120 feet between the years 1921 and 1930. Recent work has involved the cleaning-out of old open cuts and diamond drilling.

Massive fragmental volcanic rocks underlie the northern part of the claim group, and are younger than the black argillites which are exposed a short distance south of the surface showings. The volcanic rocks are everywhere fractured and exhibit a rusty weathered surface. They are andesitic in composition and contain one-eighth to one-half inch angular to subrounded fragments in a fine-grained to aphanitic matrix. The rocks are locally brecciated and are transected by numerous one-sixteenth inch carbonate stringers.

The mineralized showings are confined to quartz-barite-jasper-pyrite vein-like deposits, replacing the volcanic rocks along east-northeast trending fracture zones. The deposits have fairly sharp, near vertical contacts with the country rocks. Earlier reports indicated the presence of two subparallel vein-like deposits about 100 feet apart. The northern or No. 1 zone is between 2 and 20 feet wide as exposed in a series of open cuts over a length of 750 feet. The southern or No. 2 zone is 10 feet wide and is exposed in only two open cuts 125 feet apart. Recent drilling information suggests that the No. 2 zone may be an offshoot of the larger No. 1 zone to the

* By N. C. Carter.

north. The drilling does not support the view that the No. 1 zone extends over a length of 750 feet as exposed in the open cuts, but indicates that the most westerly open cut, some 450 feet west of a group of five may represent a separate replacement deposit which has been faulted. Prominent surface lineaments near this exposure support this view, as does the presence of a graphitic shear zone in a drill-hole collared 100 feet to the east.

The replacement deposits are commonly brecciated and are composed of quartz, carbonate, barite, jasper, and pyrite with varying amounts of galena, sphalerite, tetrahedrite, and some native silver. In surface showings, considerable leaching has taken place and brown manganese oxide staining is prominent. Azurite and malachite staining was noted in several open cuts. Banding parallel to the contacts of the deposits is represented by alternating bands of light and dark quartz and jasper.

Samples were selected at locations along the three zones. Results are tabulated below:—

Sample No.	Location	Width	Silver	Copper	Lead	Zinc
		Ft.	Oz. per Ton	Per Cent	Per Cent	Per Cent
1	Western zone	12	15.0	0.17	0.13	0.09
2	No. 1 zone	12	4.4	0.07	0.08	.....
3	No. 2 zone	10	10.4	trace	0.07	0.02

During 1964, between the months of August and October, 2,589 feet of diamond drilling was done. A crew of eight men was under the supervision of G. B. Tribble.

[References: *Minister of Mines, B.C.*, Ann. Rept., 1951, pp. 93–94; *Geol. Surv., Canada*, Mem. 175, pp. 57–58.]

Moose (Silver Butte Mines Ltd.)* (55° 129° N.W.) Company office, 581 Hornby Street, Vancouver 1. B. Brynelsen, president. This property, consisting of four Crown-granted claims and one fraction (Lots 1241–1244), is on the east slope of the Kitsault River valley immediately north and west of Trout Creek. The property is approximately 21 miles north of Alice Arm. A jeep-road north from the old Torbrit camp affords access to within 1 mile of the camp.

Country rocks are massive fragmental volcanics of andesitic composition. They are fine grained, grey-green, brown to purple in colour and are characterized by angular to rounded fragments one-eighth to one-half inch in diameter that differ little in composition from the matrix. Occasional 1-foot-wide andesite dykes were noted intruding the volcanic rocks.

Mineralized showings are found in a quartz-barite-jasper-pyrite replacement deposit striking roughly east-west and dipping steeply to the north. Drilling carried out in 1964 in the eastern part of the property near the Climax boundary indicates that the deposit is 12 feet wide and may be continuous with the replacement body seen in the Climax adit some 300 feet southeast. The vein-like replacement deposit has sharp to gradational contacts with the volcanic rocks and probably was formed in fractures. The deposit is wider to the west, up to 40 feet wide in some drill intersections, with gradational contacts and prominent inclusions of country rock. Mineralization includes quartz, carbonate, barite, jasper, pyrite, and hematite with varying amounts of galena and silver-bearing tetrahedrite.

* By N. C. Carter.

Work done during 1964 consisted of 2,040 feet of diamond drilling. An average crew of eight men was employed between July and October under the direction of G. B. Tribble. (*See* Annual Report, 1951, pp. 94–95.)

Silver-Lead

Ace and Galena (Silver Butte Mines Ltd.)*

(55° 129° N.W.) Company office, 1030 West Georgia Street, Vancouver 5. T. S. MacKay, president. This property of 10 recorded claims is located on the east side of the Kitsault River 23 miles north of Alice Arm. Work on the property during the months of September and October consisted of 850 feet of diamond drilling carried out under the supervision of G. B. Tribble. (*See* Annual Reports, 1951, pp. 91–93; 1963, p. 12.)

Copper-Silver

Basin (Sirmac Mines Limited)†

(55° 129° N.E.) Registered office, Suite 1326, 67 Yonge Street, Toronto. D. H. Baird, president. The property consists of a lease comprising four old Basin claims and four Silver Basin claims held by record. The claims are near the head of Stark Creek and midway between the Kitsault River and Kinskuch Lake. Work consisting of cleaning out the old trenches and resampling was done by a crew of three men under the supervision of G. B. Tribble. Transportation was by helicopter. The property was not visited. (*See* Annual Report, 1924, p. 54.)

OBSERVATORY INLET

Copper-Silver

Redwing (Magnum Consolidated Mining Co. Ltd.)†

(55° 129° S.W.) Company office, 700 Burrard Building, Vancouver 5. J. D. Little, president; S. Wise, engineer in charge. The property consists of three Crown-granted claims at the head of Glacier (Tauw) Creek, approximately 4 miles south of the old village of Anyox. Work, carried out by a crew of eight men, commenced on July 14th and was suspended August 16th. A portable air compressor was taken to the property, the old adit was cleaned out, and three diamond-drill holes cored 399 feet. Equipment was transported by barge to Granby Bay, and a helicopter was used to carry men and equipment from the beach to the property. The property was not visited. (*See* Annual Reports, 1932, pp. 53–55; 1963, p. 13.)

QUEEN CHARLOTTE ISLANDS

Moresby Island

Iron-Copper

Tasu (Wesfrob Mines Limited)‡

(52° 132° N.E.) Wesfrob Mines Limited is a wholly owned subsidiary of Falconbridge Nickel Mines Limited, 7 King Street East, Toronto 1; Vancouver office, 504, 1112 West Pender Street, Vancouver 1. P. N. Pitcher, president; G. Davis, camp foreman. The property is on Tasu Sound near the entrance of Fairfax Inlet, and consists of 21 Crown-granted claims and 70 recorded claims. As work progressed throughout the year, the crew size increased from 14 to 125 men. Diamond drilling during the year totalled 22,525 feet, most of which was on the

* By H. Bapty and N. C. Carter.
† By H. Bapty.
‡ By H. Bapty and A. Sutherland Brown.

No. 5 zone, but nine holes totalling 2,346 feet were on the old Tasu townsite on Hunger Harbour. A 2,000-ton bulk sample for metallurgical testing was flown off the hill by helicopter. Timber was felled over 150 acres and was cleared from 75 acres. The Sewell–Newcombe Inlet access road was advanced 3.7 miles, and the Tasu site road was advanced 0.75 mile. The building area was graded for 5 acres. The following buildings were installed during the year: One 120-man kitchen-bunkhouse trailer complex, one 40- by 101-foot pit shop was under construction at the end of the year, two 20- by 30-foot powder magazines were built, one 8- by 12-foot cap-house for the storage of detonators, and one 26- by 22-foot shop. Personnel are transported by float plane from Sandspit, while equipment and supplies are barged to the property from Vancouver. (*See* Annual Report, 1963, pp. 13–16.)

Iron

Harriet Harbour (Jedway Iron Ore Limited)*

(55° 131° S.E.) Company office, 1111 West Georgia Street, Vancouver 5; mine office, Jedway. L. T. Postle, president; A. J. McDougall, manager; G. N. Cornish, mine superintendent; F. Irwin, mill superintendent. The mine is on Harriet Harbour, near the southeastern tip of Morseby Island. The mine worked continuously throughout the year and produced 693,907 short dry tons of magnetic iron ore, from which 383,034 long dry tons were recovered by concentration for shipping. The mine employs 140 men, and various contractors employ 60 men. During the year 1,796 feet of diamond drilling was done, a new assay office was built, a shed was constructed for additional warehouse storage, and a drill storage shed was erected. The property is serviced by B.C. Airlines and by Northland Navigation Company. (*See* Annual Report, 1963, p. 16.)

BURNABY ISLAND

Iron-Copper

Jib (Burnaby Iron Mines Limited)*

(51° 131° N.W.) Company office, 1200 West Pender Street, Vancouver 1. K. J. Springer, president; W. R. Bacon, geologist. The property of 57 recorded mineral claims is on Burnaby Island 4 miles north of Jedway. In June, 1964, a combined magnetometer and sounding survey was performed by the company and by technical personnel of Nittetsu Mining Consultants of Tokyo, Japan. Transportation of supplies are water-borne from the dock at Jedway, and personnel were transported by aircraft based at Sandspit. The property was not visited. (*See* Annual Report, 1963, pp. 18–21.)

Iron-Copper

Flo, Mac (Merrican International Mines Limited)*

(52° 131° S.E.) Company office, 202, 114 West 15th Street, North Vancouver. W. R. Bandeen, president; A. J. McClellan, manager. The Flo group consists of 49 recorded claims situated between Poole Inlet and Skincuttle Inlet, and the Mac group consists of 57 recorded claims on the north-east side of Burnaby Island. On the Mac group, seven outcrops of magnetite occur over an area 400 by 500 feet. The No. 1 outcrop is exposed on the surface for a length of 75 feet, a width of 25 feet, and height up to 30 feet. A portion of the deposit is covered by overburden but is exposed at intervals in a length of 200 feet. This has been confirmed by diamond drilling. The eastern end of the No. 1 outcrop abuts greenstone. The Flo group has a magnetite outcrop lying at an elevation of

* By H. Bapty.

150 feet and less than 200 feet from tidewater. The outcrop is on a limestone cliff, and a dip-needle survey indicates a length of 125 feet and a width of 100 feet. About 600 feet east, chalcopyrite outcrops in the limestone as two occurrences, 200 feet apart and with lengths of 30 and 75 feet respectively. Widths range from 10 to 15 feet, with assays showing 4 per cent copper and 1 per cent copper. Approximately 500 feet of diamond drilling completed on these showings was insufficient to indicate an economic deposit.

A tractor-trail, 1½ miles in length, was built from the northeastern corner of the island to the Mac showing. Work on the trail commenced in January, and diamond drilling commenced in February and continued until November with an average crew of six men. Sixteen holes were drilled on the Mac group with a total length of 5,507 feet. Transportation is by boat from Jedway. The property was not visited. (*See* Annual Report, 1963, p. 18.)

BANKS ISLAND

Gold

Banks, Banker, etc.*

(53° 130° S.E.) Falconbridge Nickel Mines Limited, 1112 West Pender Street, Vancouver 1, holds 206 claims by record in the Banks, Banker, Isle, Waller, Bay, Mik, Lilly, and Keetcha groups in a belt about 20 miles long in the southwestern part of Banks Island. Gold-bearing mineralization is associated with shears and fractures in and near sedimentary remnants lying within rocks of the Coast Intrusions. A skarn alteration is common.

Between March and November a crew of 18 men built 5 miles of trail and cut 60 miles of line for geochemical and self-potential surveys. Approximately 100 rock cuts, pits, and trenches were spread throughout the property, and a total of 13,074 feet of diamond drilling was done in 96 holes. J. J. McDougall was in charge of the work. The property was not visited. (*See* Annual Report, 1963, pp. 21–23.)

TERRACE

Gold-Copper

Lucky Luke*

(54° 128° N.E.) Lucky Luke Mining Co. Ltd., P.O. Box 1269, Terrace, holds the Hummer and Lucky Luke Crown-granted claims under option and two other claims by mineral lease. The property is about 1½ miles below Usk, close to the railway, about 12 miles northeast of Terrace. A road was built to the showings, and old workings were reopened by a crew of two men.

Molybdenum

JB, Molly, HM (Canex Aerial Exploration Ltd.)*

(54° 128° N.E.) Company office, 700, 1030 West Georgia Street, Vancouver 5. L. Adie in charge of exploration. Twenty claims of a once more extensive group held by Huestis Mining Corporation Ltd. were under option to Canex Aerial Exploration Ltd. Additional claims were located to bring the total number to 83. The property is on a small creek known as Bell Creek at Pitman on the railway 22 miles northeast of Terrace. Two molybdenite showings occur in granodiorite of the Coast Intrusions. Eight men worked between May and October under B. M. Dudas on geological mapping, soil-sampling, and building access roads. Six holes were diamond drilled with an aggregate length of 1,621 feet. The property was not visited.

* By M. S. Hedley.

Copper

Northwest, Bet* (54° 128° S.E.) Purdex Minerals Limited (Vancouver office, 314, 355 Burrard Street, Vancouver 1) holds 40 claims under option and 10 claims by record. The property is on Treasure Mountain, on Salmon Run Creek, a tributary of the Zymoetz River. It is reached by 28 miles of road from Terrace and 4 miles of trail. Bornite and chalcocite mineralization occur in volcanic flow and fragmental rocks. A crew of nine men worked for four months starting in August and did geological mapping, soil-sampling, 260 feet of trenching, and diamond drilled 1,078 feet in three holes. The 4-mile trail was rehabilitated, but helicopters were used to expedite the work, which was done under the supervision of Dolmage, Mason and Stewart, consultants. The property was not visited.

BABINE RANGE

Molybdenum

Molly, Moly, Red, Canyon, Tom, Len (Southwest Potash Corporation)† (55° 127° N.E.) Executive office, 1270 Avenue of the Americas, New York 20. F. Coolbaugh, president; British Columbia office, 718 Granville Street, Vancouver 2. The company holds 69 claims and 5 fractions under option from The Buttle Lake Mining Company Limited. The claims lie about 24 miles north of Hazelton to the east of the head of Shegisic Creek on a northerly trending ridge of Mount Thomlinson. The 1963 tent camp at 6,050 feet elevation in a saddle on the ridge was reoccupied. The camp was serviced by helicopter.

Geology of the area is shown on Figure 6. Massive black argillaceous sediments of the Hazelton Group have been intruded by a roughly circular stock of pale-buff to light-pinkish white quartz monzonite porphyry. Outside the contact aureole the sediments tend to be massive and black, with conchoidal and blocky fractures or a poorly developed slaty cleavage. Near the contact the sedimentary rocks have been deformed and metamorphosed. In most areas there is a well-developed schistosity approximately parallel to the contact, over a zone 300 to 500 feet wide. Most of the rocks in this zone are medium to dark brownish-grey schists, the brown colour being due to metamorphic biotite.

Biotite, muscovite, cordierite, andalusite, and apatite have formed in the contact aureole. Cordierite and andalusite were only identified in prominently " spotted " rocks that occur along the southern contact. Recrystallized quartz and feldspar(?) are slightly coarser than in the original rocks.

Wherever seen, the contact of the stock is very sharp. The margin is foliated for a few hundred feet from the contact, parallel to the contact and parallel to the schistosity in the intruded rocks. The foliation and schistosity were probably formed during intrusion. The foliation is marked by alignment of biotite crystals, and quartz phenocrysts have been drawn out into lenses and broken down into mosaic aggregates of crystals. Coarse potash feldspar phenocrysts characteristic of the core of the stock are much less abundant and smaller in size in the foliated contact zone.

The core zone of the stock is marked by 1 to 3 per cent of coarse, zoned potash feldspar phenocrysts which are over 2 inches long at some localities. Quartz and plagioclase phenocrysts range up to one-half inch in diameter. The plagioclase (An_{12-30}) is oscillatory zoned; it constitutes about 40 to 50 per cent of the rock, and the potash feldspar about 10 to 25 per cent.

In many areas the stock is cut by very narrow pale-buff to white aplite dykes. These dykes commonly occur in swarms and generally range from 1 to 4 inches in

* By M. S. Hedley.
† By R. V. Kirkham.

width and may be several tens of feet or more long. The largest known dyke of this type occurs north of the camp and is about 6 feet wide. These dykes occupy well-defined fractures. They are mainly restricted to the stock itself and do not occur outside the contact aureole. In the thin-sections examined they have a typical aplitic texture and are either granitic or quartz monzonitic in composition.

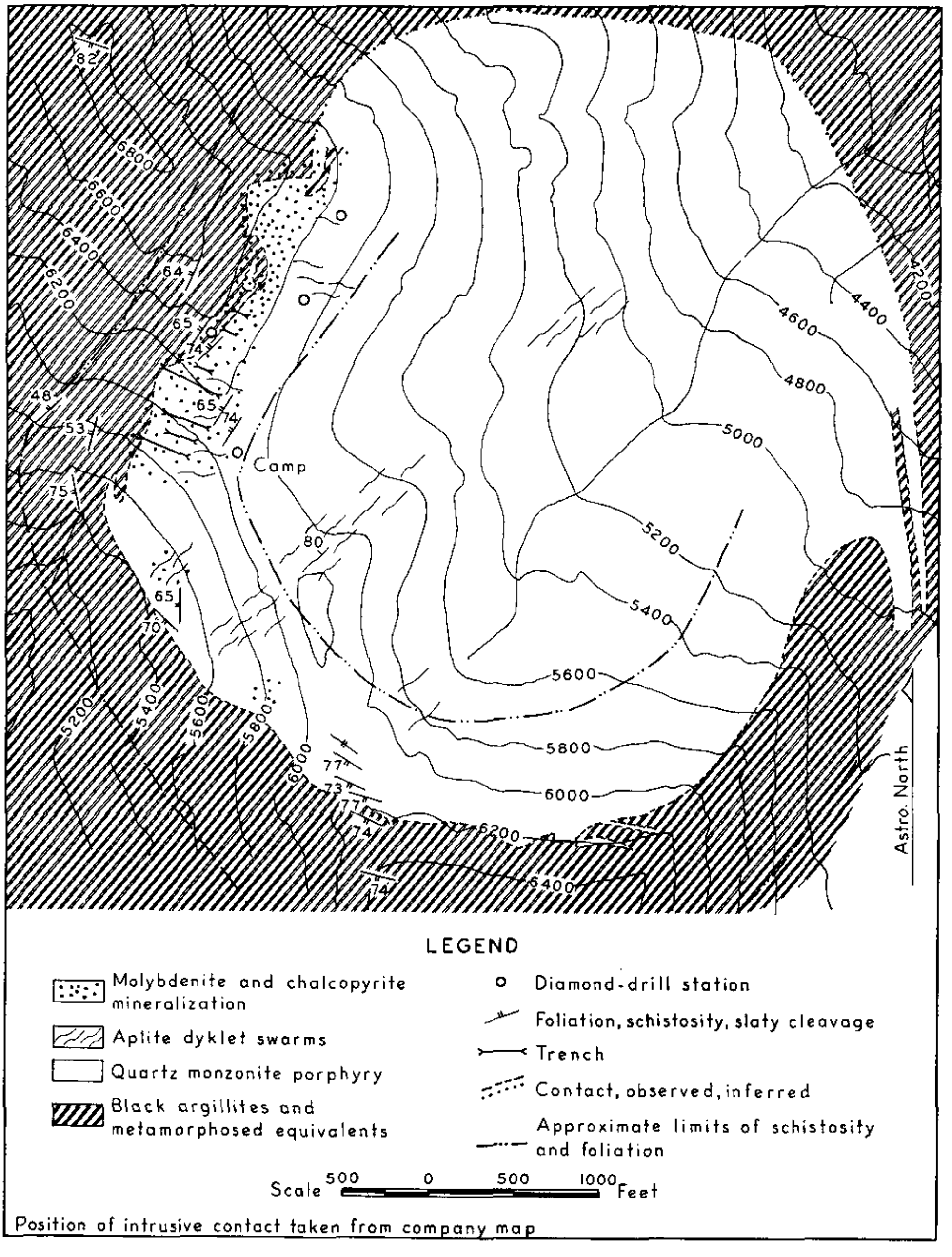


Figure 6. Geology of Mount Thomlinson molybdenite showings.

A few medium- to light-grey porphyry dykes, intermediate in age between the main quartz monzonite porphyry and the aplite dykes, have been found near the drilled area. These dykes are quartz monzonite porphyry close to granite in composition.

The main mineralized zone is shown on Figure 6. Molybdenite, chalcopyrite, and pyrite occur in a stockwork of quartz veinlets. Minor amounts of magnetite and scheelite occur with the sulphides. In general, 10 per cent or more of the rock is made up of quartz veinlets which are more extensive than the area of sulphide mineralization. Veinlets are parallel to and cut the foliation and are later in time than the aplite.

Three chip samples of about 10 pounds each, taken about 70 feet apart in the longest trench, gave the following assays:—

Sample	Gold	Silver	Mo	Calculated MoS_2	MoS_2
			Per Cent	Per Cent	Per Cent
No. 1	*Nil*	Trace	0.07 =	.118	0.05
No. 2	*Nil*	Trace	0.07 =	.118	0.11
No. 3	*Nil*	Trace	0.12 =	.20	0.17

These results indicate that a considerable amount of the molybdenum is in the oxide form at the surface. There is about one-third of 1 per cent copper in areas of highest-grade molybdenite.

In the mineralized zone, biotite has been altered to carbonate, muscovite, opaque minerals, and chlorite; feldspar has been altered to carbonate and muscovite (sericite in places); and the quartzofeldspathic matrix of the porphyry has been recrystallized and has increased in grain size. Perthitic microcline is relatively fresh compared to other feldspars.

Figure 6 shows that the mineralization has been localized in the contact area. In general the mineralization extends farther into the porphyry than into the sediments, and in many places the amount of mineralization drops off sharply at the contact.

Weathering of mineralization has been considerable, and in many areas extends to 200 to 300 feet below the surface. Limonite, ferrimolybdite, malachite, and, to a lesser extent, azurite are the main secondary minerals.

The mineralized stock lies about one-half mile north of a much larger granitic body which underlies the summit and upper slopes of Mount Thomlinson. The latter intrusion is shown on Preliminary Map 44-24 of the Geological Survey of Canada.

Work on the property was carried out from May 24th to September 1st. Five diamond-drill holes totalling 4,517 feet were completed from the sites shown on Figure 6. Geologic mapping was done by A. J. Sinclair. A total of 18 to 22 men was employed under the supervision of G. W. Mannard.

Silver-Lead

Rio Nos. 1–4*

(55° 126° S.W.) These claims were leased from Rio Tinto Canadian Exploration Limited, 736 Granville Street, Vancouver 2, by Steve Homenuke, of Hazelton, and A. F. Claussen. Two and one-half tons of selected ore was sacked and shipped from surface open cuts. The property is on French Peak, 40 miles east of Hazelton, at an approximate elevation of 6,000 feet. The property is served by tractor on a

* By R. V. Kirkham.

winter road. Further work is contemplated this winter. The property was not visited.

SMITHERS

Silver-Lead-Zinc

Silver Creek, Silver Lake, Trade Dollar (Hudson Bay Mountain Silver Mines Ltd.)*

(54° 127° N.E.) Company office, 602 West Hastings Street, Vancouver 2. The property consists of a number of Crown-granted mineral claims and fractions formerly owned by Sil-Van Consolidated Mining and Milling Company Ltd. They are at elevations between 5,000 and 7,000 feet on the northwest shoulder of Hudson Bay Mountain near the divide between Silvern and Toboggan Creeks. In 1964 the existing tractor-road was extended about 1½ miles to about 6,000 feet elevation on the northwest slope. Trenching and stripping in this area by bulldozer was successful in uncovering some veins. A test sample of 1.2 tons of picked ore shipped to the Trail smelter contained: Gold, .144 ounce; silver, 104 ounces; lead, 1,461 pounds; zinc, 157 pounds.

Five men under the direction of H. Gilleland worked on the property from June to September.

Molybdenum

Glacier Gulch (Climax Molybdenum (B.C.) Limited)†

(54° 127° N.E.) Executive office, 1270 Avenue of the Americas, New York 20. H. A. Sawyer, president. British Columbia office, 718 Granville Street, Vancouver 2; R. E. Anderson in charge. The company holds a total of 236 recorded claims and fractions and 14 Crown-granted claims centred on Glacier Gulch on the east side of Hudson Bay Mountain. The 14 Crown-granted claims and 30 recorded claims are held under lease and option from W. Yorke-Hardy and partners, of Smithers. Widespread low-grade molybdenite mineralization occurs under and near the toe of the glacier in Glacier Gulch. Molybdenite occurs in a stockwork of narrow quartz veinlets in altered volcanic and intrusive rocks. Information to date indicates that there is a large sill-like body of highly altered granodiorite(?) and a number of small porphyritic granitic and aplitic dykes and perhaps small stocks in the mineralized area. The company at present is seeking to delineate higher-grade areas of sufficient grade and tonnage to constitute orebodies.

Work in 1964 consisted of surface diamond drilling and reopening and reaming of old holes for the purpose of accurate surveying. A total of 16,300 feet of AX and EX drilling was done. Hole depths ranged from 1,450 to 2,600 feet. Transportation of personnel and equipment was done by S-58, S-55, and Hiller 12E helicopters. A crew averaging 20 men was employed from June 15th to November 1st. D. Jonson, from Golden, Colo., was the engineer in charge.

Silver-Lead-Zinc

Cronin (New Cronin Babine Mines Limited)*

(54° 126° N.W.) Company office, 844 West Hastings Street, Vancouver 1. L. C. Creery, president; H. Hill & L. Starck & Associates Ltd., consulting engineers. The company owns the Sunrise No. 7 Crown-granted mineral claim and holds seven claims under option. The property is on the east slope of Mount Cronin, about 30 miles by road from Smithers. A description of the property was given in the 1949 Annual Report, pages 94–98. In

* By R. V. Kirkham and H. Bapty.

1964 work on the property was done by the lessee, Paul Kindrat, and two men from July until the end of October. Production: Ore milled, 500 tons, which produced 45 tons of lead and 79 tons of zinc concentrate.

A crosscut driven 100 feet on No. 6 level (4,675 feet elevation) encountered a 2-foot vein, which was reported to be well mineralized. A total of approximately 1,400 feet of diamond drilling was done from underground as well as a little surface trenching. The property is served by a narrow truck-road.

Debenture (Native Mines Limited)*

(54° 126° N.W.) Company office, 718 Granville Street, Vancouver 2. T. P. Bowes, president. The property is situated in the Babine Range 10 miles northwest of the New Cronin Babine mine. During the year a new bunkhouse-mess hall, an oil-shed, garage, and repair bay were built. A portable 600-c.f.m. compressor and shops have been placed near the new portal, from which 100 feet was driven with an average crew of five men under the direction of F. B. Messner, manager. Transportation is by truck over a newly constructed road to the mine. (*See* Annual Report, 1916, p. 130.)

Copper

Astlais (Noranda Exploration Company, Limited)†

(54° 126° N.W.) Vancouver office, 1050 Davie Street, Vancouver 5. B. O. Brynelsen, manager. The Astlais, Ast, Billie, Ralph, and other groups, totalling 45 claims, are on the south slope of Astlais Mountain, 12 miles east of Smithers. Interbedded volcanic and sedimentary rocks are intruded by dykes and masses of feldspar porphyry and rhyolite. Pyrite, bornite, chalcopyrite, and malachite occur in the intrusive and the volcanic rocks. In July a three-man crew put in several trenches, built access roads, and diamond drilled two holes totalling 250 feet. The property was not visited.

BABINE LAKE

Copper

Newman (Noranda Exploration Company, Limited)†

(54° 126° N.E.) Vancouver office, 1050 Davie Street, Vancouver 5. B. O. Brynelsen, manager. A total of 253 mineral claims held by record include the Newman group of 11 claims and several other groups. The property is on the Newman Peninsula on Babine Lake and is reached by water from roads on the west side of the lake.

Interbedded sedimentary and volcanic rocks are intruded by dykes and masses of feldspar porphyry. Pyrite, specular hematite, chalcopyrite, chalcocite, bornite, and magnetite occur disseminated in both porphyry and adjacent volcanic rocks. Four miles of road was built to provide access to most parts of the property from a trailer camp on the lake-shore. About 44 line-miles of geophysical work was done, several trenches were put in, and 24,091 feet of diamond drilling was done in 98 holes. An average crew of 11 men was at work most of the year. The property was not visited.

* By H. Bapty.
† By M. S. Hedley.

Copper

DA, AX, etc. (Noranda Exploration Company, Limited)*

(55° 126° S.E.) Vancouver office, 1050 Davie Street, Vancouver 5. B. O. Brynelsen, manager. The company holds 126 claims by record, chiefly in the DA and AX groups, lying east of Nakinilerak Lake, which is about 12 miles east of the north end of Babine Lake. Interbedded sedimentary and volcanic rocks are intruded by dykes and masses of feldspar porphyry. Pyrite and minor chalcopyrite occur disseminated in the porphyries. Geophysical and geochemical surveys were conducted over 15 line-miles. Six holes totalling 405 feet were diamond drilled, and 4,000 feet of trenching was done. An average crew of eight men worked from August till the end of November. The property was serviced by helicopter, but a 20-mile tractor-road connects the camp with the northeast arm of Babine Lake. The property was not visited.

TAKLA LAKE

Silver-Lead-Zinc

Lustdust (Takla Silver Mines, Limited)*

(55° 125° N.E.) Company office, 402 West Pender Street, Vancouver 3. Leonard Belliveau, president; Douglas D. Campbell, consulting engineer. The Lustdust Nos. 1–15 claims are at the head of Silver Creek, about 50 miles by road west of Manson Creek. Two northerly trending steeply dipping shear zones and an intermediate diagonal shear zone cross intercalated volcanic and sedimentary rocks. Stripping and sampling were done by a crew of six men, and a camp and mining equipment and supplies were moved onto the property late in 1964. The property was not visited.

MORICE LAKE

Molybdenum

Lucky Ship, Sam, Ram, Road (Southwest Potash Corporation)†

(54° 127° S.E.) Company office, 718 Granville Street, Vancouver 2. R. A. Barker, manager. The company holds the Lucky Ship property of 109 recorded claims and fractions on the Nanika River east of Morice Lake, 50 miles west of Houston. Mineralization consists of molybdenite in a quartz-vein stockwork in a quartz porphyry pluton. A 6-mile access road was constructed from the Morice-Nanika forestry development road to the property. Geological mapping and geochemical surveys were carried out on 38 miles of line. Four holes totalling 4,200 feet were diamond drilled. An average crew of 16 men was employed on the property from May 15th to October 15th under the direction of T. J. R. Godfrey.

TAHTSA LAKE

Copper-Molybdenum

Len (Kennco Explorations, (Western) Limited)‡

(53° 127° N.E.) Company office, 1111, 1030 West Georgia Street, Vancouver 5. C. J. Sullivan, president; J. A. Gower, manager. This company holds 44 claims in the Len group on Huckleberry Mountain east of Tahtsa Lake at a distance of about 80 miles by road from Highway No. 16 near Houston. Work in 1964 was directed by P. T. Black and employed a crew of 15, including drillers on contract, from May until August. It included 4,647

* By M. S. Hedley.
† By H. Bapty.
‡ By J. M. Carr.

feet of wire-line diamond drilling in nine holes, bringing the total footage drilled on the property to 5,600 feet.

At the end of July a visit lasting three days was spent logging drill core and examining the available exposures at the showing, which is centred on a low knoll at about 3,400 feet elevation at the southwestern foot of Huckleberry Mountain. Drilling at this time had been done in an area measuring about 1 mile from east to west and about one-half mile across, in and around a stock of quartz diorite porphyry some 2,000 feet long in a northeasterly direction and about 1,000 feet wide. Figure 7 is a sketch map of the simplified geology, with localities appearing as on a

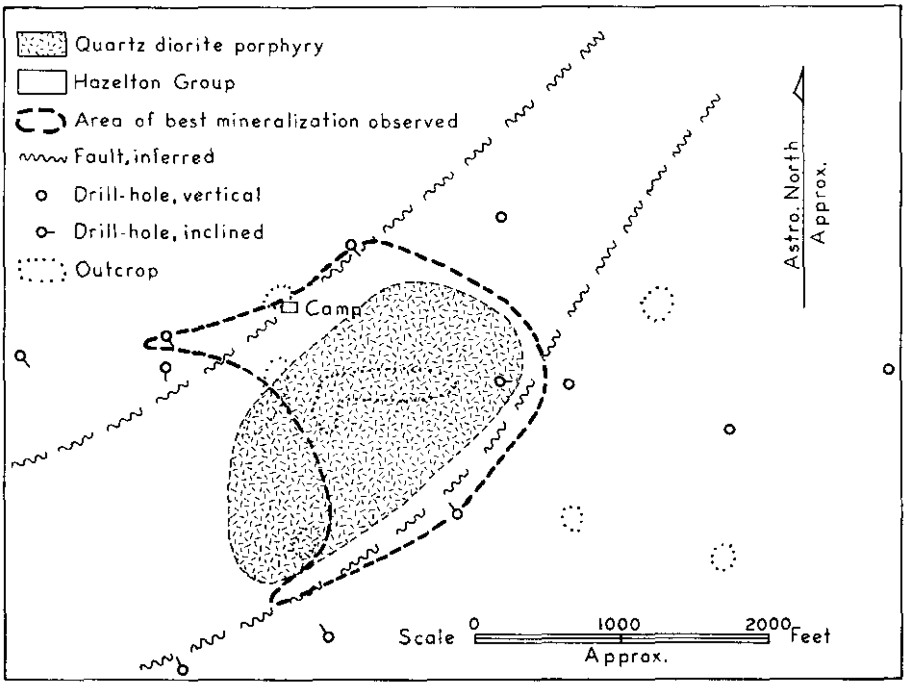


Figure 7. Len group, Huckleberry Mountain.

vertical air photograph of the area. The stock and adjacent dykes are emplaced into altered tuffs and tuffaceous sedimentary rocks assigned to the Hazelton Group, which is mainly of Middle Jurassic age. According to evidence obtained from vertical drill-holes and rare outcrops, bedding and foliation in the Hazelton rocks are generally inclined at low to moderate angles, partly in a south-southwesterly direction.

The quartz diorite porphyry is a grey to pinkish rock of dacitic composition which weathers buff coloured. It contains closely spaced phenocrysts of white plagioclase as much as 1 centimetre long, and smaller ones of biotite, quartz, and, in places, pink orthoclase. The groundmass has a fine granitic texture and consists mainly of the same four minerals. Dykes and sheets of this rock occur with unknown attitudes and in apparently diminishing numbers away from the stock.

Hornblende feldspar porphyry forms dykes and sheets cutting the stock and adjacent rocks. It is a rock of dacitic composition which differs in appearance from the quartz diorite porphyry mainly in the presence of numerous aligned hornblende phenocrysts and the scarcity of quartz phenocrysts. The groundmass is aphanitic, pinkish, and consists mainly of quartz and plagioclase. The attitudes of the dykes and sheets are unknown, except that most are steep.

The above-described rocks are altered most strongly where they are fractured and veined, chiefly in and around the stock. Quartz veins up to 1 inch wide and partly vuggy are numerous in parts of the stock, where they tend partly to form sets of sub-parallel veins in various directions. In the Hazelton rocks, veins are slender and less conspicuous. Rock adjoining the quartz veins is marginally bleached, or is pink because of orthoclase, or is otherwise altered. Minerals in veins partly containing quartz include orthoclase, actinolite, calcite, fluorite, and epidote. Veins of the orange-brown zeolite, stilbite are plentiful, and heulandite is possibly also present. Gypsum veins occur, and disseminated anhydrite was recognized in drill core from a depth of about 600 feet below the surface. Biotite formed by alteration is partly in veinlets, but is chiefly finely aggregated in porphyry and abundantly disseminated in hornfelsed strata adjoining the stock. Chlorite and sericite alteration is strongest near faults, in sheared rock containing abundant calcite veins that are mostly post-mineral in age.

All outcrops and drill-holes contain pyrite occurring as disseminations and fracture-fillings, and in quartz veins. Copper and molybdenum mineralization is earlier than some, if not all, of the pyrite, and is concentrated chiefly near the stock, where it is apparently best in the zone indicated on Figure 7. Chalcopyrite is the principal copper mineral and is locally accompanied by traces of bornite. Limited surface oxidation has in places produced small quantities of copper carbonates. Chalcopyrite, which is generally accompanied by pyrite, occurs partly disseminated in altered rocks and partly as coarsely crystalline coatings, nests, and blebs in quartz veins. Molybdenite occurs in smaller amounts as fine particles and streaks, in or near quartz veins, generally in the vicinity of chalcopyrite but in places accompanied only by pyrite. Magnetite in veins and other local concentrations apparently formed before the sulphides.

Many faults apparently of pre-mineral age are conspicuous in drill-holes but are poorly exposed on surface. A pair of curved northeasterly lineaments prominent on air photographs are inferred to be pre-mineral faults confining the stock closely (Fig. 7). The southern fault is intersected in four drill-holes and shows strong sericitic, chloritic, and calcitic alteration accompanied by sulphides. The northern fault may split into a number of small faults partly intersected by holes designated E and No. 3 respectively.

Dark diabase dykes of unknown attitude in the mineralized rocks are themselves unmineralized and only weakly sheared. (*See* Annual Report, 1963, p. 28.)

Whit (Kennco Explorations, (Western) Limited)*

(53° 127° N.E.) Company office, 1111, 1030 West Georgia Street, Vancouver 5. C. J. Sullivan, president; J. A. Gower, manager. Since 1963 this company has held about 50 claims on the south slopes of Sibola Peak at elevations ranging mainly between 3,800 and 6,000 feet. The property is north of the Len group, about 6 miles distant by road. In 1964 work was directed by P. E. Hirst and included 6 miles of road construction, 15,000 lineal feet of trenching, geophysical surveying, and 1,177 feet of diamond drilling in 10 holes. A maximum crew of 16 men camped at Whiting Creek from June to September.

The property, which was visited in July before drilling started, is underlain by dark-green fragmental Hazelton volcanic rocks that are poorly exposed and appear

* By J. M. Carr.

to dip southward. Intrusive rocks include the Sibola granodiorite stock in the northwestern part of the property; porphyritic quartz diorite or granodiorite at Whiting Creek, and reportedly farther northeast near Comb Creek; and numerous later dacite porphyry dykes. These dykes are of several kinds, are in places closely spaced, and mostly strike northwestward or west-northwestward. Later, unmineralized and only slightly altered diabase dykes occur also with these strikes. Alteration and mineralization are extensive. The upper slopes are conspicuously oxidized to form widespread gossans, and the lower valleys of creeks draining the gossans are partly filled with stratified conglomerates and breccias of country rock debris set in a brown-red iron-rich clay matrix. These local deposits were probably formed in glacial lakes resulting from ice dams in Whiting Creek.

At localities spaced as much as 1½ miles apart on the property, chalcopyrite, molybdenite, and in places magnetite and specular hematite occur either together or separately as disseminations, streaks, and fracture fillings in rocks which mostly contain quartz veins. Pyrite accompanies these minerals and also occurs extensively alone or with very minor amounts of other sulphides in rocks that are quartz veined, silicified, or otherwise altered. Rock alteration is generally accompanied by pyrite and has produced minerals which include biotite, quartz, sericite, kaolinite, chlorite, calcite, and epidote. A strong tendency was noted for disseminated sulphide to replace secondary biotite and chlorite in the intrusive rocks.

Widespread fracturing probably indicates the existence of numerous faults. Mineralized faults were seen in several places; at Whiting Creek a chloritic fault strikes northward, dips to the west, and is several feet wide; elsewhere, some faults are sericitic and follow silicified, pyritic porphyry dykes of northwesterly trends.

Berg (Kennco Explorations, (Western) Limited)*

(53° 127° N.E.) Company office, 1030 West Georgia Street, Vancouver 5. C. J. Sullivan, president; P. T. Black, engineer in charge at the property. The company holds the Berg group of 38 recorded claims between Nanika and Tahtsa Lakes, about 11 miles northwest of the Whit group. The mineralization consists of pyrite, chalcopyrite, malachite, azurite, and molybdenite in fractures and disseminations associated with a feldspar porphyry stock. Work on the property started August 16th and stopped October 1st. An average of 17 men comprised the work crew. Three bulldozer tractors were used to construct a road and bulldozer trail for the 20 miles from Twinkle Lake to the property. Roads and drill sites were prepared, and approximately 40,000 cubic yards of rubble was excavated to form 22 trenching sites. About 190 rock geochemical samples were taken from the trenches. A total of 3,267 feet of NX wire-line diamond drilling was done at the stations. Transportation is by four-wheel-drive vehicle. The property was not visited.

Molybdenum

Jumbo*

(53° 127° S.W.) Phelps Dodge Corporation of Canada Limited, 55 Yonge Street, Toronto; Vancouver office, 1112 West Pender Street, Vancouver 1. J. L. DeLeen, exploration manager; L. Kiss, engineer in charge at the property. The company holds 34 recorded claims between the Gamsby River and the Tsaytis River about 11 miles south of Seel Lake. The claims cover the contact area between metavolcanics and granite. An aplitic phase of the granite contains minor molybdenite and quartz. Four men were employed from August 26th until September 18th on 280 feet of

* By H. Bapty.

trenches, taking 20 bulk samples, and prospecting. Transportation was by float plane and helicopter. The property was not visited.

WHITESAIL LAKE

Molybdenum

Cob (Kennco Explorations, (Western) Limited)*

(53° 127° S.E.) Company office, 1030 West Georgia Street, Vancouver 5. C. J. Sullivan, president; P. T. Black, engineer in charge at the property. A group of 10 claims optioned in the summer of 1963 was returned to the optionors (C. V. and W. H. Harrison) in 1964. The claims lie southeast of the west end of Whitesail Lake. The mineralization consists of disseminated pyrite and molybdenite in quartz veins in the vicinity of a granitic mass. Work started on August 5th and stopped August 12th with a crew of two men. Thirty rock chip samples (total sampled length, 224 feet) and 16 geochemical samples were taken. The property was not visited.

EUTSUK LAKE

Molybdenum-Copper

CAFB (Phelps Dodge Corporation of Canada Limited)†

(53° 127° S.E.) Field office, 404, 1112 West Pender Street, Vancouver 1. J. L. DeLeen, manager. This company holds 121 claims extending northward from Haven (Bone) Lake across the western part of Red Bird Móuntain between elevations of 3,600 and 6,000 feet. Haven Lake is 8 miles west of Pondosy Bay on Eutsuk Lake, and access to the property is by air. At this property since 1959 the company has investigated widespread occurrences of molybdenite with accompanying chalcopyrite, which chiefly occur near the contacts of a granodiorite porphyry stock. Work in 1964 was supervised by A. J. Schmidt and included 8,435 feet of surface diamond drilling in 15 holes with wire-line machines. A crew of 11 men, including drillers on contract, camped on the property from May to September.

The following notes are based on a visit of a few days' duration made in July.

The porphyry stock is about 5,000 feet in length from north to south and about 4,000 feet wide. The stock is emplaced in volcanic rocks of the Hazelton Group which appear to occupy the northern limb of an open anticline whose axis trends north of west. At its wider, northern end the porphyry stock encloses a large screen or roof pendant of altered volcanic rocks which extends nearly the entire width of the stock and contains steep east-trending bands of mylonite that pre-date the emplacement of the stock.

The stock consists mainly of a pale-grey or pink granodiorite porphyry that possesses a fine crystalline groundmass together with prominent phenocrysts of plagioclase, quartz, biotite, and, in places, orthoclase 1 inch in length. This rock is cut in a central drill-hole by dykes of a similar but darker porphyry and in some northeastern outcrops by other dykes of a light-coloured quartz porphyry which have northerly strikes and cut the volcanic rocks of the roof pendant.

In exposures and drill-holes mainly near the edges of the stock, the rocks are altered and contain quartz veins which are mostly mineralized. In places the quartz veins are closely spaced and range in width up to several inches, although most are narrower than 1 inch. Veins in the volcanic rocks are mostly thin, impersistent, and irregular in attitude. In porphyry, many veins follow fractures belonging to

* By H. Bapty.
† By J. M. Carr.

one or more conspicuous sets, of which a steep northeast-trending set exists in the eastern part of the stock and a northwest-trending set exists along part of the western contact.

Porphyry adjoining the veins is partly silicified by quartz flooding into the groundmass, and the silicified rock contains disseminated flakes of sericite. Plagioclase is variously either chalky, due to kaolinization and sericitization, or is yellowish or greenish, due to other kinds of alteration. In some places biotite books are bleached to a bronze colour, although elsewhere they are fresh and in places are accompanied by fine biotite that is possibly hydrothermal. Chlorite is present in small amounts. Orthoclase remains generally pink and fresh looking, and some which mantles plagioclase may be hydrothermal.

Altered volcanic rocks adjoining the stock are somewhat foliated and contain abundant fine-grained biotite, part of which crystallized subsequently to mosaic-textured quartz veins in the rocks. Volcanic rocks on the west side are strongly bleached and silicified.

Molybdenite is concentrated in the quartz veins, only minor amounts being in the adjoining rock. It is mostly finely disseminated and imparts a blue-grey colour to the quartz. Pyrite accompanies molybdenite and has a wider distribution. Together with small amounts of chalcopyrite, it forms weak disseminations and more abundant fracture-fillings, some of which cut the quartz-molybdenite veins. Mineralized outcrops are commonly stained by secondary minerals of both copper and molybdenum. Copper-molybdenum ratios are reported to be generally higher in the volcanic rocks than in porphyry. A showing which was visited about one-half mile from the stock contained chalcopyrite in the volcanic rocks without evident molybdenite and no quartz veins.

The attitude of faults on the property is generally unknown. One or two faults exposed in the northeastern part strike north and northeast, contain gossan, and apparently precede the mineralization. (*See* Annual Reports, 1962, p. 17; 1963, p. 29.)

ENDAKO

Molybdenum

Endako Mines Ltd.*

(54° 125° S.E.) Company office, 1218, 1030 West Georgia Street, Vancouver 5. T. H. McClelland, president; R. G. Weber, mine manager. This company, which is controlled and managed by Canadian Exploration Limited, holds 197 mineral claims north of the east end of Francois Lake, 115 miles west of Prince George. Thirteen of these claims are held under a mineral lease. A large molybdenite deposit which had been outlined by surface diamond drilling in 1962 and 1963, mainly on the Jay No. 10 and Boot Nos. 1, 2, and 6 mineral claims, was bulk sampled from underground workings in 1963. In 1964 additional surface diamond drilling was done, and in May the company announced plans for production from this orebody by open-pit mining starting in 1965. Ore reserves were stated to include 66½ million tons of ore containing 0.21 per cent molybdenum sulphide with dilution allowed for. During the year 12,730 feet of surface diamond drilling was done in 25 holes, bringing the total footage diamond drilled in the vicinity of the orebody since 1962 to 88,299 feet in 194 holes. In addition, in 1964 six holes totalling 862 feet were drilled north of the mine area on the Pat group of claims, and by arrangement with Julian Mining Co. Ltd. six holes totalling 388 feet were drilled on the Deer group north of the Endako orebody in the proposed tailings-disposal area. The Deer claims were subsequently transferred from Julian

* By J. M. Carr.

Mining Co. Ltd. to Endako Mines Ltd. and are included in the total number of claims given above.

The following geological description of the Endako orebody is based on an examination lasting for several weeks in June and July, when the orebody was still largely covered by overburden. The examination was chiefly of drill core, limited surface exposures in the western part of the orebody, and underground workings of the adit zone, which is also in the western part of the orebody. It was supplemented by information obtained from geological logs of all drill-holes, which were provided by the company, together with maps and other data.

The orebody is 2½ miles north of Francois Lake at about 3,400 feet surface elevation, and is in a granite batholith belonging to the Topley Intrusions. These intrusions of Lower Jurassic and younger ages extend beneath a partial cover of later rocks for distances of 80 miles both to the northwest and to the southeast of Endako. Two miles west of the mine, unmineralized Cretaceous or Tertiary volcanic rocks overlie the granite extensively. Beyond the southern edge of the batholith, which underlies Francois Lake, a fault belt as much as 6 miles wide and 12 miles long involves Tertiary and older rocks and strikes northeastward toward the mine, which therefore lies close to the intersection of two major geological structures—the belt of Topley Intrusions and the northeasterly fault belt.

The freshest granite at the mine is a reddish medium-grained rock without foliation, consisting mainly of quartz, red orthoclase, white plagioclase, and black biotite. The granite contains occasional rounded inclusions which are biotite-rich and have the general composition of quartz diorite. Irregular and mostly narrow dykes of pink aplite occur in the granite and are earlier than porphyry dykes which cut the granite and are mineralized. The porphyry dykes occur in about half the drill-holes, and their attitude is as yet poorly known. The few which were seen at surface possessed strikes that were variously to east and west of north, and dips that were generally steep. The porphyry dykes are of two kinds, the brown ones being of biotite-plagioclase porphyry which is dacite or quartz latite in composition, and the somewhat later, pale to buff-coloured ones being of quartz-orthoclase porphyry which is rhyolite in composition.

Wallrock alteration affects both the granite and the porphyries and is most intense in heavily fractured rock. Types of alteration include silicification and sericitization adjacent to quartz veins, orthoclase introduction, formation of hydrothermal biotite, argillic alteration of the plagioclase feldspar either to a white, yellow, or green colour, and production of calcite and other carbonates in the rock as veins and disseminations. A common alteration is one which renders the plagioclase feldspar greenish and leaves the orthoclase and biotite of the granite still looking fresh. Under the microscope, the plagioclase of rocks altered in this way appears more or less entirely altered to kaolin, carbonate, sericite, chlorite, and biotite in proportions which vary considerably. Plagioclase, which is altered to a chalky white appearance, apparently contains hydromuscovite as an alteration product, together with carbonate and flecks of biotite.

Molybdenite occurs principally in quartz veins, partly as coarse leaves and ribbons in the veins or on their walls, but mostly as a fine dissemination in the granular, dense quartz mosaic of the veins, which are thereby coloured blue-grey and frequently are ribboned in alternating dark and light layers. Some mineralized veins contain calcite in addition to quartz. Only a small proportion of the molybdenite occurs disseminated in altered rocks adjoining the veins. Molybdenite-bearing quartz veins range in width from very narrow to as much as 5 feet, and their length in places exceeds 160 feet, as in the drift of the adit zone. Many of the wider veins of an area tend to lie in a single general direction, which in the western part of the mine is east-northeast with a dip to the southeast of about 45 degrees. Occurring with this somewhat regular system of veins are other intersecting veins, mostly narrow, which form a stockwork of no definable pattern. Some of the latter narrow mineralized veins appear later than others which they cross, suggesting more than one age of both quartz and molybdenite deposition. In the porphyry dykes, wide veins are apparently not developed and molydenite occurs in slender veinlets, generally with quartz. A molybdenite-bearing quartz vein on surface, more than 1 foot wide in the granite, pinched to a fraction of an inch wide on intersecting the wall of a porphyry dyke, and rapidly died out.

Pyrite accompanies molybdenite in a general way and extends into rocks which contain quartz veins without much molybdenite. In the orebody, pyrite partly fills fractures and occurs also as disseminated well-shaped crystals. At least partly it is later than molybdenite, which it appears to crosscut and be emplaced into. Company engineers suggest that pyrite forms less than 1 per cent of the orebody. Other metallic minerals present include magnetite, some of which is hydrothermal, and forms rare vein fillings as well as sparse disseminated replacements; specular hematite, which may accompany magnetite locally in molybdenite-bearing quartz veins; and chalcopyrite, which is rare.

Faults are numerous in the orebody, but their attitudes are as yet poorly known. The most prominent ones show clear evidence of post-mineral movement, with slickensides indicating oblique slip displacement. These faults are frequently wide and contain gouge and strongly chloritized rock together with, in places, unmineralized grey or dark-green biotite-lamprophyre dykes which are partly sheared and altered to chlorite and calcite. In the adit several faults of this type are exposed, none of which contain lamprophyre. The most northerly fault strikes northeastward and dips steeply southward, and includes gouge with a high content of molybdenite at the point where sampled, which was adjacent to a dragged mineralized vein on the footwall. The more southerly fault also strikes northeastward but dips northward at about 60 degrees. It is about 4 feet wide and here forms the southern limit of ore, the rock to the south being altered and pyritized but containing only a few quartz veins, not all of which contain molybdenite. Faults between the described faults in the adit strike northwestward and dip southward at angles between 40 and 70 degrees. Gouge collected from one of these faults was found to contain only small amounts of molybdenite. Evidence of post-mineral faulting is seen in the frequent occurrence of sheared molybdenite and locally pyrite on the walls of quartz veins. On surface in the northwestern part of the orebody, small faults cause horizontal offsets of a few feet on the veins, some of which are offset to the right by north- and northwest-striking faults and to the left by northeast-striking faults. Some ribboned, mineralized quartz veins in the adit show remarkable forms; some are like folded veins which either pinch out or are offset by or truncated against hairline fractures. These complicated displacements are apparently mainly of post-mineral age.

Pre-mineral faults are not easy to identify. Possibly some of the prominent faults originated at this time, as is suggested by the apparent concentration of better-looking mineralization in the vicinity of many such faults in the drill core. Many of the wider quartz veins apparently follow shear fractures of pre-mineral age and contain bands, streaks, and vestigial layers of a dense fine-grained siliceous black or grey rock which, under the microscope, is resolved as siliceous fine-scale breccia or mylonite. The dark colour is shown by spectrographic analysis not to be due to molybdenite or other metallic minerals, and is probably due to graphite.

Ore controls at Endako are far from clear, and there is as yet no explanation available for the location and form of the orebody. According to company plans based primarily on the results of close-space drilling, mainly in vertical holes, the orebody trends west-northwestward, is about 5,000 feet long, and ranges in width from 500 to 1,200 feet. It extends in depth for as much as 500 feet, with mineralized sections occurring at yet greater depth.

Open-pit preparation and construction work commenced in April and extended throughout the year. Men employed varied from a low of five to a peak of 400. The majority of men were employed by various contractors. The open-pit preparation consisted of the removal of over 1,000,000 cubic yards of overburden. Some assessment work and road work were done on various groups of claims. Fifty tons of bulk sampled ore was sent to Canadian Explorations Limited, Salmo, for metallurgical test work.

Buildings such as those for primary crusher, secondary crusher, dry, warehouse, office, assay office, auxiliary power-house, maintenance-shop, and concentrator, for a 10,000-tons-per-day plant, were constructed. Installation of machinery commenced in November. Pumps, pipe-line, and tanks for water supply were constructed and installed. (*See* Annual Report, 1963, pp. 30–38.)

Deer, Elk, Nu, Dis, Dat (Julian Mining Co. Ltd.)*

(54° 125° S.E.) Company office, 409 Granville Street, Vancouver 1; field office, 1396 Fifth Avenue, Prince George. B. G. Gore, president; R. Macrae, engineer in charge. These groups consist altogether of about 74 claims which adjoin the northern and western boundaries of the Endako Mines Ltd. property. Work was done between August and November by a crew of seven under the direction of D. Petersen. It included geochemical surveys and 1,908 feet of diamond drilling in 22 holes, the majority of which were on the Nu and Elk groups to the west of the Endako mine. (*See* Annual Report, 1963, p. 32.)

Rob, Fran (Utica Mines Ltd.)†

(54° 125° S.E.) Company office, 1030 West Georgia Street, Vancouver 5. G. L. Mill, president. The Rob and Fran groups consist of 28 recorded claims adjoining the western boundary of the Endako Mines Ltd. property and the southern boundary of the Elk group. Access to part of the property is by four-wheel-drive vehicle over 3 miles of logging-road leading west from the public road near the Nithi River resort, and to other parts of the property from near the Endako mine. During July and August, trenching and cutting of base-lines with a D-8 bulldozer tractor were done by a crew of two men supervised by R. G. Coutts. This work discovered molybdenite at localities which include one on or near the Fran 40 claim about 1 mile south-southwest of the Endako mine. When seen early in July, this locality contained disseminated molybdenite and more abundant pyrite in altered, fractured granite with chloritized biotite. Quartz veins were not in evidence, and the showing was on the east side of a northeasterly gully which may overlie a fault. (*See* Annual Report, 1963, p. 32.)

Bell (Julian Mining Co. Ltd.)†

(54° 125° S.E.) Company office, 409 Granville Street, Vancouver 1; field office, 1396 Fifth Avenue, Prince George. B. G. Gore, president; R. Macrae, engineer in charge. In 1964 this company held 21 claims under option and two recorded claims in the Bell group adjoining the eastern boundary of the Endako Mines Ltd. property. Work was done from March to June by a crew of eight men under R. S. Adamson and included geophysical surveying and 2,180 feet of diamond drilling in 11 holes. The drill core, when briefly examined, showed that all the holes

* By H. Bapty.
† By H. Bapty and J. M. Carr.

intersected granite which is partly fresh and partly altered. In places the altered rock is mineralized with pyrite, molybdenite, and rare chalcopyrite. Dyke rocks include brown porphyry in hole No. 9 and lamprophyre in hole No. 3. Chloritic faults are apparently largely post-mineral in age. (*See* Ann. Rept., 1963, p. 35.)

MS (New Indian Mines Ltd.)*

(54° 125° S.E.) Company office, 661 Hornby Street, Vancouver 1. T. E. Blossom, president; F. J. Hemsworth, consulting engineer. This group of nine recorded claims in the MS group lies on the south side of Highway No. 16, 4 miles west of Endako. Work commenced May 15th and continued until July 30th by a crew of two men. A soil-sampling survey was conducted. Transportation is by road vehicle. The property was not visited.

AX and BX (New Indian Mines Ltd.)*

(54° 125° S.E.) Company office, 661 Hornby Street, Vancouver 1. T. E. Blossom, president; F. J. Hemsworth, consulting engineer. This group of recorded claims, including the AX 1–10 and the BX 1–8 as well as the AB fraction, lies adjacent to and south of Highway No. 16, 7 miles west of Endako and 1 mile south of the railway station of Savory. Work commenced May 15th and continued until July 30th by a crew of two men. A soil-sampling survey was conducted over the property. Transportation is by road vehicle. The property was not visited.

VO (New Indian Mines Ltd.)*

(54° 125° S.E.) Company office, 661 Hornby Street, Vancouver 1. T. E. Blossom, president; F. J. Hemsworth, consulting engineer. This group of recorded claims, VO 1–16, lies 5 miles north of Endako. Work commenced in May and continued until July by a crew of two men. A soil-sampling survey was conducted over the property. Transportation is by road vehicle over a mining-trail. The property was not visited.

Leo and Mo (Skeena Silver Mines Ltd.)*

(54° 125° S.E. and 54° 124° S.W.) Company office, 844 West Hastings Street, Vancouver 1. F. A. McGonigle, president; H. L. Hill and F. L. C. Price, consulting engineers. The Leo group consists of 20 recorded claims northwest of Endako, and the Mo group consists of 20 recorded claims 5 miles southeast of Endako on the east side of the Stellako River. A crew of three men did about 200 feet of trenching in August on each of the Leo and Mo groups. Transportation was by truck over mining-trails. These claims were not visited. (*See* Ann. Rept., 1963, p. 35.)

NITHI MOUNTAIN

Molybdenum

Molly, Pogo, Sandy, Linda, Ruff, Enco, Scott (R & P Metals Corporation Ltd. and Navajo Mines Ltd.)†

(53° 124° N.W.) This property consists of 122 recorded claims, of which 54 claims in the Enco and Scott groups are owned by Navajo Mines Ltd. (company office, 800, 789 West Pender Street, Vancouver 1) and the remainder by R & P Metals Corporation Ltd. (company office, 605, 1030 West Georgia Street, Vancouver 5; A. Robertson, president). Navajo Mines Ltd. is a newly formed company in which New Indian Mines Ltd. holds an interest. The prop-

* By H. Bapty.
† By J. M. Carr.

erty is on the western and southwestern slopes of Nithi Mountain, whose summit is at 4,435 feet elevation, and is accessible by 7 miles of dirt road leaving Highway No. 16 at Chowsunkut Lake turn-off near Fraser Lake village. Work from May to November was done by a crew averaging 10 men including drillers. It was supervised by R. C. Coutts and included road construction, trenching, stripping, and laying out of base-lines by bulldozer, soil-sampling, and 7,994 feet of diamond drilling in 14 holes, of which two were extended onto the adjoining Jen claims of Jodee Explorations Limited. A drillers' camp was established on the property in June. The property is underlain by several varieties of granite which belong to the Topley Intrusions and partly resemble granite at the Endako mine about 10 miles to the west, even to the occurrence of small resorbed xenoliths. Close to molybdenite showings on the Molly 1 and 2 claims and the Enco fractional claim, the granite is cut by an irregular northerly dyke of quartz porphyry, or rhyolite porphyry, which contains small quartz vugs and green and yellow uranium minerals but little or no molybdenite. About 2,500 feet farther south, near other molybdenite showings on the Molly 8 claim and the Enco 2 fractional claim, the same dyke or a similar one apparently turns southeastward and is cut by several green altered but unmineralized diabase dykes which trend mainly west-northwestward but also northward. Similar green post-mineral dykes occur 2,500 feet farther to the east-southeast on the Molly 9 claim. Quartz veins with molybdenite occur widely on these claims; they are mostly less than 1 inch thick, but some are larger and locally swell to thicknesses of as much as 2 feet. The strike of the veins is predominantly between north 55 degrees east and north 65 degrees east, and the dip is more often northerly than southerly, at moderate to steep angles. In some exposures the veins show complex minor dislocations comparable to those affecting veins in the Endako orebody. Molybdenite disseminations occur locally, mainly in strongly silicified, sericitized granite. Pyrite disseminations and fracture-fillings are of general occurrence; specularite occurs in places on shear surfaces. The mineralized granite is altered in much the same way as at the Endako mine. Plagioclase is partly chalky and partly greenish; orthoclase remains fresh and pink, and may locally in part be hydrothermal; and chlorite is present. Quartz and sericite together largely replace the granite adjacent to some veins, and rock altered in this way is commonly stained by manganese oxide.

When the property was last visited in early August, seven widely spaced holes had been drilled, all vertically except for No. 7, which was inclined southward at minus 50 degrees. Molybdenite mineralization mainly below commercial grade was intersected in several holes. (*See* Annual Report, 1963, p. 36.)

KO (Julian Mining Co. Ltd.)*

(54° 124° S.W.) Company office, 409 Granville Street, Vancouver 2; field office, 1396 Fifth Avenue, Prince George. B. G. Gore, president; R. Macrae, engineer in charge. The KO group of 12 recorded claims is on the northwestern slope of Nithi Mountain and adjoins the western boundary of the Enco group. Access is by the old " Burma " road from the Stellako River road. Work commenced September 15th and was completed by October 15th by a crew of two men under the guidance of D. Petersen. A magnetic survey was conducted over the claims, some geological mapping was done, and trenching was undertaken with the aid of a bulldozer. Transportation was by four-wheel-drive vehicle over mining trails. The property was not visited. (*See* Annual Report, 1963, p. 36.)

* By H. Bapty.

Bat (Julian Mining Co. Ltd.)*

(54° 124° S.W.) Company office, 409 Granville Street, Vancouver 2; field office, 1396 Fifth Avenue, Prince George. B. G. Gore, president; R. Macrae, engineer in charge. The Bat group of 34 recorded claims is near the KO group on the west slope of Nithi Mountain. Work commenced June 1st and was completed by June 15th by a crew of four men under the supervision of R. S. Adamson. Geochemical sampling was conducted over the claims, some geological mapping was done, and trenching was undertaken with the aid of a tractor bulldozer. Transportation was by land vehicle over mining-trails. The property was not visited.

Tip, Tan (Fort Reliance Minerals Limited)†

(53° 124° N.W.) Company office, 3100, 25 King Street West, Toronto 1. J. A. Harquail, president; A. D. Wilmot, resident engineer, Kelowna. This company holds about seven recorded claims and fractions named Tip and Tan which lie on the north slopes of Nithi Mountain northeast of the Molly and Ruff groups. In June, 1964, work was done by a small crew under A. D. Wilmot, consisting mainly of geological mapping and hand-trenching at a molybdenite showing discovered on the Tan 4 claim late in the previous season. This showing and others adjacent to it are a short distance east of the eastern corner of the Ruff 8 claim and are in well-jointed medium-grained altered granite which contains pyrite rather widely on fractures. Finer-grained granite a short distance farther north is also pyritized. At the showing, quartz with molybdenite occupies fractures largely of two sets striking north 60 degrees west and north 30 degrees east and dipping at moderate angles southwestward and northeastward respectively. The fractures are rather widely spaced. In one trench the intersection of these sets appeared to control the localization of coarsely disseminated molybdenite within a pencil-shaped body of orthoclase-enriched granite measuring about 10 feet in length northward and about 1 square foot in cross-section. Molybdic ochre was prominent on fractures in the vicinity of molybdenite.

M.J.M. (Scope Development Ltd.)†

(54° 124° S.W.) This company, which is a wholly owned subsidiary of Alscope Consolidated Ltd. (company office, 549 Howe Street, Vancouver 1; N. Martini, president; V. M. Prescott, secretary-treasurer), holds 10 claims in the M.J.M. group partly adjoining the eastern boundary of the Tip group at about 2,800 feet elevation on the north side of Nithi Mountain. The claims were acquired in 1964 from Marvin Scheuerman and M. and J. Bibby and are partly a relocation of the Tobby claims. Access is by about 4 miles of dirt road from the Chowsunkut Lake turn-off on Highway No. 16. A small crew under R. S. Addison prospected the ground in June and discovered one or more small occurrences of molybdenite. An occurrence examined by the writer is about 700 feet east of the road, on the south slope of a granite ridge situated between linear gullies that trend slightly north of east, parallel to the general direction of glacial advance in the area. A few closely spaced quartz veins a fraction of 1 inch wide strike eastward and dip steeply to the north in scarcely altered, fairly coarsely grained granite and contain small amounts of specularite and traces of molybdenite. Pyrite is sparingly disseminated in the granite here and elsewhere on the ridge.

* By H. Bapty.
† By J. M. Carr.

CARIBOO

WELLS-BARKERVILLE (53° 121° S.W.)

Gold

Aurum (The Cariboo Gold Quartz Mining Company Limited)*

Company office, 675 West Hastings Street, Vancouver 2; mine office, Wells. J. Royden Morris, president; Marcel Guiguet, general manager; Charles McNeil, mine superintendent; J. J. Stone, mill superintendent. Capital: 4,000,000 shares, $1 par value. This company operates the Aurum mine on the east side of Island Mountain. The mine is adjacent to the community of Wells and is 51 miles by road from Quesnel. The mine has been in production since 1934 and has been operated by the present company since 1954. It is developed from a main haulage adit at the 4,000-foot level, from which a three compartment internal shaft 1,450 feet deep is sunk. Eleven levels have been developed from the Aurum shaft.

The following is a summary of development work done during 1964:—

	Ft.
Drifting and crosscutting	6,542
Raising	1,041
Box-holes and sub-drifts	281
Diamond drilling	22,612
Test-holes (jackleg and ribbon steel)	12,384

A total of 29,630 tons of ore was milled, yielding 19,867 ounces of gold and 3,816 ounces of silver. An average crew of 113 men was employed. (*See* Annual Report, 1962, pp. 19–20.)

LAC LA HACHE

BIG TIMOTHY (TAKOMKANE) MOUNTAIN (52° 120° S.W.)

Molybdenum

Boss Mountain (Noranda Mines, Limited, Boss Mountain Division)†

British Columbia office, 1050 Davie Street, Vancouver 5; mine office, Box 247, 100 Mile House. L. R. Redford, manager; W. G. Clarke, mine superintendent; J. Austin, mill superintendent; A. Ozols, plant superintendent; R. C. Heim, geologist. The property comprises 11 Crown-granted and 114 recorded claims. The mine is on the east slope of Big Timothy (Takomkane) Mountain, about 35 air miles northeast of 100 Mile House, from which it is reached by 57 miles of road via Forest Grove and Canim Lake. From Canim (Eagle) Creek on the north shore of Canim Lake, the Hendrix Creek forest access road is followed to Hendrix Lake, where a townsite has been laid out, and from which 6 miles of company road leads to the camp at about 5,050 feet elevation. An additional mile of road leads on to the surface showings on and near Molybdenite Creek, at approximately 5,500 feet elevation. The access and general layout are shown on Figure 8.

The original discovery of molybdenite was made in 1917. A large number of strippings, trenches, pits, and open cuts were made by The Consolidated Mining and Smelting Company of Canada, Limited, in the 1930's, principally on the Southwest vein zone, in which two short adits were driven. In 1942 the British Columbia Department of Mines did 1,363 feet of X-ray diamond drilling in the main breccia orebody. In 1955 H. H. Huestis and associates acquired the Crown-granted claims at tax sale, and the following year located 94 additional claims. From 1956 to

* By W. C. Robinson.
† By G. E. P. Eastwood.

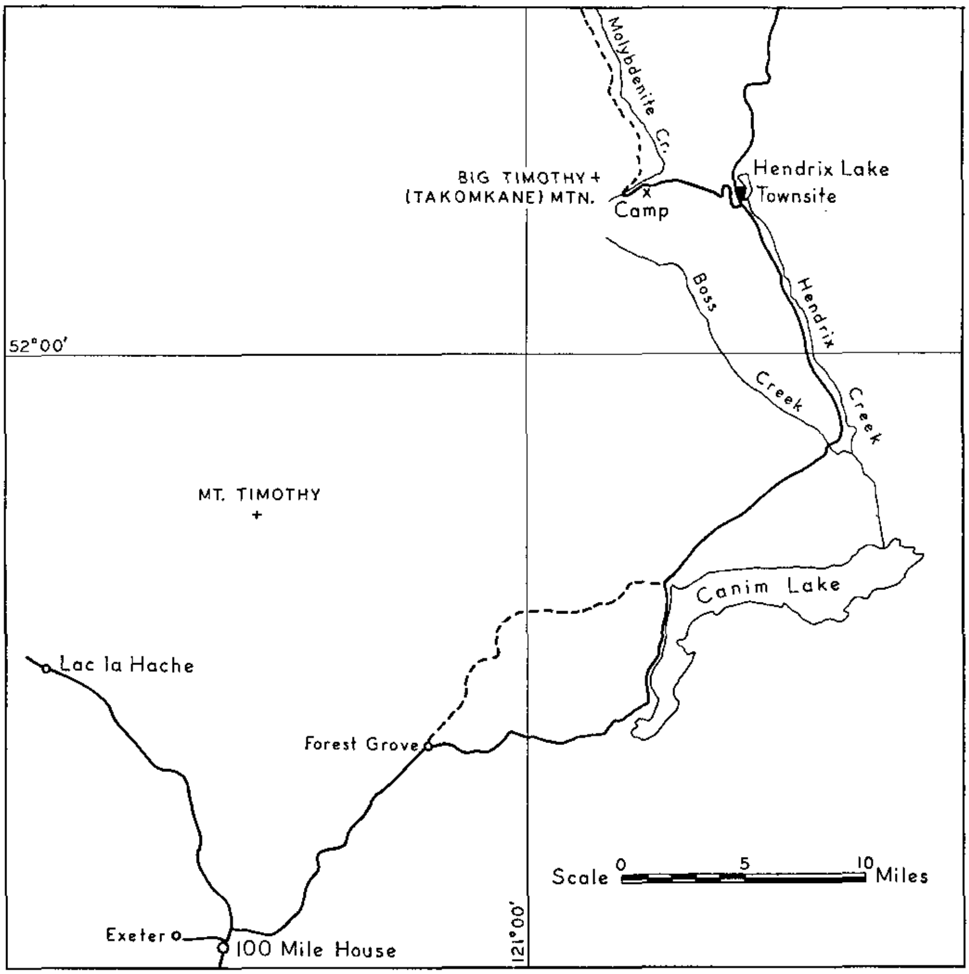


Figure 8. Index map, Boss Mountain mine.

1960 the property was held under option by Climax Molybdenum Company, its successor, American Metal Climax Inc., and a subsidiary, Southwest Potash Corporation, who are reported to have done 37,000 feet of diamond drilling, in addition to considerable trenching.

In 1961 the property was acquired by Noranda Exploration Company Limited. Geochemical surveys were made, and additional diamond drilling and trenching were done. In 1962–63 a mile-long adit at 5,045 feet elevation and a raise from it to surface at 5,488 feet were driven. In 1964, 4,897 feet of crosscutting and drifting and 1,246 feet of raising were done in preparation for mining the Main breccia orebody and the Fracture orebody. Stope preparation included 31,000 feet of longhole drilling and the stockpiling of 11,000 tons of ore.

In 1964 there were under construction a 1,000-tons-per-day mill just below the portal, an office building and other permanent buildings nearby, and a Panabode bunkhouse and cafeteria for 40 men on a site about 1,000 feet north of the portal. A large area adjacent to the south end of Hendrix Lake was filled for a townsite, and construction of 30 houses was begun. A water pipe-line route from Hendrix

Lake to the camp and mill was laid out. Right-of-way was cleared and erection began of a 66,000-volt transmission-line to the townsite and camp.

Diamond drilling totalled 12,965 feet, of which some 3,000 feet was from surface, in the Southwest vein zone, and the balance from underground.

The company employed an average of 40 men underground, 40 on surface, and 28 on staff. The several contractors employed as many as 200 men.

Mine Workings

The main haulageway is an adit crosscut at 5,045 feet elevation, driven 5,600 feet almost due west from the portal to the vicinity of the orebodies. It curves into a main drift which passes along the northeast side of the Main breccia and Fracture orebodies and continues beyond them to the northwest (*see* Fig. 9). Several cross-cuts pass through the orebodies, along the southwest side of which a drift was being driven in 1964. The southerly of two raises leads to the 5085 sublevel in the Main breccia orebody. The northerly raise, in the Fracture orebody, leads to the 5280 level drift. A vertical raise from this drift leads to surface at 5,488 feet elevation and is equipped with two exhaust fans.

In addition to these main workings, there are three old adits and many trenches, pits, and open cuts on the property (*see* Fig. 9). No. 1 adit, driven into the right bank of the most westerly tributary of Molybdenite Creek, is caved. Nos. 2 and 3 adits are in the Southwest vein zone. No. 2 extends 10 feet from an open cut, and No. 3 is caved.

In the earlier work on the property a large number of openings were made by hand in the Southwest vein zone. Fourteen old trenches were found above No. 1 adit, just off the area of Figure 9. Since 1956 many trenches have been excavated by bulldozer in the vicinity of the present orebodies and on the hillside and ridge nose to the east.

Geography

The location of the camp and townsite are shown on Figure 9. A low ridge separates the deep valley of Hendrix Lake and Creek from a broad trench along the eastern foot of Big Timothy Mountain. Boss Creek enters this trench 3 miles south of the camp and flows toward Canim Lake, and Molybdenite Creek enters it just north of the camp and flows toward Horsefly Lake. The mill-site, portal, and camp are about 200 feet above the trench and the tailings pond will be on the trench floor on the Boss Creek drainage.

The east slope of the mountain rises gently to moderately to about 6,000 feet elevation, above which several rock bluffs, particularly around the head of Molybdenite Creek, provide most of the good rock exposure in the area. Elsewhere the bedrock is mantled with a thin to thick cover of till, and natural exposures are small and scarce below 6,000 feet. The bedrock beneath the till is weathered to a depth of several tens of feet, so that exposures provided by road cuts and trenches are rubbly and difficult to study.

The principal stream in the mine area is Molybdenite Creek. Three small tributaries are useful for reference, and are designated west, middle, and east creeks on Figure 9.

The slopes are timbered, mainly with balsam fir, to about 6,500 feet elevation. Underbrush is generally light. The mine area has a fairly heavy snowfall, and the ground is usually snow-covered from early October to mid-June. The summers are short, cool, and windy.

The mountain, 7,057 feet in elevation, is visible from vantage points along the Cariboo Road, and was early known as Big Timothy. In the 1920's a surveyor

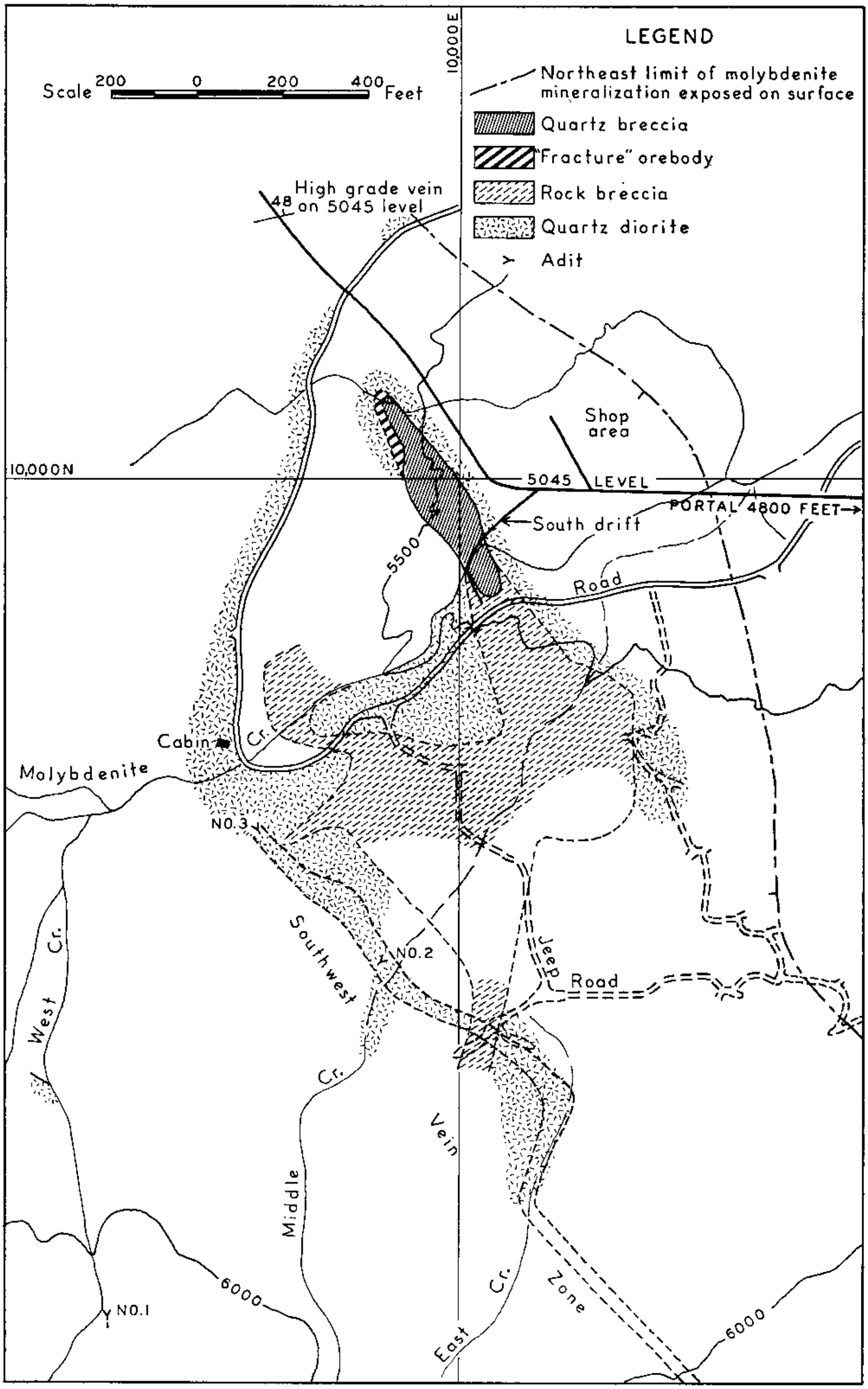


Figure 9. Geology of Boss Mountain mine area.

erroneously identified it as Boss Mountain, which actually lies 16 miles to the east. The survey monument on the summit was named Boss, and the property came to be called Boss Mountain. Because of the confusion with Mount Timothy, 20 miles to the southwest, and with Boss Mountain, the Geographic Board in 1938 adopted the Indian name Takomkane. In 1961 the name was officially changed to Big Timothy.

Outline of Geology

The regional geology has been mapped by R. B. Campbell for the Geological Survey. Early reports on the property were prepared for the Department of Mines by J. S. Stevenson in1940 and 1942 and by A. Sutherland Brown in 1957. F. M. Vokes described the property for the Geological Survey in 1958. The present report derives from a two-month structural study of the mineralized area.

The mineralization is in the northeast part of a batholith which intrudes Mesozoic volcanic rocks and is overlain on the north and west by Miocene flows. In the mine area the batholithic rock is quartz diorite, although Sutherland Brown has described monzonite and syenodiorite south and west of the mountain summit, and there appears to be a dioritic or gabbroic border zone in contact with the Mesozoic volcanic rocks.

The quartz diorite has been intruded by an array of irregular dykes and a granite stock, injected by several systems of veins, broken by various fractures and faults, and has been locally brecciated and locally mineralized. Rock alteration is slight.

Mineralization by molybdenite, quartz, and pyrite appears to focus on an irregular body of brecciated rock. Disseminated pyrite appears to form a halo, 1 to 1½ miles across, roughly concentric with the breccia body, which is about 700 feet across. Quartz veins appear to increase in number toward the breccia body. Most of the molybdenite appears to be in a relatively narrow irregular ring around the body, occurring in some of the quartz veins and as seams in the rock. It also occurs in parts of the breccia body itself. Sporadic molybdenite has been found outside this ring, but there it does not seem to form either local concentrations of appreciable size or a large aggregate amount.

The breccia typically is a jumbled mass of fragments of quartz diorite and dyke rocks, set firmly in a sparing fine-grained matrix that appears largely to be comminuted quartz diorite. In two relatively small sections of the breccia, abundant quartz has been introduced between the fragments, forming what are known as the Main and South quartz breccia bodies. The remainder of the breccia, which has had little or no quartz introduced between the fragments, is known as rock breccia.

Much, though not all, of the quartz breccia has been well mineralized with molybdenite, forming the Main and South breccia orebodies. Near the Main breccia orebody a section of the veined and seamed country rock has been found to be of ore grade and is known as the Fracture orebody. A large and rather complex vein farther out in the country rock contains relatively abundant molybdenite and is known as the High Grade vein. Much of the early work on the property was concentrated on a long, narrow zone of mineralized quartz veins southwest of the breccia, but an orebody has not been demonstrated there.

The mine area has had a rather long and complex history, and the geologic conditions that led to the mineralization are not altogether clear. A number of inferences can be drawn from space and time relations with the various intrusions, veins, and structures, but some events were apparently too distant or too late to have had any appreciable effect on mineralization. Most of the age relationships are reasonably well established, but some are less than conclusive and a few are unknown. The following geologic time-table is therefore partly tentative. Most of the vein types form a clear-cut sequence, which is used for relative dating of mineralization, structures, and some intrusions. Absence of this sequence of veins from the granite stock suggests, but does not prove, that the stock is younger. The breccias appear on balance to be younger than banded veins and molybdenite-bearing slips, and older than the other veins. The buff dykes and older lamprophyres preceded all of the veins, but their ages relative to each other were not determined. The relatively rare grey dykes and aplites are known only to be post quartz diorite.

TENTATIVE GEOLOGIC TIME-TABLE

Rocks	Veins	Structure
Muck and alluvium.		
Till.		
Takomkane basalt.		
	Calcite veinlets.	
Lamprophyre II.		Gouge zones.
	Quartz-pyrite in granite.	
		Soft, kaolinic zones.
		Slips and tight shears.
Granite stock.		
	G=calcite-zeolite.	
		Open shears; some gouge and breccia zones.
	QS with molybdenite II.	
		Most shear zones; some gouge and breccia zones.
	FZ with some molybdenite II.	
	A and F with minor molybdenite II.	
	Q=thick, barren quartz.	
		Some shear zones.
		QUARTZ BRECCIA.
Pink porphyry.		ROCK BRECCIA.
	Molybdenite I seams and veinlets in slips.	Slips.
	Banded veins with molybdenite I.	Some flat shear zones.
Buff dykes.		
Grey dykes.		
Lamprophyre I.		
Aplite.		
BATHOLITHIC QUARTZ DIORITE.		
Dioritic xenoliths.		
(Mesozoic volcanics east of the batholith.)		

Rocks

The quartz diorite is uniform in colour and texture over a considerable area, but locally it shows some variations. It consists of coarse-grained light-grey to very pale-pink plagioclase and minor quartz, speckled with greenish-black hornblende or with biotite. Locally in the north part of the 5045 level drift, ferromagnesian minerals are scarce, and the rock is almost white. Locally on surface in the general mine area, and more generally to the south, the quartz diorite is medium grained. At the intersections of some fractures and along some veins the plagioclase of the quartz diorite is more or less replaced by orthoclase. The ferromagnesian minerals outline a faint steep foliation.

In and near the mine the quartz diorite contains thinly scattered xenoliths of medium-grained dark-grey dioritic rock. They range from a few inches to nearly 2 feet across.

The dykes include lamprophyre of two ages; buff-coloured bodies of felsite, quartz porphyry, and quartz feldspar porphyry; pink porphyry; aplite; and a dark-grey andesitic-looking rock. The lamprophyres and buff dykes are by far the commonest. These small bodies are called dykes because most of them appear tabular and are up to 20 feet thick, but some are highly irregular. Aplites and grey dykes are from 1 to 5 feet thick. The thicker tabular bodies are essentially vertical, but some of the thinner ones dip at angles as low as 30 degrees. Preferred strikes are apparent only among the lamprophyres, the older dykes tending to strike northwestward and the younger westward.

The aplite is finely sugary, and looks like a fine-grained variety of the quartz diorite. Some dykes contain notably large mafic crystals. The aplite has not been seen in contact with other dyke rocks, and its early age assignment is based on the assumption that it is a late injection of the quartz diorite proper.

The lamprophyres are fine-grained greenish-black to black rocks. The older and younger lamprophyres are generally not distinguishable in themselves. The older lamprophyres are injected by all the veins, and one was observed to be transected by a dyke of pink porphyry. The younger lamprophyres, on the other hand, transect all the veins except some very small calcite veinlets, and some intrude the granite stock.

The fine-grained grey dyke rock is most commonly seen as small fragments in rock and quartz breccia, but two larger bodies, plugs, or large fragments were seen north of the cabin, and two dykes are exposed in bulldozer trenches, just east of the limit of molybdenite mineralization on surface. The dykes contain prominent needles of black amphibole and in thin-section are seen to be quartz andesite. In relative age they are known only to be post quartz diorite and pre breccia. Possibly they are variants of the older lamprophyre.

The buff dykes are grouped together because of their general similarity and because there is no reason to believe that they differ in age. They are dense creamy buff felsites that weather buff or light brown, or porphyries which are identical, except that they contain phenocrysts of quartz or quartz and feldspar. A buff dyke in the adit crosscut near the west contact of the granite contains also phenocrysts of amphibole. These buff intrusives have locally contributed abundant fragments to the rock breccia. They are post quartz diorite and pre vein.

The pink porphyry consists of quartz and a few feldspar phenocrysts in a pale- to light-pink aphanitic groundmass. It contains almost no ferromagnesian minerals. It is post older lamprophyre, and its relations with rock breccia are equivocal.

A granite stock is traversed by the adit crosscut, its west contact being 230 feet east of Figure 9. It is reported to be exposed on surface east of the area shown and to plunge southwest. It is a coarse-grained rock, green near the west contact but red farther east. It is much broken by shear and gouge zones, but the only veins that it contains consist of quartz and pyrite. Similar quartz-pyrite veins have not been observed outside the granite. The west contact of the stock is a wide breccia zone, which involves quartz diorite and granite. Because the granite contains neither molybdenite nor the types of vein that occur abundantly in the quartz diorite, nor dykes other than lamprophyre, it is probably younger than all of them.

The Takomkane olivine basalt was not examined by the writer. It consists of a cinder cone with breached crater and a small lava flow, of pre-glacial or interglacial age.

Veins and Structures

The rocks adjacent to the breccias have been injected by a great many narrow veins and a few wider ones. Most of the veins contain quartz, but some consist entirely of calcite and zeolites, and some very narrow ones appear to consist entirely of molybdenite. The extremes in thickness are 0.04 inch and 3 feet, but most of the veins are from 0.1 to 4 inches thick. The veins tend to be persistent, those thicker than an inch being generally more than 20 feet long, and two 4-inch veins were traced for more than 80 feet.

In a general way the veins seem to decrease in number away from the breccias. For instance, the incidence of veins thicker than 0.5 inch is 20.8 per 100 feet of working in the Shop area and adjacent part of the adit crosscut and is 13.3 in the south drift, but is 12.1 in the main drift north of the Main quartz breccia body and 6.7 between the most easterly crosscut and the west contact of the granite. Thinner veins were not mapped, but seemed to decrease in number even more sharply. Near the portal only three veins were found in a 100-foot section of the adit. On surface the decrease is not as well established, because the exposures are scattered and the veins are less readily seen in the rubbly trenches, but distant outcrops of solid bedrock appear to contain very few veins. The incidence of veins in the rock breccia and quartz breccia is highly variable, but probably is generally less than in adjacent quartz diorite.

Several systems of veins are differentiated on the bases of mineralogy, texture, internal structure, relation to other structures, and relative age. A few veins are difficult to place in the sequence, but most have well-defined characteristics. Relative ages were determined from displacement of one vein on another and, less commonly, from interruption of one vein by another. The sequence is shown in the time-table, and the individual systems are described below.

Structures include various kinds of breaks and some soft kaolinic zones. In view of their special significance, the breccias are described separately below. All of the veins have probably formed along breaks, and where vein terminations are exposed the veins are seen to pinch out in fractures which continue for a few inches or a few feet beyond.

The breaks include simple fractures, slips, shear zones, and gouge and breccia zones. Simple fractures are rarely apparent, except as feather ends of veins and shear zones, but they may have been the most numerous of the breaks. Slips are small but fairly numerous and are important as carriers of molybdenite. Shear zones are larger and less numerous, and many of them contain no vein material, although a large modifiied shear zone is host to the High Grade vein. Gouge and breccia zones are the largest and least common of the breaks, and they rarely contain vein material.

Many of the breaks displace older structures, and some of the shear zones show evidence of repeated movement. The ages of shear zones in the time-table refer therefore to discernible ages of movement relative to the vein sequence rather than to ages of initiation of the shear zones. The amount of movement ranges from a fraction of an inch to 20 feet or more, and is generally much less on the simple fractures and slips than on the shear and gouge and breccia zones.

The slips appear in section as dark bands in the rock, and where they form part of the wall of the working they appear as polished, planar, dark-green surfaces. In detail, a central fracture with polished walls is flanked by about a millimetre of dark-green mylonite. The slips commonly persist for 5 to 15 feet. A few pass into quartz-bearing veins, but most die out in rock at both ends. A majority appear to have steep dips, but no preferred strike is evident. In the north part of the main drift there are several sheeted zones, each about 5 feet wide, consisting of close-spaced parallel slips, striking about north 80 degrees east, and vertical or dipping steeply south.

The molybdenite seams in the slips are 1 to 2 millimetres thick and persist for distances between 1 and 10 feet. They appear macroscopically to consist entirely of molybdenite, but it is reported that a little quartz has been seen in them under the microscope. The molybdenite is fine grained.

The shear zones are characterized by appreciable thickness, anastomosing surfaces of parting, schistose material, and in part by introduced quartz. Most are from 5 to 12 inches thick, but thicker and thinner ones are present. They are long, and none was traceable for its entire length in the mine workings. In a few places tight shear zones were seen to terminate in the wall or back of a working. Some feather out as bundles of simple fractures which are separated by unsheared rock, and die out in a foot or two. Others narrow to simple fractures which grow progressively fainter over several feet, to the point where they are no longer discernible. Most of the shear zones dip steeply and strike between north and east. The thicker ones tend to dip north at moderate angles and strike eastward.

The shear zones consist typically of schistose rock, but some contain quartz veins, and a few of the thicker ones contain lenses of non-schistose rock. The schistose material appears chloritic, but other minerals are doubtless present and may predominate. The non-schistose lenses are dark and resemble fragmented lamprophyre. The three thickest shear zones found are in lamprophyre dykes. One is host to the High Grade vein and is described under orebodies. The other two are at the north end of the Shop area and consist of green mud, schist, fragments, and softened rock, into which quartz and minor molybdenite have been injected. The zones are 2½ to 4 feet thick, and the main quartz veins are 12 to 14 inches thick. Molybdenite forms thin lenses and isolated crystals along the walls of the main veins.

The quartz veins in shear zones are designated by the abbreviation QS in the time-table. They are thought to have formed late in the vein sequence because one of them has been injected into a shear zone that displaces two FZ veins, and because the quartz, and molybdenite where present, are coarse grained. Also, at least one of these veins contains a little calcite. It is possible, however, that the QS veins may not all be of the same age.

Typical gouge and breccia zones lack the coherence of typical shear zones, and they do not appear chloritic. They range from mud seams a fraction of an inch thick to zones more than 10 feet wide. The thicker zones consist predominantly of muddy breccia—more or less coherent fragments of rock separated by mud seams. Virtually all of these zones are water bearing. They were probably initiated late in the sequence of veins and structures, judging by the general absence of chlorite and vein minerals. Gouge zones in the granite were probably initiated still later.

Here and there in the quartz diorite, and more commonly in the granite, there are zones of soft kaolinic material which spalls readily at the touch of a pick. The soft material is damp but oozes little water. The zones are 5 to 15 feet wide, of unknown length, and have various attitudes. Some veins are cut off by them, and the only veins occurring in them are quartz-pyrite veins in granite. If the kaolinic zones all developed at the same time, they are post granite.

Banded Veins.—The banded veins consist of quartz, chlorite, and molybdenite. Most of them are characterized by seams or films of fine-grained chlorite or molybdenite along the walls, or within the vein and parallel to the walls. The quartz is generally fine grained and distinctly grey, and contrasts with medium- to coarse-grained white quartz in younger veins. A few narrow grey veins show no banding, and some well-banded veins are almost white; these appear to be variants of the more characteristic ones.

Banded veins thinner than a half inch are generally short and show little preferred orientation, whereas thicker veins are longer and more inclined to parallelism. Most veins thicker than an inch can be traced for 20 feet or more, they strike mostly between north 37 degrees east and north 55 degrees east, and they dip between 60 degrees northwest and 80 degrees southeast. The smaller veins tend to interconnect with the larger, and where they are abundant, as in the Shop area, they form a skimpy stockwork. The fractures along which the interconnecting veins were injected can perhaps be regarded as forming an indistinct shatter zone. Many of the banded veins may have developed along narrow shear zones. The two thin-sections made of banded veins show country rock more or less comminuted alongside the vein, and tongues, wisps, and ragged remnants of this ground-up rock in the vein. Clearly, these two veins have developed in crush zones, and apparently they have formed at least partly by replacement.

Generally, veins thinner than a half inch do not show macroscopic internal banding, and the chlorite and molybdenite are restricted to lensy seams about 0.5 millimetre thick along the vein walls. The thicker veins show also internal seams of chlorite and molybdenite that are generally less than 0.2 millimetre thick and are rarely spaced closer than 3 millimetres. The internal seams extend for 6 inches to possibly as much as 10 feet, and pinch out in tight fractures in the quartz. It seems clear that the quartz of the thicker veins was refractured parallel to the vein walls. The two veins sectioned are thin and do not show macroscopic banding. Under the microscope, however, one of them displays several persistent fractures through rock wisps and vein quartz, and shows that the reason they are not macroscopically visible is that they lack chlorite or appreciable sulphides.

The molybdenite content of the seams varies with the location of a banded vein. Near the breccia bodies the seams are mostly or entirely molybdenite, but in veins farther away the seams are mostly chlorite. Since, in addition, the banded veins decrease in number away from the breccia bodies, their contribution to the total molybdenite mineralization falls off sharply.

The banded veins are offset on the slips and all other veins, and are therefore the oldest veins in the mine. In some cases the offset is slight, but the grey banded veins are clearly interrupted by the other veins. The relative age of the seams within the veins is less certain. Some are sharply cut off at contacts with younger veins, but others pinch out rather raggedly an inch or two from the contact. The fractures in which the seams lie nowhere extend into a younger vein, but rather are abruptly truncated or are pinched off at the contact. The molybdenite seams in banded veins are thought to be older than other quartz veins, but they may be of the same age as molybdenite seams in slips in the rock.

The grey colour appears to be caused largely by pyrite dust in the quartz. It probably is somewhat enhanced by shadowing caused by abundant microfractures.

Q veins are thick, do not follow shear zones, and consist entirely of coarse-grained quartz. They are much less common than other types of veins, occurring sporadically in and near the quartz breccia. They appear to be slightly younger than the matrix quartz of the breccia, and one of them is sliced by a shear zone that is in turn crossed by an F vein.

A and F veins consist of quartz or quartz and orthoclase. They do not follow shear zones and contain no open spaces. The quartz is white, medium grained, and granular. Minor medium-grained molybdenite occurs along the walls of some of the veins. These veins offset banded veins and molybdenite-bearing slips and traverse quartz breccia.

The A veins consist entirely of quartz, are rather uniformly 0.75 to 1 inch thick, and are vertical or steeply dipping.

The F veins consist of quartz and orthoclase, range in thickness from 0.25 to 4 inches, and dip at angles ranging from 15 to 75 degrees. The ratio of orthoclase to quartz appears inversely proportional to thickness in any one vein, and the ratio varies from vein to vein for a given thickness. For example, where the vein is three-quarters of an inch or less it commonly consists entirely of orthoclase, but as the vein thickens quartz appears in the central part and orthoclase is restricted to a ragged band of crystals along each margin. If and where the vein attains 1½ inches there is commonly no orthoclase in it, although adjacent plagioclase in the quartz diorite may be largely replaced by orthoclase for one-half inch from the vein wall.

Evidence was not found concerning the ages of A and F veins relative to each other, and they are provisionally placed in the same age bracket.

The FZ veins consist characteristically of quartz, orthoclase, and zeolites, and commonly contain also coarse-grained pyrite and molybdenite. Some veins contain a little calcite and chlorite. Like the F veins, they tend to consist entirely of orthoclase where they thin out. Unlike the older veins, however, they are commonly vuggy. The quartz is white, coarse grained, and somewhat cross-fibred. The veins are 1½ to 3 inches at their widest, and dip at angles less than 25 degrees. They are much less common than the banded veins and the A and F veins near the breccia bodies, but they do not decrease nearly as sharply away from the breccias. Their molybdenite content however decreases markedly. They are thought to be somewhat younger than the F veins, largely on the basis of their mineralogy and texture, and they are older than some of the quartz veins along shear zones, for they are displaced by the shear zones.

G veins consist of calcite and zeolites, and rarely contain a little molybdenite. They are characteristically cavernous and heavily water bearing. A cavity along the wall of one vein is 10 inches across. They occupy fissures on which the other veins have been faulted. Some have been laminated, slipped, and slickensided by renewed movement. The veins themselves, neglecting cavities, are commonly one-quarter to three-quarters of an inch thick. They generally dip within 10 degrees of vertical and strike approximately northeast.

Six quartz-pyrite veins in granite were mapped in 200 feet of adit crosscut. They are from 0.5 to 1 inch thick, they strike about north 25 degrees east and dip 50 to 70 degrees southeast. Two consist entirely of pyrite, the rest of pyrite and quartz. Some are vuggy.

Since the other veins have not been found in the granite, it is tentatively concluded that the granite is younger than all of them, and the quartz-pyrite veins are necessarily younger still. The vuggy pyrite-bearing veins resemble the FZ veins in texture, but lack the variety of minerals and could not reasonably be correlated with them.

Rock Breccia and Quartz Breccia

Rock breccia is brecciated rock showing little or no quartz between fragments, whereas quartz breccia is brecciated rock showing abundant quartz between fragments. The rock breccia is a hard coherent rock consisting of more or less angular fragments of quartz diorite and the various dyke rocks, set in a sparing matrix of relatively fine-grained grey rock. The rock breccia differs from the breccia zones described above in that it is a rock the fragments of which are firmly held together by the matrix and do not fall apart when the breccia is exposed in the wall of the working. It also differs from the same breccia zones in occurring as an irregular body that is not tabular or notably elongated in any particular direction. It differs from quartz breccia in that the matrix is minor grey rock rather than abundant white quartz.

In the rock breccia the fragments of dyke rocks are outlined sharply against the matrix, and where abundant they show that fragments predominate over matrix —that is, the matrix between fragments is thin. The dyke fragments are not distributed uniformly, but rather are common in some parts and are rare or lacking in others. It is not known whether they do or do not occur in any definite pattern in the rock breccia.

Rock breccia containing fragments of quartz diorite alone has been found in several diamond-drill cores and several clean, solid outcrops along Molybdenite Creek, and it may be at least as common as rock breccia containing also fragments of dyke rocks. However, quartz diorite fragments are rarely discernible in the usual rubbly trench exposures, and rock breccia can be identified there only if it contains dyke fragments. The rock breccia is therefore difficult to outline, and can be shown only roughly on Figure 9. Locally on and near Molybdenite Creek, contacts that could be mapped between rock breccia and unbrecciated quartz diorite appeared irregular.

The quartz diorite fragments commonly show vague contacts with the matrix, and in thin-section this is seen to be due to a scattering of small fragments of quartz diorite through the matrix near the larger fragment. The matrix is composed of the same minerals as the quartz diorite, although biotite is rather more common and is apparently responsible for the darker colour of the matrix. Typical matrix is rather uniformly fine grained and shows a distinct elongation of minerals parallel to contacts with adjacent larger fragments. In other words, there appears to be a foliation in the matrix that tends to wrap around the larger fragments. Tongues of the matrix extend into the larger quartz diorite fragments. The matrix appears largely to be comminuted quartz diorite in which the smallest fragments have been recrystallized.

Fragments of the felsic dykes show little or no change, but fragments of lamprophyre are commonly recrystallized to medium-grained hornblendite.

The fragments most commonly seen range up to 12 inches across, but a few fragments 2 feet across were found, and the maximum size is not known. The larger fragments are of quartz diorite and are seen less readily than dyke fragments, therefore they may be more common than present observations indicate.

The underground workings have not entered the main mass of rock breccia. A band of breccia in the south drift may perhaps be an offshoot of it but more probably is an older breccia zone. The band is about a foot thick, strikes north 27 degrees west through unbrecciated quartz diorite, and dips 77 degrees northeast. It consists of quartz diorite fragments set firmly in a matrix similar to that in typical rock breccia. It is crossed by a banded vein and contains a concordant water-bearing G vein. Evidently the breccia was healed prior to injection of the banded vein. The thinness of the band and its uniform width and attitude across the drift suggest that it is a breccia zone similar to but much older than the breccia zones described in the preceding section.

Quartz breccia consists essentially of a matrix of vein quartz in which are embedded fragments of quartz diorite and dyke rocks. It differs from the rock breccia only in having the fragments enclosed in abundant quartz instead of sparing grey rock. The quartz generally constitutes about a quarter of the rock-mass.

The quartz breccia occurs as two separate bodies, known as the Main and South breccia bodies, aligned on a north 35 degrees west axis. The Main body only is shown on Figure 9. It is exposed in the banks of Molybdenite Creek, in several trenches, and in the underground workings. The South body is blind, being overlain by rock breccia, and has not been entered by the mine workings. It is known from diamond drilling to lie about 300 feet southeast of the Main body, and is reported to be 220 feet long by as much as 120 feet wide. The following discussion applies only to the Main quartz breccia body.

This body is enclosed by unbrecciated quartz diorite on three sides. The southeast end is in contact with rock breccia at surface and has not been exposed underground. The body is roughly elliptical, with tongues extending into the quartz diorite on the northwest. Omitting the tongues, it is about 400 feet long, and widens from 120 feet at surface to about 180 feet on the 5045 level. The southwest contact is essentially vertical, and the northeast contact dips steeply outward. The plunge appears to be essentially vertical.

The contacts are most clearly seen underground. The main northeast contact and the contacts of the tongues are sharp and vein-like against the quartz diorite. A continuous, essentially planar band of white quartz is in contact with the quartz diorite, and rock fragments appear in the quartz from 2 to 4 inches from the contact. Some 6 to 8 inches from the contact the quartz breccia attains its characteristic pattern of fragments of various sizes isolated from each other by white quartz. The southwest contact, as exposed in the south drift, is gradational in that it is not marked by a continuous band of quartz, but rather by fingers of matrix quartz pinching out among semi-detached blocks of quartz diorite. On the 5085 sublevel, part of the southwest contact is obscured by a dense pale-coloured rock that ramifies among the fragments, taking the place of the white quartz, and irregularly intrudes the unbrecciated quartz diorite. This rock appears variously violet-brown, lavender, and pink, and in part contains small quartz phenocrysts; it may be a variant of the pink porphyry. The contact is further obscured by a narrow irregular stockwork of white quartz veins. These veins have been injected into lavender porphyry and quartz diorite, but are not distinguishable from matrix quartz where they enter quartz breccia. It is not clear whether the stockwork represents a penetration of matrix quartz into fractures in the unbrecciated rock or a distinctly later injection.

The contact between quartz breccia and rock breccia is poorly exposed in one bulldozer pit. Several small rock surfaces, isolated from each other by extensive rubble, suggest a transition zone perhaps 20 feet wide in which the quartz between the fragments decreases to almost *nil*. To the southeast, sporadic quartz occurs between some fragments, but the rock is essentially rock breccia rather than quartz breccia.

Dyke fragments are sparingly and more or less uniformly distributed through the central part of the Main quartz breccia body, but not in the marginal parts. For example, on the west part of 5085 sublevel a narrow band of the breccia contains abundant lamprophyre fragments and is flanked by breccia containing no lamprophyre fragments. Some exposures of the marginal parts of the breccia show only quartz diorite fragments. It is suggested here that movement of fragments may have been negligible near the boundaries of the body, but that the average total translation increased toward the centre.

The amount of rotation of the fragments, as distinct from translation, may have been slight. Where the attitude of the weak foliation in fragments of quartz diorite could be measured, it was essentially parallel to the weak foliation in unbrecciated quartz diorite. However, attitudes in fragments in the centre of the body were not measured.

The age of the breccias relative to each other and to dykes and veins is not a simple matter. The breccias have evidently been produced by a combination of processes including brecciation, reconsolidation of the grey matrix, and rather localized introduction of quartz. The brecciation itself was clearly not one simple, single event, but rather a process of some duration. Pink porphyry ramifies through rock breccia in some exposures and occurs as fragments in the breccia in others. Apparently the process consisted of two or more pulses of brecciation separated by a quiescent interval in which the porphyry crystallized.

The duration of any one or all of these processes is not known, and there are some indications that they may have overlapped. A fragment of molybdenite-bearing quartz in rock breccia may suggest some localized fragmentation after introduction of the matrix quartz. The general lack in the quartz breccia of the sparing grey matrix characteristic of the rock breccia, and the abundance of matrix quartz, together indicate that the quartz has replaced the grey matrix, and possibly also part of the rock fragments. This replacement took place much more readily in two parts of the rock breccia than elsewhere, producing the quartz breccia bodies. In other words, movement of the quartz-forming fluids appears to have been much freer in these two parts, suggesting that the rock structure was more open. Either the grey matrix had not been fully reconsolidated there or the rock breccia was there rebrecciated prior to introduction of the fluids. In summary, the breccias and pink porphyry were apparently produced by several processes operating at various times within a certain interval of unknown duration.

Of the other dyke rocks, the younger lamprophyre traverses quartz breccia and is obviously younger than the breccias. The older lamprophyre is pre-pink porphyry, and has contributed abundant fragments to the breccias. The buff dykes and grey dykes have also contributed many fragments to the breccias, and nowhere have been found to intrude or ramify through them; they therefore appear to be distinctly older rather than more or less contemporaneous with the processes of brecciation and quartz injection. The granite is deduced from indirect evidence to have been intruded long after these processes ceased.

The balance of evidence presently available indicates that the interval of brecciation and injection of matrix quartz followed the formation of banded veins and molybdenite-filled slips, and preceded injection of all other veins. F, QS, and G veins traverse quartz breccia and are clearly younger. The Q and A veins appear from a distance to traverse the quartz breccia, but at close range the vein quartz and matrix quartz are indistinguishable, and no contact is visible between them. The impression of planar walls to the Q and A veins is given by aligned flat sides of rock fragments. Commonly, also, two rock fragments on opposite sides of a vein can be matched, and were clearly one fragment that has been split by the vein. The vein-bearing fracture developed after brecciation ended, and apparently after considerable reconsolidation of the breccia. If, as suggested above, the rock breccia was not completely reconsolidated prior to introduction of matrix quartz, then the vein-bearing fracture probably developed after this introduction, and the vein is entirely post breccia.

The evidence as to age relations with the banded veins is conflicting, but appears on balance to indicate that these veins were fully developed prior to brecciation. On the one hand, one banded vein was found in rock breccia and two poorly banded veins were found in quartz breccia. On the other hand, a host of banded veins has been injected into quartz diorite around the Main quartz breccia body, and several are truncated by the matrix quartz. The ages of the three banded veins in breccias were not determined relative to other veins, and it is possible that they are considerably younger than most of the banded veins. Also, the fragment of molybdenite-bearing quartz in rock breccia may have been broken out of a pre-existing banded vein. No molybdenite-bearing slips have been found in the breccias. The development of the slips and of the secondary fractures responsible for the banded structures in the veins probably was not synchronous with brecciation, for molybdenite has not been found in rock breccia.

The brecciation was a process which not merely broke up the rock into fragments of various sizes but also moved them around individually and jumbled them. It was not directly related to intrusive stoping because the matrix does not appear to be intrusive but is the product of fragmentation. It probably did not occur along a fault zone because the breccia body is irregular in shape and does not lead into any recognizable fault zone. The breccia is clearly not a shatter zone, produced by movements on close-spaced intersecting fractures, for the fragments do not have plane surfaces and they appear to have moved individually and in different directions.

Mineralization and Orebodies

The ore mineral is molybdenite. Pockets of magnetite occur locally in the breccia. Specks of chalcopyrite have been found in various places within the pyrite halo. Pyrite is common and widespread, but an assay disclosed only traces of gold and silver in it. A little scheelite is reported to have been found in the quartz breccia. But molybdenite is the only mineral which has any apparent economic potential.

The molybdenite occurs as pockets and veinlets in the quartz breccia, as seams in slips in the quartz diorite, and as seams, pockets, and veinlets in various quartz veins. Rarely it is disseminated in quartz diorite. The various vein systems are not equally good carriers of molybdenite. In the mine the best mineralized are the banded, FZ, and shear zone veins. All three of these vein types, together with the slips, generally contain less and less molybdenite with distance from the breccias; the banded veins also decrease in number.

The breccia orebodies are not coincident with the bodies of quartz breccia, but lie within them. The molybdenum content of the quartz breccia varies widely and erratically. As determined by company assays, the Main and South breccia orebodies are highly irregular in outline and contain irregular blocks of waste. For mining purposes these irregular assay boundaries have been adjusted to a more regular outline. In the Main quartz breccia body the resulting mineable orebody approximates a vertical prism 70 feet thick, 300 feet long, and more than 500 feet deep. It tends to hug the southwest contact of the Main quartz breccia body, and pulls away from the downward-flaring northeast contact. The South quartz breccia orebody is known only from diamond drilling.

The Fracture orebody is a block of unbrecciated quartz diorite in which slips and quartz veins are sufficiently close spaced and sufficiently well mineralized with molybdenite to make the block of ore grade. As outlined for mining, the Fracture orebody is about half as large as the Main breccia orebody and plunges steeply northwest. It wraps around a tongue of quartz breccia on surface, adjoins the breccia body on the 5280 level, and is separated from it by less well-mineralized quartz diorite on the 5045 level. Most of the molybdenite is in slips and in banded and FZ veins.

The High Grade vein, as exposed for a length of 90 feet on the 5045 level, comprises quartz and molybdenite in a sheared lamprophyre. The dyke is 9 feet thick, strikes north 77 degrees east, and dips 48 degrees north. The hangingwall half of the dyke is softened and blocky but is little sheared and is generally poorly mineralized. The footwall half has been largely converted to chlorite schist and has been injected by several concordant quartz veins. The quartz is very coarse grained and occurs as one main vein, 2 to 3 feet thick, and as several parallel stringers in the schist, 2 inches or less in thickness. The main vein contains several chloritic partings parallel to the walls. The molybdenite occurs as narrow bands along the walls of the veins and as parallel and cross-veinlets within the main vein. It also occurs as scattered grains in the schist. The High Grade vein has not been identified in diamond-drill core, and its extent is not known.

The Southwest vein zone was extensively trenched in the early work on the property and was diamond drilled in 1959 and 1964, but it is still not well understood, and an orebody has not been outlined. It strikes about north 35 degrees west, parallel to the axis of the breccia and Fracture orebodies. Some of the individual veins strike parallel with the zone and dip gently or steeply to the southwest, but others are short and crosscutting, and appear to be the master veins in small quartz stockworks. The veins are generally much thicker than in the fracture orebody, commonly ranging from 6 inches to 2 feet. The molybdenite in the veins is generally coarse grained and occurs as pockets in the quartz and as marginal and crosscutting veinlets.

The molybdenite was apparently deposited during two distinct and separate intervals. It is common in banded veins and slips in the rock, and again in the much younger FZ and QS veins, but is rare in the Q, A, and F veins of intermediate age. The older molybdenite is fine grained, whereas the younger is coarse to very coarse. The molybdenite in the quartz breccias is generally coarse grained, and probably was deposited during the later interval. The older molybdenite may have been deposited prior to brecciation, as noted above in discussing the age of the breccias.

[References: Campbell, R. B., *Geol. Surv., Canada,* Prelim. Map 42-1961; Heim, R. C., *Western Miner,* Vol. 37, No. 12, 1964, pp. 27–28; Minister of Mines, B.C., Ann. Repts., 1957, pp. 18–22; 1963, pp. 39–41; Stevenson, J. S., *B.C. Dept. of Mines,* Bull. 9, 1940, pp. 34–47; Stevenson, J. S., 1942, private report; Vokes, F. M., 1963, *Geol. Surv., Canada,* Econ. Geol. Rept. No. 20, pp. 246–256.]

LILLOOET

Bridge River (50° 122° N.W.)

Gold-Antimony

Ace Mining Company Limited*

Mine office, Gold Bridge. The company holds a large number of claims lying for the most part north of Carpenter Lake and extending west of Gun Creek. During 1964, 352 feet of drifting and crosscutting was done in the old Congress mine. Other work included 875 feet of diamond drilling, from underground, in the area of the Howard vein and 1,222 feet of diamond drilling, from the surface, in the area of the Paul vein, which is on the northeast side of Gun Creek. Work commenced in October and continued for the remainder of the year.

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

* By W. C. Robinson.

Gold

Bralorne Pioneer Mines Limited* Company office, 355 Burrard Street, Vancouver 1; mine office, Bralorne. G. H. Davenport, president; J. S. Thomson, resident manager; J. P. Weeks, mine superintendent; E. H. Hall, mill superintendent; A. J. Learmonth, plant superintendent. The company operates the Bralorne mine on Cadwallader Creek. It is reached by 51 miles of road from Shalalth or 75 miles from Lillooet, both stations on the Pacific Great Eastern Railway. Development of the surface showings began about 1898, and production has been continuous since 1931. The property is described in some detail in the 1958 Annual Report.

The workings are approached by a main haulage adit on 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, 2,300 feet deep from No. 26 to No. 41 level. Most of the present production is mined by the cut-and-fill method. Most of the stopes are sand-filled with mill tailings, which are piped into the mine. The ore is hoisted in the Queen shaft to No. 26 level and is then hauled by battery locomotive to the Crown shaft, hoisted to No. 8 level, the main haulage level of the mine, and hauled by trolley locomotive to the mill. The ore is treated in a 600-ton cyanide mill. In 1964, 153,080 tons of ore was milled, yielding 73,848 ounces of gold.

A summary of development work done in 1964 is given below:—

	Ft.
Drifting	3,231
Crosscutting	1,607
Raising	1,365
Diamond drilling	9,322

The 77 vein was further developed by drifting on No. 41 level. Other development work included the driving of a ventilation raise, by Alimak raise machine, between No. 41 and No. 38 levels.

The number of employees was 315, of whom 241 were underground.

TYAUGHTON CREEK (51° 122° S.W.)

Mercury

Dot, Silverquick, etc. (Silverquick Development Company (B.C.) Ltd.)† Company office, 325, 1155 West Georgia Street, Vancouver 5; mine address, Gold Bridge. Robert E. Woods, president. This company controls 38 mineral claims that straddle Tyaughton Creek just west of Relay Creek. The main showing on the property, a zone of cinnabar mineralization, is at 5,475 feet elevation, 1 mile up a small creek that flows north into Tyaughton Creek 2 miles west of its junction with Relay Creek.

A good road has been built from the showings down the creek to Tyaughton Creek and thence down the north bank of Tyaughton Creek to the old Manitou mine road. This latter road follows down Tyaughton Creek to Tyaughton Lake and then continues on past Mowson Pond to the Bridge River road. The showings are 21 miles by road from the company reduction plant which has been built at Mowson Pond.

The mineralization is reported to have been originally discovered in 1942 by H. H. Huestis, then prospecting for Pioneer Gold Mines of B.C. Limited. In 1943 the latter company had a crew spend four months trenching and stripping on the

* By W. C. Robinson.
† By J. W. McCammon.

property. Nothing further appears to have been done until 1954, when W. C. Sevrens located four claims on the same ground. In 1955 Mr. Sevrens retorted one flask of mercury at the property. The claims were kept in good standing and were leased to Silverquick Development Co., Inc., in August, 1961. The next year this company located more claims around the original ones, improved access, and began construction of a camp at the showings. In 1963 the company, now Silverquick Development Company (B.C.) Ltd., completed camp construction, mined and stockpiled a small amount of ore, and trucked one load of the ore to a mill-site on Mowson Pond, where the erection of a Gould rotary furnace reduction plant was begun. In 1964 the reduction plant was completed and put into production at a rated capacity of 10 tons per day, the road to the mine was improved, and mining was carried on.

Apart from poor exposures in the creek, the only bedrock visible near the showings is in mine workings and road cuts. Most of the trenches are old and are now sloughed in, so even there observations are limited. The country rock is conglomerate, mapped by Cairnes as part of the Middle to Upper Jurassic Taylor Group. It consists of fairly well-rounded pebbles ranging from a fraction of an inch to several inches in diameter. The most abundant pebbles are chert. No structure was noted in the conglomerate, but a few thin interbeds of sandy shale indicate the rocks strike east-west and dip 45 to 55 degrees south. This is perpendicular to the attitude shown half a mile to the south on Cairnes' map, and so indicates a major structural disruption nearby, perhaps a continuation of the northwest-trending fault shown crossing Tyaughton Creek at Noaxe Creek. In the workings the rocks are badly fractured by joints and faults. The joints are multidirectional, but many strike within

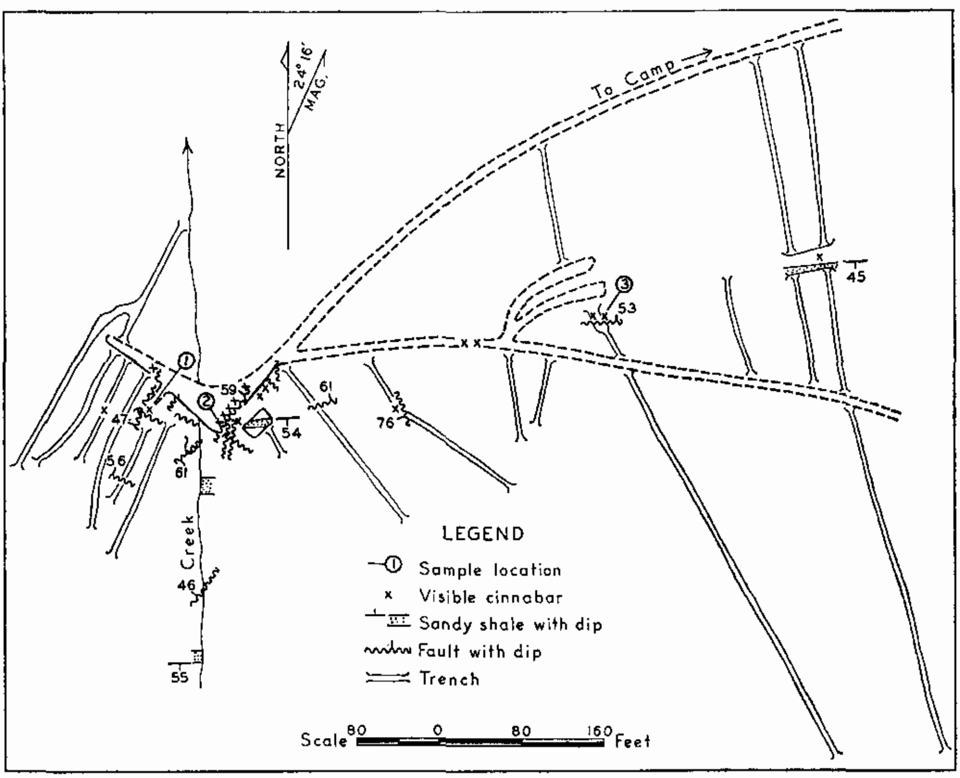


Figure 10. Silverquick workings. Pace and compass sketch.

a few degrees of east-west or north-south and most are nearly vertical. Their spacing ranges from a few inches to 3 or 4 feet. The faults, too, are multidirectional but can be roughly arranged into three groups that strike northwestward, northeastward, and nearly east-west. The majority dip northward at moderate to steep angles. The interrelationship of the different sets was not determined. Relative movement on most of the faults was essentially horizontal or nearly so. It took place both before and after ore deposition.

Mineralization on the property consists of cinnabar associated with quartz, calcite, limonite, and a clay mineral, probably dickite. The cinnabar is present as disseminated grains, streaks, and small lenses in brecciated conglomerate; as smears on slickensided fault surfaces; and in the mud of gouge seams. The best mineralization exposed was in the main open cut at the creek and in the face of the adit. Cinnabar was also seen at four widely separated points in old trenches and a road cut as shown on Figure 10.

At the time of examination the adit had been driven 22 feet into the hillside on a bearing of south 44 degrees west and then turned to continue for 14 feet on a bearing of south 16 degrees west. The mineralization seen was near the floor on the west wall at the turn. It was in a wedge of brecciated conglomerate between two intersecting faults with trends of about 20 degrees east of north and northwest dips of 47 and 18 degrees. A channel sample across 11 inches between the faults at floor level assayed 2.20 per cent mercury (sample 1 in Fig. 10).

Until the middle of August, work had been concentrated on mining out a high-grade oreshoot from an open cut beside the creek. The cut had been excavated from the creek for 90 feet northeastward along the steep gully slope and had a maximum face height of 30 feet. The ore extended 60 feet diagonally across the cut from its southwest corner to the gully edge. Its strike was north 30 degrees east and its dip was 59 degrees northwest. Loose rock covered the band of ore in the floor, and only its vertical trace in the end wall of the cut could be seen. The ore consisted of brecciated conglomerate mineralized with cinnabar accompanied by quartz, calcite, limonite, and clay. It was 18 inches wide at floor level and pinched out between converging faults about 6 feet above the floor. A channel sample across 18 inches at floor level on the end wall of the cut assayed 0.56 per cent mercury (sample 2 in Fig. 10). Besides that in the main oreshoot, cinnabar was conspicuous as smears on slickensided fault surfaces and in thin gouge seams exposed along the walls of the open cut. Numerous fault and joint faces of various orientations were visible, but the cinnabar seemed to be restricted chiefly to those surfaces that trended northeastward and dipped moderately northwestward.

An old trench 400 feet east of the creek had uncovered a shear striking east-west and dipping 53 degrees north. A sample from a 2-inch-thick zone of gouge and mineralized conglomerate breccia from the top of the shear assayed 7.72 per cent mercury (sample 3 in Fig. 10).

In the course of scaling the walls of the main open cut in preparation for mining a lower bench, all mineralized rock seen was stockpiled. A grab sample from the pile, which contained 2 to 3 tons of ore, assayed 1.82 per cent mercury.

A grab sample consisting of chips taken at random from a 200- to 300-ton dump of ore at the reduction plant assayed 0.51 per cent mercury.

Spectrographic analysis showed a trace of antimony in sample No. 1 but no arsenic or antimony in any of the other samples.

When operations ceased in September, about 300 tons of ore had been processed and 73 flasks of mercury had been produced and shipped.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1943, p. 77; 1955, p. 33; 1962, p. 23; 1963, p. 42; *Geol. Surv., Canada,* Paper 43-15.]

TEXAS CREEK (50° 122° N.E.)

Molybdenum

Index*

Texas Creek Mines Limited, 569 Howe Street, Vancouver 1, holds 13 Crown-granted claims and 62 recorded claims. The property is on the summit between the north fork of Texas Creek and Phair Creek and is at an elevation of 8,000 to 8,500 feet. Access is by jeep-road via Texas Creek, which flows into the Fraser River from the west about 13 miles south of Lillooet. Work in 1964, which commenced in March and was suspended in October, consisted mainly of road construction. The property was not visited. (*See* Annual Report, 1949, pp. 113–114.)

PEMBERTON

Molybdenum

R, EE*

(50° 123° N.E.) The R group of 32 recorded claims and the EE group of 46 recorded claims are on Salal Creek, a tributary of the Lillooet River, and is about 40 miles northwest of Pemberton. Norpax Nickel Mines Ltd. holds a 60-per-cent interest and Purdex Minerals Ltd. holds a 40-per-cent interest in the property. The address of both companies is 405, 25 Adelaide Street West, Toronto 1. It has been reported that the showings consist of exposures in the beds of a half dozen torrential creeks which have incised canyons on the southeast flank of a mountain of weathered monzonite. The monzonite is a plug within granodiorite of the Coast Range intrusions. The mineralization consists of quartz, pyrite, and molybdenite.

Work on the property during 1964 commenced on July 1st and was suspended on November 15th. Work included sampling, mapping, and trail construction. One diamond-drill hole, 748 feet long, was drilled from the bottom of the mountain. An average crew of seven men was employed under the direction of Hadden Agnew. Access to the property was by aircraft from Vancouver to the outwash plain of the icefield at the head of Bridge River and thence by helicopter to the camp. The property was not visited.

LYTTON

Copper

Rocky, Tom, Nav (Lytton Minerals Limited)†

(50° 121° S.E.) Company office, 624 Howe Street, Vancouver 1. E. Koblanski, president; Bruce C. Macdonald, geologist. This company holds about 111 claims, mainly in the Rocky, Tom, and Nav groups on the south slopes of the Scarped Range, near Pitquah on the north side of the Thompson River. The geology and location of mineralized zones were described briefly in the Annual Report for 1963 (pp. 42–43). Until its termination in December, 1964, a working agreement existed between the company and The Patiño Mining Corporation Ltd. Work begun in 1963 was continued until about April, 1964, and included 12 holes diamond drilled from surface in the Pop mineralized zone. The holes, none of them longer than 240 feet, are reported all to be vertical and spaced over a distance of about 1,900 feet along the zone, which dips northward into the hillside at a moderate angle. In August other surface exploration was done on the property, of which no details are available. D. W. Asbury was geologist in charge for The Patiño Mining Corporation Ltd.

* By W. C. Robinson.
† By J. M. Carr.

HIGHLAND VALLEY*

Copper-Molybdenum

The majority of properties in and near Highland Valley are shown numbered on the accompanying index map (Fig. 11), which differs considerably from the one included in the Annual Report for 1956. The property of Chataway Exploration Co. Ltd. (19) is accessible by road from Broom Creek south of Mamit Lake and the WDR group (2) adjoins the road from Mamit Lake to Savona; the remaining properties are accessible by roads leading off the Highland Valley road, which is paved for 27 miles from Ashcroft to the Bethlehem mine.

WDR (2), Dave, Lodge (6), Outrider, Bay (9), Toketic, Bethsaida, BL (11) (Valley Copper Mines Ltd.)

(50° 120° W. and 50° 121° E.) Since April, 1964, this company, which is managed by The Consolidated Mining and Smelting Company of Canada, Limited, owns properties in Highland Valley consisting altogether of 389 claims and formerly owned variously by Bethsaida Copper Mines, Limited, The Buttle Lake Mining Company Limited (BL group), Huestis Mining Corporation Ltd. (Dave, Lodge groups), Northwest Ventures Ltd. (Outrider, Bay, Toketic groups), and W. D. Rorison and associates (WDR group). The Toketic group is west of Calling Lake and is beyond the limit of the area shown on Figure 11.

Work from June to the end of the year was directed by D. W. Heddle and employed mainly a small crew including initially T. W. Muraro and latterly G. R. Rosseau and A. deVoogd. Geological work was done on all groups, and other work done included geochemical prospecting on parts of the BL group, magnetometer surveys on parts of the BL and WDR groups, trenching on the Outrider, Bay, and BL groups and on the Bethsaida claims, and about 1,500 feet of diamond drilling in three holes on the Duke, Tamarac, and IXL Crown-granted claims, which are among the Bethsaida claims. One of these holes was completed by further drilling in January, 1965. An induced polarization survey, partly completed in 1964 on the Dave and Lodge groups, was continued in 1965.

The writer briefly examined trenches on the WDR group made in 1963. The northernmost trench exposes a steep mineralized fault which strikes north 50 degrees east and is parallel to joints in the adjacent older quartz diorite of the Guichon batholith. Chalcopyrite and lesser amounts of bornite are present as fracture-fillings and are partly oxidized to malachite, which is accompanied by limonite, possibly representing former specularite. The rock near the fault is bleached, probably by kaolinization of plagioclase, and contains pink orthoclase veinlets and others of calcite. At a point east of the Rorison ranch house, a trench near the access road exposes a northeast-trending fault in hornfels that probably is altered volcanic rock. A short distance to the west a similar hornfels occurs as float and is partly mineralized by disseminated pyrite and chalcopyrite.

Trojan (5) (South Seas Mining Limited)

(50° 120° N.W.) Company office, 1411, 409 Granville Street, Vancouver 2. W. H. Pierre, president; A. R. Allen, consulting engineer. This company now wholly owns about 57 claims, including 24 which are Crown granted, to the north and east of the south peak of Forge Mountain and which were formerly owned by Trojan Consolidated Mines Ltd. In May, 1964, the company made an agreement with Mitsui Mining & Smelting Company, Ltd., for exploration to be done by the latter company. Work on behalf of the Mitsui

* By J. M. Carr, except as noted.

company began in June, and by year-end it included 13,235 feet of wire-line diamond drilling in 23 holes, all or mainly in the vicinity of the Trojan breccia pipe. T. Takeda, geologist, and A. Fustos were in charge of the work, which employed an average crew of 20 including drillers on contract (Ann. Rept., 1963, p. 44). The company also holds about 18 claims named Elk, Kos, and Ram to the west of the Krain property and for which no details of work done in 1964 are available.

List of properties shown in Figure 11:—

1. Krain, DW groups (North Pacific Mines Ltd.).
2. WDR group (Valley Copper Mines Ltd.).
3. F group (North Pacific Mines Ltd.).
4. Transvaal group.
5. Trojan property (South Seas Mining Limited).
6. Dave, Lodge groups (Valley Copper Mines Ltd.).
7. Cow, BX groups.
8. Bethlehem Copper Corporation Ltd.
9. Outrider, Bay (Valley Copper Mines Ltd.).
10. AL, IC groups (Continental Consolidated Mines Ltd.).
11. Bethsaida property and BL group (Valley Copper Mines Ltd.).
12. Norex group (Noranda Exploration Company, Limited).
13. Lornex Mining Corporation Ltd. and E. H. and I. E. Lorntzsen.
14. Victor (Skeena Silver Mines Limited).
15. Anaconda American Brass Limited.
16. Jericho Mines Ltd.
17. BUM group (South Seas Mining Limited).
18. Kennco Explorations, (Western) Limited.
19. Chataway Exploration Company Ltd.

Bethlehem Copper Corporation Ltd. (8)*

(50° 120° S.W.) Company office, 1825, 355 Burrard Street, Vancouver 1; mine office, Box 520, Ashcroft. H. H. Huestis, president; D. W. Pringle, manager; J. Stitt, general superintendent; C. J. Coveney, production superintendent; R. G. Blundell, mill superintendent. Access to the property is by about 30 miles of paved road from Ashcroft. This company holds 56 Crown-granted and 146 recorded claims and fractions immediately east of Quiltanton (Divide) Lake.

In 1964 the mill capacity of 3,500 tons per day was increased to 6,000 tons per day. Additions to the mill in 1964 included an 11- by 14-foot rod mill, a 48-foot-diameter copper concentrate thickener, one flotation air cell, four cleaner cells, and a 30-inch conveyor. Additions to the crusher-house include a 7-foot standard cone crusher, screens and conveyors; capacity of the crusher-house has been raised to 650 tons per hour. An interesting feature of the Bethlehem operation is the mill reclaimed water system which is now capable of supplying 3,400 gallons of water per minute. Fresh water is obtained from a deep well on Shula Flats that will supply water at the rate of 800 gallons per minute. The installation of an additional mill circuit, started in 1963, has been completed, and a molybdenum concentrate is now being recovered. Concentrates are hauled by truck to the Vancouver Wharves in North Vancouver. Copper concentrate produced in 1964 totalled 22,654 tons. Molybdenum concentrate produced in 1964 totalled 40 tons.

Mining of the East Jersey open pit was under contract. In 1964 production from the East Jersey zone pit was 3,070,562 tons of waste, 312,251 tons of marginal ore, and 1,168,162 tons of ore. Production from the Jersey zone pit was 254,561

* By David Smith.

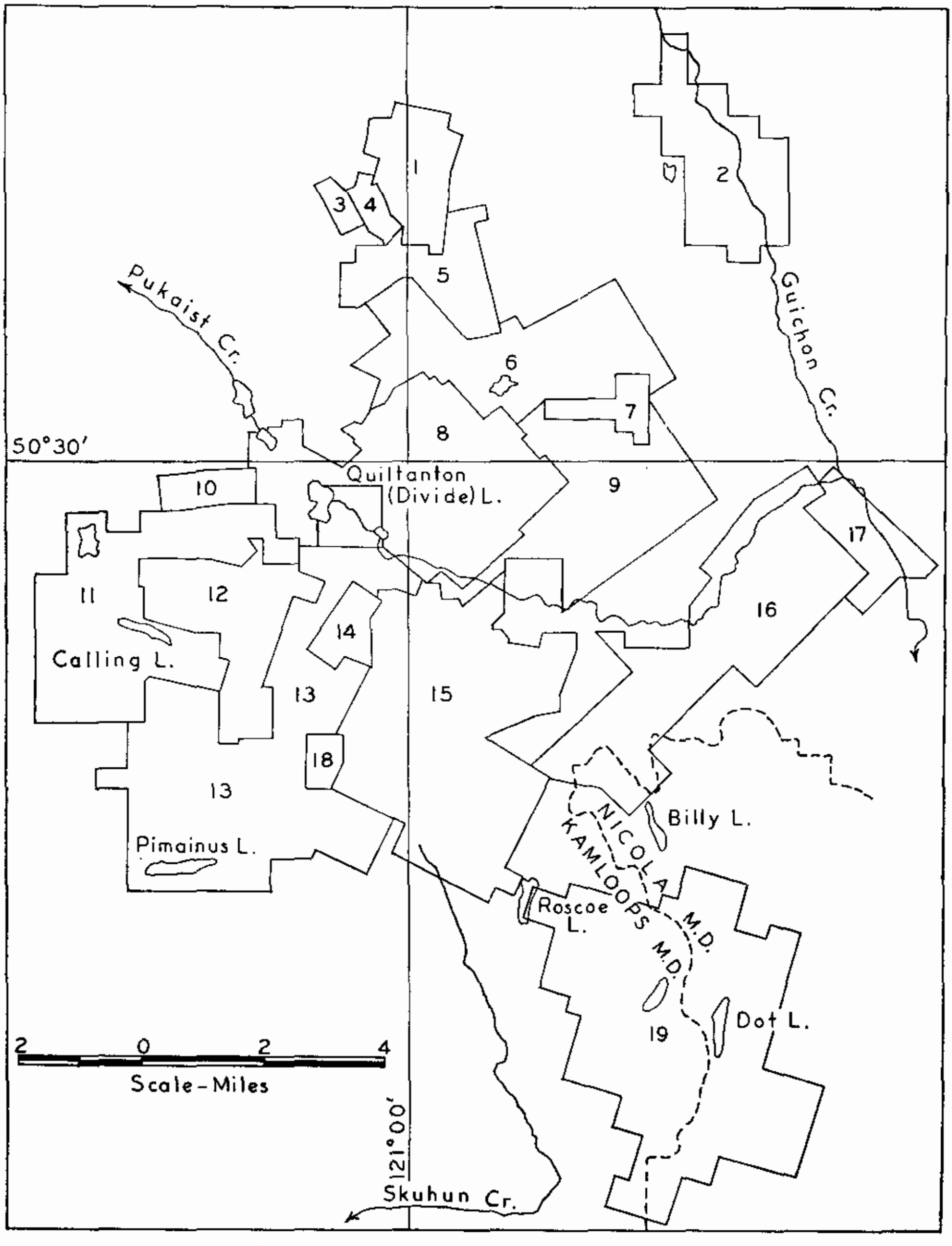


Figure 11. Property map, Highland Valley area.

tons of waste, 17,488 tons of marginal ore, and 65,275 tons of ore. The East Jersey pit has reached the final stage of production contemplated in the initial planning.

Additional equipment placed in service in the pit in 1964 included an electric shovel with 8-yard bucket and four 35-ton trucks. There has been no work underground.

In 1964 the number of persons employed was 190, of whom 92 were employed by the company and 98 by the contractors. No housing is provided at the property, the employees commuting to Ashcroft.

Other work done on the property in 1964 consisted of further exploration on known ore zones. A total of 14,215 feet of surface diamond drilling was done, 12,032 feet of which was on the Huestis zone.

North Pacific Mines Ltd. (3)

(50° 120° N.W. and 50° 121° N.E.) Company office, 1411, 409 Granville Street, Vancouver 2. Jack Wiley, general manager; A. R. Allen, consulting engineer. This company controls about 120 recorded claims in the F, Cat, Dog, JB, CL, and other groups which, although mostly not shown on Figure 11, are in the eastern and northern parts of the Highland Valley area. Work done in 1964 is not known in detail, but on the CL group it included trenching, soil-sampling, magnetometer and geological surveying done by a crew of about six men from May onward. Trenches visited on the CL group are 3¼ miles east and slightly north of Bose Lake (the lake shown on Fig. 11, in property 6) and are reached by 7 miles of road leaving the Highland Valley road about 1½ miles east of the airstrip. The trenches surround the headwall of a gully draining south and east in the west side of which an old caved adit existed. The CL group is recorded by C. W. Dansey on ground formerly part of the PG group (Annual Report, 1963, p. 48), and the trenched locality is on or near the former Fran 8 claim held by Deer Horn Mines Limited in 1956. Malachite, chalcopyrite, and pyrite occur in and adjacent to several northeasterly faults and shear zones which cut older and younger quartz diorites of the Guichon batholith and mostly dip to the northwest at moderate and high angles. On the east side of the gully the older quartz diorite encloses and invades a large mass of grey hornfels. Actinolite, orthoclase, epidote, chlorite, calcite, and clay minerals are present, due to hydrothermal alteration of the rocks. Other work done on these claims by the company included soil-sampling.

At the year-end this company obtained control of the Krain property, which includes the Krain and DW groups (1).

AL, IC (10) (Continental Consolidated Mines Ltd.)

(50° 121° S.E.) Company office, 535 Howe Street, Vancouver 1. R. W. Liversidge, president; H. H. Cohen, consulting engineer. This company holds 23 claims in the adjoining AL and IC groups west of Quiltanton (Divide) Lake on either side of the road to the OK mine. Work in 1964 included trenching and diamond drilling two adjacent holes of unstated length close to a showing east of the road which was found in 1961 by Pat Gouthreau (Ann. Rept., 1961, p. 30). The trenches are on either side of an unexposed contact between Skeena quartz diorite to the west and Bethsaida granodiorite to the east. The Bethsaida granodiorite exhibits a steep foliation trending north 40 degrees east and is traversed by malachite-coated joints with approximately this trend. The holes were drilled near the western trenches, in which Skeena quartz diorite is exposed.

Lornex Mining Corporation Ltd. (13)*

(50° 120° S.W.) Company office, 558 Howe Street, Vancouver 1; mine office, Ashcroft. E. H. Lorntzsen, president; A. C. Skerl, consulting geologist. This company holds 134 recorded claims to the southeast of Quiltanton (Divide) Lake and is accessible by jeep-road, 3 miles off the end of the paved road to the Bethlehem camp. At present the camp of the Skeena Silver property is used as headquarters for this operation. Late in 1964 a new showing on the A.M. No. 42 claim and Lornex No. 1 fractional claim was explored by about

* By David Smith and J. M. Carr.

3,600 lineal feet of bulldozer trenching. The showing is on or close to the contact of younger quartz diorite and the later Bethsaida granodiorite stock and is reported to consist of chalcopyrite and copper carbonates in quartz veins and in fractured rock within an area measuring about 1,600 feet long in a northerly direction and as much as 1,200 feet wide. Trenching was also done about 1½ miles distant from the showing, in a south-southwesterly direction. About 5 miles of road was constructed. A crew of two was employed under the direction of Mr. Lorntzsen.

Sheba, Highmont, Minex, B.X. (15) (Anaconda American Brass Limited)

(50° 120° S.W.) Company office, 409 Granville Street, Vancouver 2. Glenn C. Waterman, vice-president and chief geologist. This company holds about 157 claims on option on Gnawed Mountain, including, from north to south, the Sheba property, which is controlled by Peel Resources Limited (company office, 230 West Broadway, Vancouver 10), the Highmont property, owned by Torwest Resources (1962) Ltd. (company office, 404, 409 Granville Street, Vancouver 2), and two properties owned by Minex Development Ltd. (company office, 310, 850 West Hastings Street, Vancouver 1) and B.X. Mining Company Limited (company office, 1500, 355 Burrard Street, Vancouver 1). Work from May to October, 1964, was done by a crew averaging 10 men including drillers on contract, and it included road-building, geological, geochemical, and magnetometer surveying, induced polarization surveying, trenching, and wire-line diamond drilling of 11 holes totalling 7,585 feet. P. A. Lindberg was geologist in charge. The operating company reported in September that no new copper mineralization of significance had yet been found.

UP and April (Red Rock Mines Ltd.)

(50° 120° S.W.) Company office, 310, 850 West Hastings Street, Vancouver 1. J. A. Hallberg, president; H. H. Cohen, consulting engineer. This private company holds about 35 claims, mainly in the UP and April groups west of the Jericho property in the eastern part of Highland Valley near Witches Brook. No details are available of work done in 1964.

Jericho Mines Ltd. (16)

(50° 120° S.W.) Company office, Room 14, 1531 Davie Street, Vancouver 5. Henry Hockin, president. This company holds about 156 claims south of Witches Brook, about 7 miles east of Divide Lake. Work in 1964 was supervised by R. Philp, engineer in charge for Alrae Exploration Ltd., which managed the operation for the company. A maximum crew of 15 was employed, including diamond drillers on contract, and the work included driving an exploratory adit a further 834 feet to a total length of 884 feet, bulk sampling the adit for 685 feet of its length, doing 4,166 feet of underground percussion drilling and 13,627 feet of wire-line diamond drilling on surface in 33 holes, bulk sampling from underground, constructing roads, and trenching. A lower adit, 9 feet square in cross-section, was started from a portal situated about 2,000 feet distant northerly from and at about 500 feet lower elevation than the upper adit, and at year-end was approximately 95 feet long. The contractors used a trackless mining method.

The following notes are based on a brief examination of the upper adit and on information provided by the company. The upper adit is about 2¼ miles southwest of the Jericho camp on the Highland Valley road, on a low ridge on the Bob 14 claim at about 4,700 feet elevation. Directed north 84 degrees east and open to the surface at both ends, the adit has backs of about 80 feet and partly intersects the No. 1 zone of mineralization, which was known previously from induced polarization surveys and diamond drilling. It intersected one or more varieties of the younger quartz diorite of the Guichon batholith, which is foliated by crystal alignment in a direction north 55 degrees west. Beginning at about 150 feet from the portal, mineralized quartz veins occur in the adit and mostly possess strikes of between 45 degrees west and north 70 degrees west, with northerly dips of about 65 degrees. The principal sulphide, bornite, is partly associated with chalcocite that is apparently of primary origin. Chalcopyrite and molybdenite are both present, the latter partly as seams and partly disseminated in quartz. The vein walls are strongly chloritic and sericitic and are partly sheared. Sulphides are only weakly disseminated between the veins, whose spacing and thickness generally control the grade of mineralization. Approximately the easternmost 250-foot length of the adit is in mineralization estimated to contain more than 1 per cent copper. In the eastern part of the adit, one or more gougy faults strike east-northeastward. Surface drill-holes and drill-holes as much as 90 feet long in the adit wall at 20-foot intervals have established that the No. 1 zone of mineralization lies mainly north of the adit, that it trends in a direction slightly more easterly than the adit, has a minimum length of 400 feet and a width ranging from 3 to 35 feet, and that it persists with a steep northerly dip to a depth of 400 feet below the elevation of the adit. According to information given out by the company, the zone contains 1.48 per cent copper, appreciable amounts of silver, and unknown amounts of molybdenum.

A fault striking about north 60 degrees east and dipping northwestward is assumed from surface drilling to underlie a gully immediately east of the adit, and may prove to be related structurally to the No. 1 zone and to one or more zones of mineralization suspected to exist on the southeast side of the assumed fault. A second zone of mineralization was reported to have been intersected in surface drill-holes subsequently to the writer's visit.

Chataway Exploration Co. Ltd. (19)

(50° 120° S.W.) Company office, 1926 Ogden Avenue, Vancouver 9. S. W. Wright, president. This company holds about 256 claims in a large block extending from Roscoe and Antler Lakes southward to the head of Broom Creek. The permanent-type camp on Dot Lake is reached by a road 5 miles long from the Aberdeen mine on Broom Creek; other roads give access from this road to various parts of the property. Work continued throughout 1964 under the direction of S. W. Wright, mostly employing a small crew augmented for part of the time by survey and drilling crews on contract. The work included electromagnetic and induced polarization surveying, soil-sampling, preparation of a topographical map from air photographs, as much as 10 miles of road construction, trenching, and 2,930 feet of surface diamond drilling, of which about 1,800 feet was completed at the time the property was visited in August.

The property is underlain by the older and younger quartz diorites of the Guichon batholith, which are cut in places by porphyry dykes. Outcrops are scarce. Trenching and drilling in 1964 were partly done near showings already partly investigated, principally on and near the Jay 1 and the Bob 8 claims between Chataway and Roscoe Lakes, the WIZ 3 claim south of Dot Lake, and the SHO 11 claim north of Twin Lakes. Drilling was done on the SHO 3 claim, which is two claim lengths northeast of the SHO 11 claim, and on the MAR 2 and 4 claims and the Rob 3 claim, all of which are near the west side of Dot Lake. The core of most of these holes was briefly examined; quartz diorite porphyry and adjacent quartz diorite intersected in a trench and a drill-hole on the WIZ 3 claim contain disseminated bornite and are the first rocks seen to be appreciably mineralized in this part of the property.

MLM* (50° 120° S.W.) The MLM group of 84 recorded claims is owned by Mamit Lake Mining Ltd., 1091 Broughton Street, Vancouver 5. G. J. Saarse, president. It lies west and northwest of Mamit Lake on the Guichon Creek road. Electromagnetic anomalies were diamond drilled, with a total of seven holes. The work was under the supervision of Mr. Saarse.

SKUHUN CREEK

Copper-Molybdenum

Curmo, S.S. (Skeena Silver Mines Limited)† (50° 121° S.E.) Company office, 301, 744 West Hastings Street, Vancouver 1. F. A. McGonigle, president; F. L. C. Price, consulting engineer. This company controls about 26 claims in the S.S. group and partly in the Curmo group, which is optioned from W. T. Curnow and M. G. Mooney, on the south slope of Skwilkwakwil Mountain. The property contains recently discovered showings and is reached by dirt road leading up Skuhun Creek from Mile 14 on Highway No. 8 southeast of Spences Bridge. Work in 1964 was from May onward and included as much as 3 miles of road construction, stripping, trenching, and blasting, soil-sampling, electromagnetic and induced polarization surveying, and 988 feet of diamond drilling. Crews were based at Spences Bridge.

A showing visited briefly in August, before drilling was done, is at about 4,200 feet elevation on a southwesterly spur overlooking Skuhun Creek. An area measuring about 300 feet wide and as much as 400 feet in northerly length has been explored by stripping and trenching. The older quartz diorite of the Guichon batholith shows a northwesterly steep crystal alignment and is cut by northeast-trending dykes of the younger quartz diorite and by similarly oriented narrow dykes of aplite. Numerous later dykes of andesite, which are possibly equivalent to those in the Spences Bridge Group of volcanic rocks, are mainly or wholly unmineralized and trend in various northwesterly directions. Compared to the other rocks, the older quartz diorite is more fractured and altered, and contains as hydrothermal minerals orthoclase, quartz, chlorite, calcite, epidote, zeolite, and probably tourmaline. Chalcopyrite is mainly on fractures in the older rock and is locally disseminated together with small amounts of molybdenite. The mineralized fractures and shear zones mostly strike about north 35 degrees east and dip steeply eastward. Unmineralized shear zones adjacent to the late dykes strike north-northwest. On air photographs the showing is close to the apparent intersection of a broad northwesterly lineament with at least one northeasterly lineament, of which there are several visible in the area covered by the property. Bornite veins are reported to occur in a creek 3,000 feet to the north of the described showing, apparently at a locality situated at the intersection of other lineaments.

Copper

Alamo, Jae (General Resources Ltd.)†.—(50° 120° S.W.) Company office, 213, 678 Howe Street, Vancouver 1. E. M. Olts, president; R. B. Stokes, chief engineer. This company holds claims in the Alamo and Jae groups on the east side of Skuhun Creek, south of Roscoe Lake, on which work of an unspecified nature was done in 1964. The claims are underlain by rocks of the Guichon batholith.

* By M. S. Hedley.
† By J. M. Carr.

Nig, Gar, Tine (General Resources Ltd.).*—(50° 121° S.E.) This company holds a block of claims including the Nig, Gar, and Tine groups which partly adjoin the eastern boundary of the S.S. group of Skeena Silver Mines Limited. The property is reported to contain an old copper showing known as the Nigger and is partly a relocation of the B.B. group held in 1961 by Quatsino Copper-Gold Mines Limited. Work of an unspecified nature was done in 1964.

Jay (Kamloops Copper Consolidated Ltd.).*—(50° 121° S.E.) Company office, 105 Seymour Street, Kamloops. R. W. Kennedy, president; J. Sullivan, consulting engineer. This company, formerly named Kamloops Copper Company Ltd., holds the Jay group of 12 recorded claims north of Skuhun Creek between the S.S. group and the Nig, Gar, and Tine groups. Work in 1964 included magnetometer, geochemical, and geomagnetic surveys.

MERRITT

Copper-Iron

Craigmont Mines Limited†

(50° 120° S.W.) Company office, 700, 1030 West Georgia Street, Vancouver 5; mine office, Box 3000, Merritt. J. D. Simpson, president; R. E. Hallbauer, mine manager. This company holds 107 mineral claims and fractions, of which 22 claims and fractions are held in 10 separate leases. The Craigmont orebodies are on the Merrell Nos. 7 and 8 claims and the McLeod Nos. 5 and 6 claims and are between the forks of Birkett Creek at original surface elevations between 3,800 and 4,200 feet. Access to the property is by road north from Lower Nicola on No. 8 highway 5 miles west of Merritt.

Mining and milling was continuous throughout 1964. Production has been from the open pit and from the underground operation. Most of the concentrate was shipped to Japan, and the remainder was shipped to the American Smelting and Refining Co. smelter at Tacoma, Wash. The iron content of the ore was impounded with the tailings. A part of the tailings was de-slimed and returned to underground as backfill. In 1964 material moved in the open pit by contractors measured 1,793,264 cubic yards, including glacial till and waste rock. An additional 15,899,703 tons of material, including glacial till, waste rock, and stockpiled ore was moved by the company, which also mined 667,032 tons of open-pit ore. From the stockpile, 919,513 tons of ore was taken to the primary crusher. Underground work was continued on all levels and is summarized as follows:—

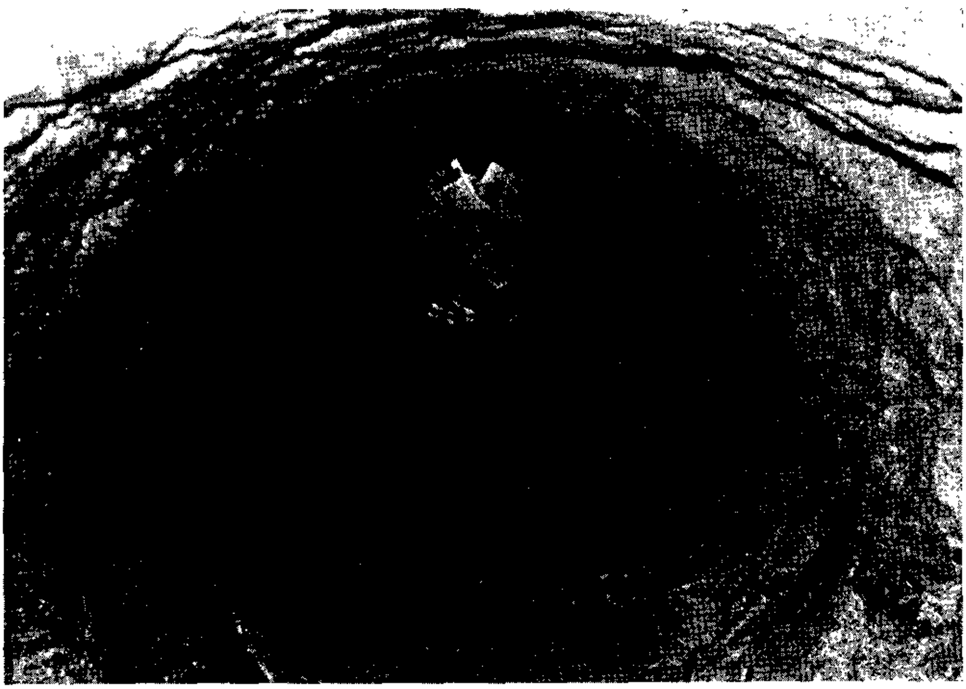
Development—	Ft.
Lateral development	13,364
Raising	7,019
Borehole (48 inches)	177
Ore production—	Tons
Cut-and-fill stopes	83,804
Blast-hole stopes	33,616
Development	108,292

Diamond drilling was continued underground and on the surface. A cut-and-fill system of mining, using tailings as backfill material, has proved relatively successful. On the 3000 level, a system of long-hole drilling has been used, in which the ore drops to a series of mucking-machine draw points. Still in the experimental stage, an Atlas Copco T4-G autoloader has been used underground. This is

* By J. M. Carr.
† By David Smith.

basically a combination mucking-machine and rear dump car, air operated and running on four pneumatic tires.

A novel raise drilling method has been used successfully to complete the 35-971 fill raise and the 28-884 ore-pass. Using a Robbins raise-boring machine, a pilot hole is drilled through to the drift below, using a conventional three-cutter rotary blast-hole bit. This bit is then removed from the drill stem, and in its place is attached a 48-inch raise head. The raise is reamed to the full diameter in one pass by " up-drilling." The cuttings fall by gravity to the drift below (*see* photo).



Looking up 48-inch raise drilled by a raise-boring machine. (Craigmont photo.)

Penetration rates achieved by the company were 7 feet per hour for drilling the 9-inch down hole and 5 feet per hour for reaming the 48-inch up hole.

With this machine it is possible to drill a raise on any angle between vertical and 60 degrees to the horizontal. Both Craigmont raises were inclined, one at 81 degrees 30 minutes and the other at 62 degrees 47 minutes, and both raises were driven with nearly perfect break-throughs. In drilling the down hole, cuttings are flushed to the surface under an air and water pressure of 500 pounds per square inch. In reaming the up hole, the cutting surface is flushed with water under pressure. There is no dust problem when the machine is operated as designed.

Additions to major equipment in 1964 included the installation in the mill of a 6- by 8-foot regrind ball mill.

In 1964 the number of persons employed was 560. No housing is provided on the property, and the crews commute from Merritt, a distance of approximately 8 miles. (*See* Annual Reports, 1959, pp. 31–34; 1960, pp. 35–40; 1961, pp. 31–37; 1962, pp. 52–53; 1963, pp. 49–51.)

Cinderella (Peel Resources Limited)*

(50° 120° S.W.) Company office, 230 West Broadway, Vancouver 10. N. H. McDiarmid, president; Chapman, Wood and Griswold Ltd., consulting engineers. This company holds under option from the owners, Mrs. K. I. Merrell and C. G. Jackson, 36 claims in the Cinderella group at elevations between 3,000 and 4,500 feet, 2 miles northeast of Merritt. Access is by jeep-trail from Highway No. 5. Work in 1964 included trenching, soil-sampling, magnetometer surveying, geological mapping, and one diamond-drill hole 144 feet in length.

The showings were visited briefly in August and are mainly in trenches of two localities about 3,000 feet apart in a northerly line. The southern showings include four old shafts, each 15 feet or less deep, in one of which chalcopyrite and quartz were seen at a northerly shear zone in nearly vertical greywacke beds of the Nicola Group, which strike slightly west of north. Limestone beds occur nearby, and the rocks are intruded by one or more northerly trending dykes of quartz diorite. Skarn veins consisting mainly of calcite and epidote occur locally in greywacke along the east side of a dyke and are mineralized with chalcopyrite and specularite. At this showing the occurrence of steeply dipping beds of mixed limy and non-limy type provides a promising setting for further exploration.

At the northern showings the attitude of the Nicola beds, which here include limestones and dark-coloured tuffaceous rocks, is somewhat variable. Near an exposed easterly fault the rocks are traversed by numerous joints and mineralized fractures which partly strike eastward and possess low southerly dips. Magnetite, specularite, chalcopyrite, and copper carbonates occur on the fractures, and the rocks contain pyrite and in places abundant epidote. A north-trending pink dyke, probably of latite, contains pyrite disseminations.

CANFORD

Copper

Copper Canyon (Hurley River Mines Ltd.)†

(50° 121° S.E.) Company office, 535 Howe Street, Vancouver 1. P. Polischuk, president. The property consists of 52 recorded mineral claims in the Copper Canyon, Eagle, Tent, and P. J. H. groups situated on the east slope of Mimenuh Mountain, which is 10 miles west-northwest of the village of Canford on the Nicola River. It is reached by jeep-road from Canford. In 1964 a three-stage geomagnetic survey was carried out on the property. A geological examination was made by W. S. Read.

NICOLA

Copper

Lake Group†

(50° 120° S.W.) This property is on the north shore of Nicola Lake about 5 miles by road from Nicola. One short diamond-drill hole was drilled on the immediate shore of the lake in the vicinity of some old workings to test an indicated shear zone. No further work is contemplated. The drilling was under the direction of F. L. C. Price.

* By J. M. Carr.
† By David Smith.

Copperado (Toluma Mining and Development Co. Ltd.)*

(50° 120° S.W.) Head office, 1040 West Georgia Street, Vancouver 5. The property consists of 60 claims held by record and the Turlite Crown-granted claim. The property is 4½ miles by road north of Nicola at elevations between 3,500 and 4,500 feet. The camp and buildings have been kept in good order. A small crew carried out check surveys and some surface exploration. The shaft was not unwatered.

ASPEN GROVE

Copper

Porcupine (Amalgamated Resources Ltd.)†

(50° 120° S.W.) Company office, 927, 510 West Hastings Street, Vancouver 2. Paul Polischuk, president; Sherwin F. Kelly, consultant. The Porcupine group comprises 36 recorded mineral claims situated on the east side of the Princeton–Merritt highway and north of Corbett Lake (Annual Report, 1963, p. 54). The working area centres on the southeast corner of the Porcupine No. 1 claim around the old inclined shaft sunk on the showing which is a bed of amygdaloidal basalt about 10 feet thick, mineralized with disseminated chalcocite, chalcopyrite, bornite, and native copper. The bed strikes north 50 degrees east and dips 45 degrees southeast.

Bulldozer trenching in 1964 exposed mineralized amygdaloidal basalt on strike to a distance of 250 feet northeast of the shaft and 200 feet to the southwest. A self-potential geophysical survey was in progress at the time of the writer's visit.

Kan (Canex Aerial Exploration Ltd.)*

(50° 120° S.W.) Head office, 700, 1030 Burrard Street, Vancouver 5. This group of 28 recorded mineral claims is reached by highway 13 miles south of Merritt, then 7 miles southwest on the Iron Mountain road. A grid was laid out on the property and an I.P. survey was conducted. A crew of six men was employed under the direction of W. S. Pentland, geologist.

Blue Jay†

(49° 120° N.E.) This group of 24 mineral claims and 5 fractions is held by record by Harry Nesbitt, Aspen Grove. The Princeton–Merritt highway passes through the claims on the west margin of the group, which is one-quarter mile northwest of Tule Lake. The showings are reached by a dirt road which leads eastward from the highway about 3 miles north of the settlement of Aspen Grove.

The general geology is shown on Geological Survey of Canada Map 888A, Princeton. The area is underlain by Nicola volcanic rocks which here are intruded by granodiorite of the Coast Intrusions. Both these formations are overlain by small outliers of the Spences Bridge and Kingsvale Groups.

The principal showings are on the Kingsvale No. 6 mineral claim. The rock is a grey albitized recrystallized rock of variable texture and uncertain origin. Its original composition appears to have been near to that of an andesite or diorite. Garnet and epidote are irregularly distributed, as are streaks and blebs of reddish albite. The mineralization consists of disseminated chalcopyrite, native copper, and bornite with minor magnetite. The mineralization is associated with small fractures; no fault structure was recognized. The mineralization is exposed by surface stripping for a length of about 800 feet in a direction of north 20 degrees west and over a width of nearly 100 feet.

* By David Smith.
† By N. D. McKechnie.

About three-eighths of a mile southeast of the above stripping at the junction of mineral claims Blue Jay No. 1, No. 2, No. 3 and No. 4, there is an exposure of dark-grey gabbroic rock containing finely disseminated chalcopyrite and bornite. Not enough stripping has been done here to clarify the situation. Of five prospect holes drilled by Mr. Nesbitt, two drilled north 80 degrees east at 45 degrees showed sparse mineralization for lengths of 15 and 16 feet respectively, and one drilled north 10 degrees east at 45 degrees showed sparse mineralization for a length of 51 feet.

Pay (Payco Mines Ltd.)*

(49° 120° N.W.) Head office, 2117 West Fourth Avenue, Vancouver 9. This company holds by record the Pay group of 40 claims surrounding Alleyne Lake, 3 miles southeast of Aspen Grove. The property is reached by a narrow road which turns north from the Kentucky Lake road about 2½ miles east of the Princeton–Merritt highway. A small amount of surface exploration was carried out under the direction of S. F. Kelley. (*See* Annual Report, 1963, pp. 55–56.)

Kentucky (Scope Development Ltd.)†

(49° 120° N.W.) This company, which is a wholly owned subsidiary of Alscope Development Ltd. (company office, 549 Howe Street, Vancouver 1; N. Martini, president; V. M. Prescott, secretary-treasurer), holds about 30 recorded claims in the Kentucky group west of Kentucky Lake and also mineral lease No. M18B, which is separated from the southwestern corner of the Kentucky group by the Tom Cat group of Crown-granted claims owned by J. Tancowny. Access to the property is by 5 miles of dirt road from Highway No. 5 at the Kentucky Lake turn-off south of Aspen Grove. In 1962 the company did a small amount of trenching. In 1964 work was done from August onward by a small crew under F. Kangas, geologist, and included nearly 1 mile of road-building, trenching, soil-sampling, geophysical surveying, and 1,850 feet of diamond drilling in four holes.

A showing at about 3,900 feet elevation on the southwesternmost recorded claim, about 1 mile southwest of Kentucky Lake, was briefly visited in August. It lies on the west side of a long, straight gully extending northwestward from Bluey Lake and is between a pair of parallel lineaments visible on air photographs and possessing a trend approximately north 60 degrees east. These features may reflect geological structures having some control on the occurrence of mineralization. At the showing, a trench exposes porphyritic diorite which is mineralized on irregular joints by malachite. The latter is probably formed from bornite and chalcocite, both of which are reported to occur in some old pits nearby. Outcrops of the diorite, immediately nearby to the east, exhibit strong jointing, mainly on planes striking north 60 degrees east and dipping northward at 60 degrees. This rock is partly brecciated and contains abundantly disseminated magnetite and calcite, chlorite, and epidote. When visited the ground beneath the trenches was about to be explored by a first drill-hole.

Pyramid‡

(49° 120° N.W.) This group of some 42 claims is held by record in the names of John Tancowny and Magnus Bratlien, both of Merritt. The group includes the June, Saw, Six, Final, and Car groups and five claims of the adjoining Bunny group. The claims are west and south of Kentucky Lake and about 4 miles southeast of the village of

* By David Smith.
† By J. M. Carr.
‡ By N. D. McKechnie.

Aspen Grove. The working area is reached by a tractor-road southward from the Kentucky Lake road about 1½ miles from the highway.

The claims are underlain by andesitic flow breccias and lavas of the Nicola Group.

Work done during 1964 consisted of drilling six X-ray diamond-drill holes on the Final No. 1, June No. 4, and June No. 5 claims, three diamond-drill holes on the Car No. 5 claim, and bulldozer stripping on the Bunny No. 23 claim. The X-ray drill core was not examined.

The cores from the holes on the Car No. 5 claim were almost entirely in andesite flow breccia. A minor amount of native copper was seen over a length of 3 feet in one of the cores; a minor amount of a very fine-grained grey metallic mineral was occasionally visible in the rest of the cores; both chalcocite and specular hematite are known to occur in these rocks.

The bulldozer stripping exposed red porphyritic andesite breccia, and a coarser-grained rock resembling diorite in hand specimen and similar to the rock at the Blue Jay showings 4 miles to the north (*see* p. 95). In the one thin-section of this rock examined, volcanic textures are somewhat more evident than in the Blue Jay specimens. The porphyritic andesite breccia shows considerable epidote and some hematite. The coarser diorite-like rock is mineralized with chalcopyrite and bornite, sparsely but in marked contrast to the breccia in the stripping and to that seen in the cores.

Rice (*Geol. Surv., Canada,* Mem. 243, p. 94) describes " coarse grained rocks with granitic texture which at first glance look like intrusive diorites, but in which volcanic structures can still be recognized " as one of the host rocks to mineralization at the old Big Sioux showings, which are just southward from the Blue Jay. It seems to the writer a quite reasonable supposition that this rock type, with its coarser grain and more evident alteration, may represent an older structure which may have been a locus of mineralization.

Par (Tormont Mines Limited)*

(49° 120° N.W.) Company office, 509, 25 Adelaide Street West, Toronto; Vancouver office, 605, 1030 West Georgia Street, Vancouver 5. The Par group of 36 recorded claims lies west of the Merritt–Princeton highway, 7 miles south of Aspen Grove. It is crossed by the Otter Creek road. Six holes totalling 2,715 feet were diamond drilled on the Par 3 and 5 claims. The work was under the supervision of Boris Nekrasov.

KAMLOOPS

Copper

Galaxy Minerals Ltd.†

(50° 120° N.E.) Company office, 1403, 1030 West Georgia Street, Vancouver 5. W. F. Evans, president. This company holds six Crown-granted and 46 recorded claims east of the road to Le Jeune Lake, about 5 miles southwest of Kamloops. Work in 1964 consisted of diamond drilling a number of surface holes. In August, 1964, management directed that further operations be carried out by Sulmac Explorations Ltd., of Toronto. A crew was based at the Makaoo camp, and claim-surveying and line-cutting were commenced. An induced potential survey is being carried out on the entire property. An average crew of eight men was employed.

* By M. S. Hedley.
† By David Smith.

Makaoo (Rolling Hills Copper Mines Limited)*

(50° 120° N.E.) Company office, P.O. Box 4183, Station D, Vancouver 9. Rolling Hills Copper Mines Limited holds by option 5 Crown-granted and 67 recorded claims from Makaoo Development Company Limited. An additional 183 claims are held by record. The claims lie in the general Coal Hill-Jacko Lake-Knutsford area southwest of Kamloops. In 1964 an electromagnetic survey was conducted over 23 miles of line and an induced potential survey was conducted over 9.3 miles of line. A total footage of 11,865 feet of percussion drilling was done using an Atlas-Copco drill and a 600 c.f.m. portable compressor. Using this method, casing can be set through a considerable depth of overburden or bedrock, and a smaller-diameter hole may then be drilled to a depth up to 300 feet. The cuttings are removed from the hole either by air or water flushing, and collected by suitable sample-gathering equipment. Penetrations of the order of 2 to 3 feet per minute are made, and recoveries of the order of 95 per cent have been achieved. The drilling was done on the Makaoo property, above the Python adit. Some of the geophysical work extended beyond the borders of Makaoo ground. An average crew of four men was employed under the direction of C. F. Millar, engineer in charge.

Copper-Gold

Afton (Colonial Mines Ltd.)*

(50° 120° N.E.) Company office, 1718 West Fifth Avenue, Vancouver 9. This company holds by option 38 recorded claims including the old Pothook workings. The group lies approximately 7 miles southwest of Kamloops. In 1964 several holes were drilled from surface with a percussion machine, in the vicinity of the Pothook workings. A crew of four men was employed under the direction of C. F. Millar.

Laura, Earl (Copper Lake Explorations Ltd.)*

(50° 120° N.E.) Company office, 1288—20th Avenue, Prince George. This company holds 26 recorded claims about 6 miles south of Kamloops and lying northeast of Edith Lake. Access is by the Brigade Lake road south of Knutsford. A magnetometer survey and some soil-sampling were carried out in 1964. Some stripping was done with a bulldozer. A crew of six men was employed under the direction of A. R. Allen.

Kimberley (New Jersey Zinc Exploration Company (Canada) Ltd.)*

(50° 120° N.E.) Company office, 905, 525 Seymour Street, Vancouver 2. This property consists of the following Crown-granted mineral claims: Kimberley, Lot 1447; Charlotte, Lot 1448; Last Chance, Lot 1449; Morning Star, Lot 1450; Stem Winder, Lot 1451; Occidental, Lot 1452; Keystone Fraction, Lot 1453. The claims lie 3 miles to the south of Kamloops and 1 mile northwest of Knutsford. Six BX diamond-drill holes, totalling 2,040 feet, were drilled by the wire-line method. A crew of six was employed under the direction of C. F. Millar, resident engineer.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1909, p. 139; 1913, p. 191; 1929, p. 509; 1956, p. 69.]

* By David Smith.

NORTH THOMPSON

North Barriere Lake (51° 119° S.W.)

Molybdenum

BAR* The Consolidated Mining and Smelting Company of Canada, Limited, holds the BAR 1–19 and the Barriere No. 6 recorded claims on the east side of Harper Creek, approximately 4 miles north of North Barriere Lake. Access is by a 5-mile logging-road up Harper Creek from the North Barriere Lake road. The mineralization consists of disseminated pyrite, with minor molybdenite and chalcopyrite in medium-grained granite. Work was carried out by a crew of three men under the direction of G. M. Gibson. The work included geological mapping and 302 feet of diamond drilling from one drill site. The property was not visited.

Clearwater River (51° 120° N.E.)

Molybdenum

Polly Ann, etc.* Southwest Potash Corporation; company office, 718 Granville Street, Vancouver 2. This company holds 55 recorded claims on the west side of the Clearwater River, including the Polly Ann 1–13, Betsy 1–17, Lizard 1–19, and Sock 7–12. The property is 6 miles north of Clearwater and access is by logging-road up Clearwater River. The showings are near the eastern edge of a major granitic batholith. Molybdenite mineralization is present mainly in a set of narrow, widely spaced quartz veinlets. Work, under the direction of D. L. Mathias, commenced in July and was completed by October. Two holes, totalling 1,414 feet, were diamond drilled. Other work included geological mapping and geochemical sampling.

ADAMS LAKE

Silver

Homestake* (51° 119° S.W.) Homestake Silver Ltd.; company office, 536 Howe Street, Vancouver 1. Coley Hall, president. This company holds 5 Crown-granted claims by option agreement and 15 claims by record. The property is on the Louis Creek–Skwaam Bay road, approximately 3 miles northwestward from the head of Skwaam (Agate) Bay on Adams Lake. Work in 1964 commenced on November 15th and was suspended on December 20th. About 2 miles of tractor-road was constructed. An average crew of five men was employed under the supervision of John Scott (*see* Annual Report, 1936, pp. D 32–D 36).

SHUSWAP LAKE

Zinc

Bet, Saul† (51° 119° S.E.) Edoran Oil Corporation Ltd., of Calgary, holds the Bet group of 43 claims and the adjoining Saul group of 4 claims. The property is on a ridge joining Crowfoot Mountain and Mobley Mountain at an elevation of approximately 6,200 feet. Access is by logging-road up Ross Creek from the north shore road of Shuswap Lake. Work included geological mapping, magnetometer surveying, and diamond drilling three holes, totalling 800 feet. An average crew of three men was employed under the direction of H. C. B. Leitch.

* By W. C. Robinson.
† By W. C. Robinson and G. E. P. Eastwood.

Samples sent to the Department consisted of marmorized limestone, mica schist, and minor granitic rock, and contained sphalerite, quartz, and minor pyrite and chalcopyrite. The presence of small amounts of tin was confirmed by assays. An attempt to isolate the tin-bearing mineral was unsuccessful, and it has not been positively identified. However, the response to attempted concentration suggests that a considerable part of the tin occurs as cassiterite.

The property was not visited.

MOUNT HENNING

Copper-Molybdenum

Independence (Fort Reliance Minerals Limited)*

(49° 120° N.W.) Company office, 25 King Street West, Toronto. J. A. Harquail, president. This company holds 93 recorded claims named FRM and 4 Crown-granted claims at the Independence mine on Mount Henning, which is between Lawless Creek and the Coquihalla River. Access to the property is from Coquihalla by 3 miles of road. Work in 1964 was directed by A. D. Wilmot and employed five men for 16 days. It included road repair, trenching, and magnetometer and geochemical surveying.

[Reference: *Geol. Surv., Canada,* Mem. 243, " Geology and Mineral Deposits of Princeton Map-area, British Columbia," H.M.A. Rice, 1947, pp. 111–112.]

TULAMEEN

Iron

Imperial Metals and Power Ltd.†

(49° 120° N.W.) Company office, 230 West Broadway, Vancouver 10. N. H. McDiarmid, president. The property includes a large group of claims encompassing the area of Lodestone and Olivine Mountains and Tanglewood Hill. The property lies about 15 miles due west of Princeton and is accessible by logging-roads from the community of Tulameen. The area has been explored, some of it in detail, in past years. In 1964, 1,000 pounds of Lodestone ore and 320 pounds of Coalmont coal were sent to the Lurgi Corporation in Frankfurt, Germany, for testing. Results of tests are not available.

Copper

Red Star†

(49° 120° S.E.) This property consists of 13 recorded claims and 2 Crown-granted claims, the Red Star and Anaconda. The property is being worked under lease by A. W. Hendrickson and Harold Hopkins, Brackendale. The property is adjacent to the Hope–Princeton highway, a distance of 22 miles from Princeton. In 1964 a road was built from the highway to the new workings. Considerable trenching has been done by bulldozer, and a new adit was started. Mining was attempted by a trackless mining system but was not very successful due to ground conditions. The ore, which appears to be vein material lying within a shear in chloritic schist, is the only stable material, and once it is removed the surrounding rock crumbles and is very difficult to hold in place. Twenty-eight tons of copper-silver-gold ore was handcobbed and shipped. Work has been carried out by two men under the direction of Mr. Hopkins.

* By J. M. Carr.
† By David Smith.

SIMILKAMEEN RIVER

Copper-Iron

Virginia, No. 14 (Thayer Lindsley and Associates)*

(49° 120° S.E. and S.W.) Thayer Lindsley and associates control 30 recorded claims and fractions and 35 optioned Crown-granted claims which are either owned by Miss Patricia S. Ravey or optioned by her from The Consolidated Mining and Smelting Company of Canada, Limited. The main property extends from a point on the Similkameen River about 1 mile north of the Copper Mountain mine eastward for about 3 miles to the Voigt camp. It contains numerous old surface showings of copper mineralization, which at the Voigt camp are accompanied by high concentrations of magnetite and specularite and were previously explored from underground. Work in the spring of 1964 was done by Fort Reliance Minerals Limited (A. D. Wilmot, resident engineer, Kelowna; Ian Bain, geologist) on behalf of Mr. Lindsley and included widespread geological mapping and sampling. It also included magnetometer surveying and soil-sampling of several adjacent claims, including the No. 14 claim at the Voigt camp, and trenching at various places, including the No. 14 claim, the adjacent Queen J recorded claim, the Virginia and June Bug claims, and the No. 18 fractional claim near Lost Horse Gulch.

Aided by maps provided by the company, the writer briefly examined trenches on the No. 14 and Virginia claims in August.

(*a*) *No. 14 Claim (Voigt Camp)*.—The new trenches explore the immediate area lying east and southeast of the old inclined shaft. Company mapping indicates that at surface the chalcopyrite-specularite-magnetite zone extends eastward from the shaft for a distance of 450 feet and decreases in width and grade as it does so. It is interrupted by several northerly felsite dykes. A strong gougy fault trends more or less parallel with the north side of the zone for at least part of its length.

[Reference: *Geol. Surv., Canada*, 1934, Mem. 178, "Geology and Ore Deposits of Copper Mountain, British Columbia," pp. 42–43.]

(*b*) *Virginia Claim*.—This claim adjoins the north side of Lost Horse Gulch less than one claim length west of the Voigt gabbro stock. Recent trenches at about 3,750 feet elevation a few hundred feet north of the road explore an area measuring about 700 feet square, which is underlain by cherty tuffs and andesite of the Nicola Group at its southern end and syenogabbro or monzonite at its northern end. One or more irregular northeastward-trending bodies of latite porphyry intrude the Nicola rocks and are in unknown relationship with the syenogabbro. The rocks are partly altered and contain veins variously of orthoclase, calcite, ankerite, and locally quartz. Pale-coloured felsite and quartz porphyry dykes with northerly strikes liberally dissect the other rocks and are mineralized only with small amounts of disseminated pyrite. The other rocks are mineralized with chalcopyrite, pyrite, and in places considerable magnetite in fractures and as disseminations. Partial oxidation of sulphides has taken place. Mineralization tends to increase in northeasterly or easterly zones as much as several feet wide. Gougy faults of pre-felsite age mainly dip steeply northward and strike in directions about east; mineralization is strongest adjacent to them. Small faults later than the felsite dykes trend both northward and northwestward.

* By J. M. Carr.

Gold

Nickel Plate (Dundee Mines Ltd.)*

(49° 120° S.E.) The old Nickel Plate property is held under option by Dundee Mines Ltd.; company office, 510 West Hastings Street, Vancouver 1. Ralph Sostad, president. Access to the present workings is by the Nickel Plate road. In 1964 a road was built to the Warhorse Crown-granted claim. Eight diamond-drill holes, totalling 3,513 feet, were drilled on the Warhorse claim. A crew of five was employed under the direction of J. Lamb and G. E. Leonard.

KEREMEOS

Gold-Silver

Horn Silver (Utica Mines Ltd.)†

(49° 119° S.W.) Company office, 1218 Burrard Building, Vancouver; mine office, Box 47, Keremeos. Andrew Robertson, president; R. E. C. Richards, superintendent. The property includes the Horn Silver and Silver Bell Crown-granted mineral claims and 41 recorded mineral claims, including the Silver Bell 1–5, 7, and 8. It is on the western slope of Richter Mountain 16 miles south and east of Keremeos and 4 miles north of the International Boundary. Access is by a newly constructed road 2½ miles long from the Keremeos–Richter Pass highway at the foot of Richter Mountain to the adit portal at 2,622 feet elevation.

Work in 1964 comprised principally the preparation of the existing underground workings for production. Limited underground exploration was performed and a small quantity of ore was stockpiled. The following is a summary of underground work:—

	Ft.
Drifting and crosscutting	1,156
Raising	326
Subdrifting	788
Diamond drilling	2,064

A new adit was begun 200 feet lower in elevation than the existing workings. Two diamond-drill holes were completed.

The east drift on the 2622 level was being driven toward the " Bromley showing," an exposure of mineralization at surface some thousand feet east of and 300 feet higher in elevation than the 2622 portal. The mineralization is exposed in a small pit in monzonite. The rock is well fractured and sparsely mineralized with pyrite and chalcopyrite. The best-developed shearing strikes north 75 degrees east and dips 30 degrees southeastward; this is 15 degrees more northerly in strike and 10 degrees flatter in dip than the mine shear zone. Quartz stringers mineralized with pyrite, chalcopyrite, galena, and grey copper occupy fractures which strike north 17 degrees east and dip 35 degrees southeast, and others which strike north 75 degrees east and dip 50 degrees northwest. There possibly are two ages of quartz present, the younger being white, less friable, and nearly barren of sulphides. The quartz is cut by a fault striking north 10 degrees west and dipping 32 degrees east.

A fault with rusty gouge up to 2 inches wide is exposed in a road cut about 200 feet in the hangingwall of the mine shear and near 2,400 feet elevation. A sample of the gouge assayed 1.4 ounces silver per ton. The fracture strikes north 30 degrees east and dips 65 degrees northwest.

Five new buildings with steel frames and metal sheathing have been constructed to house the offices, warehouse, first-aid room, dry, compressor-house, and machine-

* By David Smith.
† By N. D. McKechnie and David Smith.

shop. At the year-end a crew of 32 men was employed. (*See* Annual Report, 1960, p. 60.)

MOUNT KATHLEEN

Molybdenum

Rat* (49° 119° N.W.) The Rat group consists of 22 mineral claims, Rat 1 to 12 and 17 to 26, held by record in the name of Orville Burkinshaw, 502 Fina Building, Calgary, Alta. The group lies immediately northwest of Glen Lake and is reached by a foot-trail which leads westward from the Pennask Lake road, at a point 13½ miles from Peachland, up the east nose of Mount Kathleen.

The regional geology is shown on Geological Survey of Canada Map 15-1961, Kettle River (West Half).

Old workings on the property include an adit about 200 feet in length and a raise from the adit to surface, about 40 feet. It is not known when or by whom this work was performed, but it is within an area in which similar work (described in the 1898 and 1899 Annual Reports) was done by the Canadian-American Mining and Development Company. The ground in the vicinity of the old workings has been trenched and test-pitted by recent owners.

The area is underlain by the "white" granodiorite† of the Princeton map-area of Jurassic or early Lower Cretaceous age. In the vicinity of the workings it is slightly gneissic.

The mineralization is associated with a white, siliceous, fine-grained but unevenly textured rock locally termed "white rock." In thin-section the rock is seen to be comprised chiefly of quartz with much altered plagioclase, carbonate, and phlogopite mica with lesser apatite and cordierite. It possibly is a silicified metamorphosed limestone intruded by granodiorite, but the observed contact relationships were not clear. Test-pits indicate that it underlies an area of about 200 by 500 feet; no rock is exposed on the eastern or downhill side of the workings.

Mineralization consists of threads and stringers of molybdenite, with sparse coarse pyrite and rare chalcopyrite. It is entirely within the "white rock."

PEACHLAND

Copper-Zinc

Rainbow and Patricia (Quinalta Petroleum Ltd.)‡ (49° 119° N.W.) This property consists of the Rainbow 1–4, Patricia 1–10, and 40 other mineral claims, all held by record in the name of Orville Victor Burkinshaw, 502 Fina Building, Calgary, Alta. The claims are on Peachland Creek, upstream from its junction with Greata Creek, and 9 miles by motor-road westward from Peachland on Okanagan Lake.

The regional geology is shown on Geological Survey of Canada Map 15-1961, Kettle River West Half.

The claims are underlain by Nicola-like sedimentary and volcanic rocks which form a mass some 10 miles long and from one-half to 2 miles wide trending northwest-southeast. The mass is an inclusion in Nelson granitic intrusive rocks which in turn are cut by a small stock of Valhalla granite.

At the working-site the rocks are limestone and quartzite beds, the limestone up to 6 feet thick, striking from north 5 degrees west to north 30 degrees east and

* By N. D. McKechnie.
† *Geol. Surv., Canada*, Mem. 243, pp. 40–42.
‡ By N. D. McKechnie.

dipping fairly uniformly at 30 degrees eastward. The sediments are cut by massive andesitic greenstone which is sparsely mineralized with pyrite, pyrrhotite, chalcopyrite, and black sphalerite. Very little sulphide was seen away from the greenstone.

The workings consist of cuts in the hillside for a length of about 100 feet. Several short holes were diamond drilled. The work was done by Quinalta Petroleum Ltd., of Calgary, under the direction of F. Poznikoff.

VERNON

Copper

Goodenough (Empire Development Company Limited)*

(50° 119° S.E.) Company office, 736 Granville Street, Vancouver 2. E. C. Oates, general manager; John Lamb, chief geologist. The company optioned the Win-Art and BR groups of 20 recorded claims from Alfred Holmwood, of Kelowna. The property is 3 miles west of Okanagan Lake between Naswhito and Equesis Creeks, approximately 21 miles by road from Vernon.

Two northwesterly trending subparallel bands of limestone are separated by 700 to 1,000 feet of altered and granitized volcanic rocks. Mineralization consisting of chalcopyrite, magnetite, and pyrite is associated with northwesterly trending shear zones in the volcanic rocks.

In 1963 geochemical and geophysical surveys were made and were followed by bulldozer trenching. In 1964 a total of 3,371 feet of diamond drilling was done in 10 holes in anomalous areas. The option was dropped. The property was not visited.

WESTWOLD

Molybdenite

Brenda (Northwest Ventures Ltd.)†

(50° 119° S.W.) Company office, 718, 355 Burrard Street, Vancouver 1; H. H. Huestis, president. The property consists of 36 mineral claims held by record on the northwest side of the Salmon River, 4 miles southwest of the village of Westwold. From the Westwold–Douglas Lake motor-road at a distance of 4 miles from Westwold a logging-road leads northward about a mile and a quarter to the mineral showings at 2,750 to 2,800 feet elevation. The logging-road is passable with some difficulty by two-wheel-drive vehicles.

The Brenda group includes ground formerly held as the Kennallan, or Kenallan, group, and as such the molybdenite occurrence is described in some detail in the 1915 Annual Report, pages 217 to 219, and in Bulletin No. 9, pages 28 to 33. Molybdenite occurrences " at the rear of the settlement," which may be the same, are mentioned briefly in the Annual Reports for 1896 to 1901 as the Key group. The regional geology is shown on Geological Survey of Canada Map 1059A, Vernon.

The working area is at the top of a knob and extends some 1,200 feet northerly by 900 feet easterly. It is more or less bounded by the logging-road and a drill-site access road branching from it to the east and north.

The claims are underlain by basalts of the Kamloops volcanics, and by a window of Cache Creek sediments measuring about one-half mile wide in an east-west direction by about three-quarters of a mile north-south. The Cache Creek rocks are in contact with and intruded by diorite or quartz diorite of the Coast Intrusions. The intrusive rocks form a northern rim of the window.

The Cache Creek sediments are crystalline limestone and grey to greenish fine-grained siliceous hornfels. The latter is locally metamorphosed to a lime-

* By M. S. Hedley.
† By N. D. McKechnie.

silicate skarn which also, though to a much lesser extent, occurs in the intrusive rocks. The crystalline limestone occurs in one principal band, which exposures indicate may be more than 150 feet thick but which appears to have a relatively limited strike length. The sediments strike a few degrees east and west of north and dip about 40 degrees westward.

Only one fault was seen; it is about 6 inches wide, strikes north 25 degrees west, and dips 40 degrees southwestward. It is not mineralized.

Tongues of diorite up to 200 feet wide occupy the northerly end of the area of exposures. They are conformable with the bedding, or nearly so.

Mineralization consists of erratic concentrations of molybdenite in the skarn, with minor chalcopyrite and pyrite. It is almost wholly confined to the altered sediments. There are two principal exposures of molybdenite. The first, on the west side of the working area, is exposed in old rock trenches and is in skarn at and near contacts with crystalline limestone. The second is 1,200 feet distant to the northeast and is exposed in two old rock trenches about 150 feet apart. It is in skarn in hornfels at and near contacts with diorite. In both occurrences the molybdenite is spotty and statements of width have no meaning.

The writer was unable to recognize any structures which might control the distribution of mineral.

Two diamond-drill holes were drilled—one on the western side, the other on the eastern. The core was not accessible at the time of the writer's visit.

SALMON ARM

Nickel

Fly Hill (Barriere Lake Mines Ltd.)*

(50° 119° N.E.) Company office, 1686 West 69th Avenue, Vancouver 14. Fourteen recorded claims, the Galaxy 1–10 and Mark 1–4, were held under option from C. Bloomer, 1821 Fleetwood Avenue, North Kamloops. The property is on upper Gordon Creek, 3 miles west of Salmon Arm, and is reached in 7 miles by the Fly Hill forestry access road. Two diamond-drill holes, totalling 500 feet, were drilled. A crew of two was employed under the direction of T. Moore.

SICAMOUS

Lead-Zinc-Copper

Annis Mines Ltd.*

(50° 119° N.E.) Company office, 1413 Tranquille Road, Brocklehurst, Kamloops. J. S. McKechnie, Kamloops, president. This property of 17 recorded claims lies on the south shore of Shuswap Lake, 3½ miles west of Sicamous. Access is by one-half mile of logging-road from the Trans-Canada Highway. In 1958 an adit 85 feet long was driven to intersect the continuation of a surface showing. No mineralization is indicated in this adit. In 1964 several surface trenches were dug through the overburden with a bulldozer. Lead-zinc mineralization with some copper is indicated in these trenches. The country rocks are quartzites and schists. A crew of two was employed under the direction of D. Spankes.

MABEL LAKE

Lead-Zinc

Bright Star Trio Mining Ltd.†

(51° 118° N.W.) Company office, c/o W. Goebels, Enderby. The property includes 28 claims held by record and by bill of sale, comprising the Len, Deer, Rich, and Silver King groups. The property lies northwest of the east fork

* By David Smith.
† By N. D. McKechnie and David Smith.

of Kingfisher Creek, a southward-flowing tributary which joins the Shuswap River about one-half mile downstream from Mabel Lake. The property is reached by a logging-road which turns northward from the Enderby–Mabel Lake road about 1 mile west of Hupel. At 9 miles on the logging-road a jeep-road in very poor condition leads 1½ miles to the showings.

The general geology is shown on Geological Survey of Canada Map 1059A, Vernon. The region is underlain by metamorphic rocks of the Monashee Group, of which a carbonate member is shown on the map on the east side of Kingfisher Creek and extending, from a point about 6 miles from its mouth, northward and eastward across the creek's east fork for a distance of about 4 miles. Sulphide mineralization occurs along this carbonate member.

During 1964 work was done under option agreement by Sheep Creek Mines Limited. Six diamond-drill holes, totalling 642 feet, were drilled, and several open cuts were made by bulldozer and blasting over a distance of some 2,400 feet between elevations of 3,500 and 3,750 feet. A crew of four men was employed under the direction of R. H. Beaton. The option has been dropped.

The carbonate member is exposed at intervals from Silver King No. 21 mineral claim northeastward to Rich No. 1 mineral claim, from which it passes outside the group. The member here is comprised of recrystallized impure limestone, biotite gneiss, and calcareous quartzite. The recrystallized limestone is composed chiefly of calcite with subordinate diopside, tremolite, biotite, apatite, and fluorite. All the exposures tested effervesced freely with cold hydrochloric acid.

The bedded rocks are intruded by quartz-gabbro, biotite-granite, and pegmatite. The gabbro and granite are slightly gneissic; the granite contains noticeable amounts of red garnet. The pegmatite is comparatively massive and appears to be a sill. The exposures of gabbro and granite are too limited to show whether they are dykes or sills. One andesite dyke striking slightly west of north and dipping steeply northeastward was seen to cut the pegmatite and the granite.

Minor folds were seen on axes striking north 25 to 35 degrees east. Two faults striking north to northeastward cut the sediments and pegmatite at the northern end of the workings. The displacements are not known.

Mineralization includes pyrrhotite, sphalerite, galena, and minor chalcopyrite and pyrite. Pyrrhotite occurs in masses in the recrystallized limestone and locally may almost wholly replace it. It occurs also with the other sulphides but usually in minor quantities. The other sulphides are found sparingly in the recrystallized limestone, and their best concentration is in highly silicified rock close to the pegmatite.

The showings will be described from the lowest elevation to the highest, numbered 1 to 5.

Showing No. 1 is at 3,520 feet elevation. A rock composed chiefly of quartz and pyroxene is mineralized with sphalerite, chalcopyrite, and pyrite. The mineralized bed is about 10 feet thick and is overlain by recrystallized limestone; the contact strikes north 40 degrees east and dips 35 degrees southeast. At 125 feet to the northeast on strike the mineralized bed has thinned to less than 1 foot.

Showing No. 2 is 250 feet northeast of No. 1 at 3,565 feet elevation. A bed of silicified limy quartzite about 3 feet thick is strongly mineralized with pyrrhotite and sparsely with sphalerite. The footwall is a similar highly siliceous but finer-grained rock lightly mineralized with both pyrrhotite and sphalerite. The contact strikes north 15 degrees east and dips 50 degrees southeast. The hangingwall side is quartz gabbro.

Showing No. 3 is 1,700 feet northeast of No. 2 at 3,660 feet elevation. The rock is exposed in a vertical face about 20 feet high; at the top the rock is further exposed by stripping. Interbedded recrystallized limestone and gneiss are tightly folded on axes striking north 35 degrees east, and boudinage structure of limestone fragments in gneiss is common. The principal mineralization is in a rusty zone exposed on the vertical face. Sphalerite, galena, and chalcopyrite are concentrated along fractures having the following attitudes: Strike north 25 degrees west, dip 82 degrees northeast; strike north 80 degrees west, dip 85 degrees south; and strike north 15 degrees east, dip 45 degrees northwest. Pyrrhotite is prominent but bears no apparent relationship to this fracturing. A fracture striking north 18 degrees west and dipping 80 degrees southwest contains pyrrhotite only, but its relationship to the other fractures is not known.

Showing No. 4 is 350 feet northeast of No. 3 and at 3,665 feet elevation. A bed of silicified quartzite in contact with pegmatite is exposed for a width of about 20 feet. In the hangingwall a band of gneiss is separated from the quartzite by a tongue of pegmatite. A thin limestone bed within the quartzite strikes north 39 degrees east and dips 85 degrees northwest. The quartzite is mineralized with

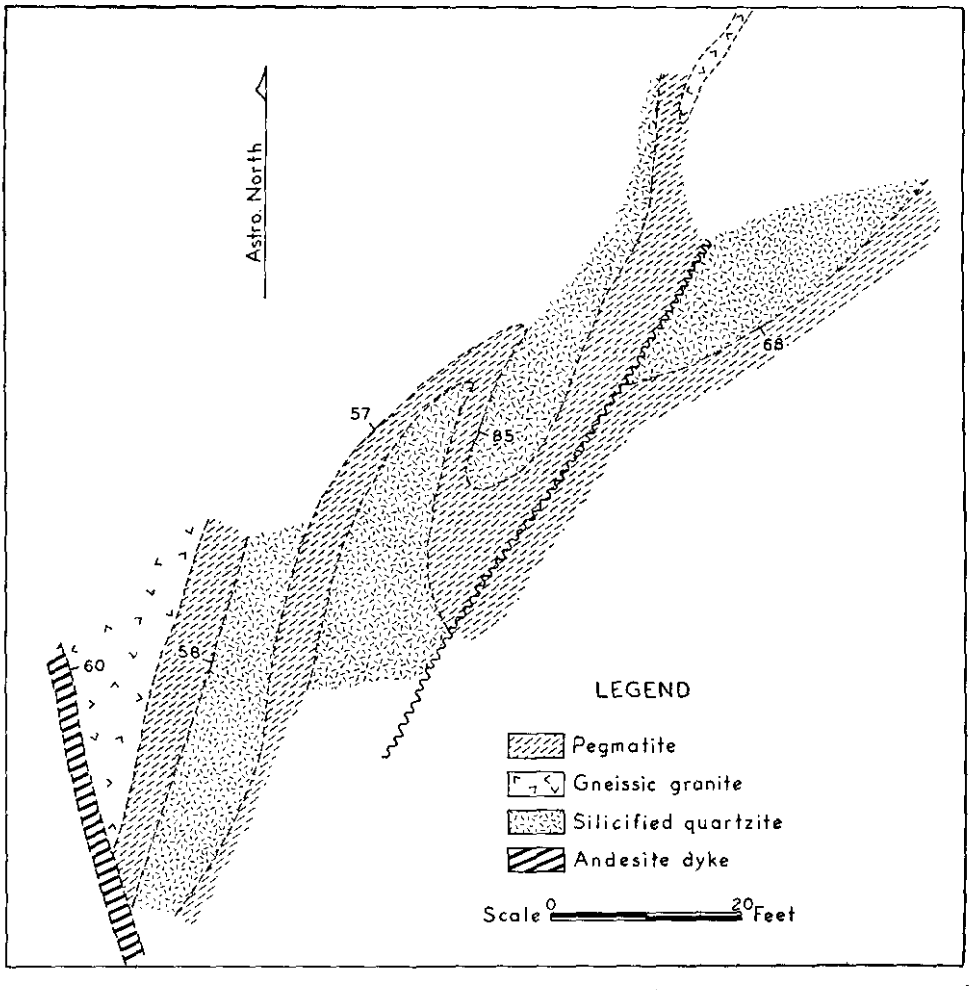


Figure 12. Bright Star Trio. Geology at main showing.

sphalerite, galena, and chalcopyrite; most of the sulphides are in and near a narrow zone of fracturing striking north 40 degrees west and dipping 65 degrees southwest.

Showing No. 5 is the principal one and is illustrated by Figure 12. It is 250 feet northeast of No. 4 at an elevation of 3,730 feet. The showing consists of a fold-like structure in a highly silicified rock consisting of quartz with remnants of diopside and a few grains of zoisite. The silicified rock is intruded by a body of pegmatite. On the western side the pegmatite is in contact with a gneissic biotite granite containing red garnets. An andesite dyke striking north 15 degrees west and dipping 65 degrees northeastward cuts all the other rocks. The fold-like structure is offset by a northeast-striking zone of discontinuous fractures which dip nearly vertical. The sphalerite-galena-chalcopyrite mineralization is confined to the quartz-diopside rock and is best developed in and near the apices of the folds. Pyrrhotite is minor in amount but appears to be confined to the same rock as the other sulphides.

The bearing of a line joining showing No. 1 to showing No. 5 is north 30 degrees east, in general parallel to observed bedding. There is no good evidence that the mineralization follows any one horizon aside from the major one of the carbonate member itself. It is possible, in view of the tight folding and the quite consistent association of the zinc-lead-copper mineralization with fractures, that the occurrences are on a zone of movement which has its principal expression in the tight folds. Such a zone would have a width of at least 400 feet if all five mineral showings were assumed to be included in it.

Pyrrhotite is of common occurrence, but it does not appear to bear any direct relationship to the distribution of other sulphides, save that in nearly massive bodies of pyrrhotite there are almost invariably no other sulphides. This would have a bearing on the application of magnetic survey methods.

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

(50° 118° N.W.) Company office, 1150 Bay Avenue, Trail. This property consists of 65 recorded claims in the Mabel Lake area. Access is by the logging-road that passes the Bright Star property. The claims lie on the east fork of Kingfisher Creek at an elevation of 2,600 feet. In 1964 a magnetometer survey accompanied by geological mapping was carried out. Four diamond-drill holes totalling 370 feet were drilled. A crew of two men was employed under the direction of R. G. Gifford.

OLIVER

Gold-Silica

Smuggler*

(49° 119° S.W.) Mine office, Box 106, Okanagan Falls. This property, of seven recorded claims and the leased Powis Crown-granted claim, lies just west of the golf course, about 4 miles southwest of Oliver. Trenching along the strike of the exposed vein was continued to an approximate depth of 8 feet. About 20 tons of ore has been hand-cobbed and stockpiled for shipment to Trail. In October, 1964, this property was sold by the owner, K. G. Ewers, to World Wide Development Company, Toronto. A diamond drill was placed on the property and several holes drilled; results were not available. Two men were employed on the property under the direction of Mr. Ewers.

* By David Smith.

Susie* (49° 119° S.W.) Mine office, Box 106, Okanagan Falls. Operator, K. G. Ewers. The Susie Crown-granted claim is under lease from Fairview Mining Company, Wallace, Idaho. Mining is carried out on the surface. Ore is a siliceous quartzite carrying low gold and silver values. Approximately 1,211 tons has been shipped to the Trail smelter as a flux. Access is by good mining-road 7 miles to the west of Oliver. Two men were employed under the direction of Mr. Ewers.

OSOYOOS

Copper-Molybdenum

Gem, Dividend-Lakeview* (49° 119° S.E.) The Gem group, consisting of 14 recorded mineral claims, 3 mineral leases, and the Gem Crown-granted claim, is owned by Kenneth Butler, R.R. 1, Osoyoos. It is situated about one-half mile west of Osoyoos Lake near the International Boundary. The option held by Sheep Creek Mines Limited was dropped. Work in 1964 consisted of trenching and some surface exploration. Two men were employed under the direction of Mr. Butler. (*See* Annual Report, 1963, pp. 65–67.)

BEAVERDELL

Silver-Lead-Zinc

Highland-Bell (Mastodon-Highland Bell Mines Limited)* (49° 119° S.E.) Company office, 502, 1200 West Pender Street, Vancouver 1; mine office, Beaverdell. K. J. Springer, president; O. S. Perry, manager; A. Zelmer, mine superintendent. The property consists of 32 Crown-granted and 4 recorded claims. Production for 1964 was obtained from the 2850, 2900, and 3000 levels, the main haulage being the 2900 adit. Development work underground has been continuous on all levels. In 1964 normal production has been 95 tons per day, of which about 87 tons was put through the mill and the remainder was hand-picked and discarded as waste. A 6- by 6-foot ball mill was installed as an addition to the grinding circuit. The following is a summary of operations for 1964:—

	Ft.
Drifting and crosscutting	2,342
Raising	684
Diamond drilling	7,905

A total of 25,090 tons of ore was milled. Concentrates were shipped to Trail. An average crew of 49 men was employed, of whom 25 worked underground.

Copper

Van, Rocco Plata (Red Rock Mines Ltd.)* (49° 119° S.E.) This property of 16 recorded claims lies on the west slope of Mount Wallace. It is accessible by the Goat Peak road, a distance of 3 miles to the east of Beaverdell. Considerable bulldozing and surface exploration were carried out in 1964. The work was done under the direction of Minex Development Ltd., 310 West Hastings Street, Vancouver 1; F. J. Hemsworth, consulting engineer.

* By David Smith.

GREENWOOD

Copper

Cabin Group (Triform Mining Ltd.)* (49° 118° S.W.) Company office, 3837 Angus Drive, Vancouver 9. J. V. San Severino, president; Gordon Hilchey, project manager. The property consists of 71 claims held by record, 3 mineral leases comprising 4 former Crown-granted mineral claims, and 4 Crown-granted claims. The ground lies south and west of Boundary Falls, on the Osoyoos–Greenwood highway, and extends southward to the international boundary. The working area, about 3 miles south of Boundary Falls, is reached by a passable dirt road.

The property includes the old Sappho workings, which are now full of water. In the period 1916–18, 112 tons of ore shipped contained 197 ounces of silver and 13,580 pounds of copper.

Present work consists of diamond drilling at the Sappho workings to test a geomagnetic anomaly thought to lie at a depth of about 200 feet, beneath that of the early work. At the time of the writer's visit the required depth had not been reached by the drill.

The rocks exposed in the open cuts are altered andesite porphyry, gabbro, and amphibolite, which form part of a body of such rock some 600 feet wide and 1,200 feet long trending northeastward. The relationships of the three rock types are not clear, though the andesite porphyry appears to be the oldest.

Mineralization consists of pyrite and chalcopyrite and appears to be confined almost entirely to the amphibolite.

Work done in 1964 was 2,300 feet of trenching and 1,580 feet of diamond drilling.

Silver-Lead-Zinc

Skomac Mine (Ganda Silver Mines Ltd.)* (49° 118° S.W.) Company office, 405, 25 Adelaide Street West, Toronto, Ont.; mine office, Greenwood. T. J. Wilkinson, president; R. D. Bell, secretary; A. E. Edwards, mine manager; A. C. Howe, consultant. Early in 1964 this company acquired control of Skomac Mines Limited. The property is reached by 2½ miles of dirt road north from the Grand Forks–Osoyoos Highway on the west side of the bridge across Boundary Creek.

The mine area is underlain by black schistose Palæozoic argillites (*Geol. Surv., Canada,* Paper 65-1, p. 58). In the workings a mylonitic rock composed of quartz grains and scapolite in a talc matrix forms the hangingwall of the vein in the face of No. 4 adit, and a rock composed of anhedral scapolite in a talc matrix is exposed in No. 5 adit. A post-mineral porphyritic diorite dyke is exposed in No. 5 adit.

The deposit is a pinching and swelling quartz vein occupying a shear striking about north 35 degrees west and dipping about 60 degrees northeast. Locally the strike may vary as much as 10 degrees, and dips as low as 35 degrees occur in the workings. The shear is about 10 feet wide and the quartz has a maximum width of about 6 feet. The quartz is mineralized with pyrite, galena, sphalerite, and argentite. A polished section showed some very small spots of polybasite in the galena. Scarce chalcopyrite is found both as separate grains and as blebs in coarse pyrite. The writer was told that native silver has been seen in the vein.

The mine is developed mainly by No. 4 and No. 5 levels, which are 45 feet apart. No. 4 level is a drift some 400 feet long and No. 5 level is a drift about 115 feet long; the three higher adits are very short. In 1964 most work was done on No. 5 level. Ore shipments to the Trail smelter amounted to 530 tons.

* By N. D. McKechnie and P. E. Olson.

Underground work was stopped early in the fall, and later efforts were limited to diamond drilling from surface.

Copper

Iva Lenore (Silver Dome Mines Limited)*

(49° 118° S.W.) Company office, 821, 789 West Pender Street, Vancouver 1. Dennis Johnston, president; F. D. Stanley, secretary; R. E. Renshaw, engineer in charge of operations at Greenwood. The property consists of 41 recorded mineral claims and 3 mineral leases located south and west of Buckhorn Creek and about 1½ miles west of Greenwood. The mineral leases include the Iva Lenore and Tam O'Shanter (*see* Ann. Repts., 1921–22) former Crown-granted claims. The property is reached by the Haas Creek road, which leads southwestward from the Greenwood–Deadwood road at about 1 mile northwest of Greenwood.

In 1964 approximately 10 miles of road and 13,000 lineal feet of stripping were made by bulldozer and 6,118 feet of diamond-drill holes was drilled. Grid lines were cut and magnetometer and geological surveys were carried out. Stripping and drilling were chiefly at the Iva Lenore showings and northwestward toward the Tam O'Shanter.

The principal rock types are Knob Hill quartzose rocks, which are composed almost wholly of silica but which megascopically have the texture and appearance of recrystallized limestone; Knob Hill greenstones, which are epidotized and serpentinized basalts and andesites in which few of the original minerals are recognizable; and Nelson intrusives, which are grey medium-grained crystalline rocks that in thin-section are seen to be composed chiefly of secondary minerals, including talc, sericite, cordierite, calcite, chlorite, zoisite, and quartz.

The principal mineralization is in the Knob Hill greenstones. No sulphides were seen in the quartrose rocks. In the Nelson intrusive rocks, pyrite is occasionally prominent with or without quartz; chalcopyrite is very sparse; molybdenite, in quartz, is rare.

In the greenstones the mineralization is of two kinds—disseminated sulphides and quartz stringers containing sulphides. The disseminated sulphides are chalcopyrite, pyrrhotite, and pyrite. The quartz stringers contain molybdenite and sometimes also chalcopyrite. Occasional grains of molybdenite look like disseminations, but close examination shows them to be associated with threads of quartz. Native copper occurs in the greenstones. Hematite stringers are found in all of the rock types.

Where seen by the writer, on surface and in the cores from two drill-holes, mineralization is sparse, although the extensive rock alteration suggests that a more concentrated mineralization may be found.

PHOENIX

Copper-Gold-Silver

Phoenix Copper Company Limited†

(49° 118° S.W.) Company office, 1111 West Georgia Street, Vancouver 5; mine office, P.O. Box 490, Grand Forks. L. T. Postle, president; P. R. Matthew, manager; J. S. Kermeen, mine superintendent; G. Hingley, mill super-

* By N. D. McKechnie and P. E. Olson.
† By P. E. Olson.

intendent. The property consists of 117 mineral claims, of which 55 are Crown-granted, 48 are recorded, and 14 are held under five leases. Mining is by open-pit methods. The following table shows 1964 production:—

	Ore (Tons)	Waste (Tons)
Old Ironsides	675,562	2,576,103
Idaho	31,637	49,845
Snowshoe	10,970	*Nil*
Stemwinder	11,005	21,615
Totals	729,174	2,647,563

The majority of blast-holes are drilled with two Ingersoll-Rand drillmasters, one of which was purchased in 1964. Blasting is done with AN/FO, which is mixed on the property, and a minor amount of commercial slurry where holes are very wet. Loading is carried out by three diesel shovels with dipper capacities of 1½, 2½, and 4½ cubic yards. Hauling is done with 20- and 35-ton trucks.

The main Ironsides pit was extended to the planned perimeter and the floor of the pit was extended to the 10th bench, the first lift below natural drainage.

There were no major changes in the mill, which treated 686,267 tons of ore during 1964. A ventilation system was partially completed in the crushing plant, and a new front-end loader was purchased to handle ore stockpiled near the crusher bin.

The tailings-disposal area was enlarged, and a new 16-stage vertical turbine pump was installed to replace the pump used previously for water reclamation. Hydrocones are used at the tailings pond to facilitate dam-building. These machines remove sands from the tailings and pile this coarser material on the dams while the finer portion is removed to the main settling areas.

Concentrates are hauled by truck to Vancouver, for shipment to Japan.

The company employed 109 men, as follows: Open pit, 39; surface, 18; mill, 35; and staff, 17.

GRANBY RIVER

Copper

Franklin Camp (Franklin Mines Limited)*

(49° 118° N.E.) Company office, 1824, 355 Burrard Street, Vancouver; field office, Grand Forks. Northwest Ventures Ltd., The Buttle Lake Mining Company Limited, and Huestis Mining Corporation Ltd. hold equal interest in Franklin Mines Limited. Franklin Mines Limited holds 257 mineral claims in the Franklin Camp area, which is on the Granby River 40 miles north of Grand Forks.

The season's work, carried out by an average crew of 10 men, was under the direction of T. Lisle and P. Chilcott. Some 26.5 miles of new road was put in, followed by 672,000 square feet of stripping and trenching and the cutting of 32 miles of grid lines. Geological mapping, soil-sampling, and magnetometer surveys were carried out, followed by sampling of mineralized zones. Work was started in late May and continued to October 23, 1964.

McRAE CREEK

Lead-Zinc-Copper

Ajax (Christina Lake Mines Ltd.)*

(49° 118° S.E.) Company office, 325, 1155 West Georgia Street, Vancouver 5; field office, Christina Lake. The property is in Burnt Basin, between Texas Creek and McRae Creek on the east side of Christina Lake. It consists of the

* By P. E. Olson.

Galena recorded claim and the former Ajax Crown-granted claim held under mineral lease.

During August and September the company did some road-building and some bulldozer stripping along a contact between a skarn zone and granite. This work was followed by diamond drilling of favourable areas. The exploration programme was stopped in December.

Gold

Albion (Albion Mining Co. Ltd.)*

(49° 118° S.W.) Company office, Suite 3, Laudin Building, Castlegar. W. W. Schwartzenhauer, president and manager. During 1964 the Albion was under option to East Utah Mining Company, with C. D. Chisholm in charge of operations. The property consists of six Crown-granted mineral claims. It is on a height of land between McRae and Big Sheep Creeks at an elevation of 5,600 feet, 2½ miles by road south of Mile 25 on the Christina Lake–Kinnaird highway.

The main showing is on the Albion No. 2 mineral claim. It is a quartz vein which contains minor amounts of pyrite and galena and is exposed by cuts, drifts, and shafts over a length of several hundred feet.

East Utah Mining Company did some bulldozer stripping through deep overburden and located a quartz vein south of the former workings. Four hundred feet of diamond drilling was done in this area, followed by 35 feet of shaft which was driven at 30 degrees from horizontal. This shaft followed the exposed quartz vein but was abandoned and allowed to flood after the company ran into difficulties. Twenty-five tons of ore was sorted from the sinking operation and was shipped to the Trail smelter. Four men were employed by East Utah Mining Company from September to December.

The ownership of the Albion reverted to Albion Mining Company about December 15th.

ROSSLAND

Copper-Gold

Velvet (Mid-West Mines Limited)*

(49° 117° S.W.) In 1964 the company name was changed to Mid-West Mines Limited from Mid-West Copper & Uranium Mines Ltd. Of the 6,000,000 shares authorized for the new company, 1,339,085 shares have been issued. S. E. Cropper is chairman of the board of directors.

The property consists of 9 Crown-granted claims, 10 recorded claims, and 1 mineral lease. The mine and mill were operated during January, when 1,736 tons of ore was treated. At the time the mine was closed, R. LeFevre was in charge of the operation.

Molybdenum

Coxey (Torwest Resources (1962) Limited)†

(49° 117° S.W.) Company office, 404, 409 Granville Street, Vancouver 2; mine office, Rossland. W. E. Garnett, president; W. G. Hainsworth, consulting geologist in charge of operations. The Coxey group consists of 13 claims situated about 1 mile northwest of Rossland on Red Mountain and the valley of Little Sheep Creek.

The group, including the Coxey, Jumbo, and several other old Crown-granted claims, was acquired late in 1963. Geophysical surveys were run in January, 1964, and in March diamond drilling started on electromagnetic and magnetic anomalies

* By P. E. Olson.
† By P. E. Olson and M. S. Hedley.

on what was assumed to be the extension of the Rossland North Belt of veins. Some holes were later drilled on the presumed extension of the oreshoot on the Jumbo, a former gold-producer. Interest then shifted to a series of old surface workings on the Coxey claim in which molybdenite was known to be present.

Open cuts and pits on the Coxey are on a north 15 degrees west zone mineralized with iron sulphides and molybdenite. The rocks are fine-grained banded metamorphics of sedimentary origin, and include what are locally called tuffs.

Diamond drilling started in midsummer of 1964 on the Coxey zone along east-west lines 80 feet apart. From drill sites at 50-foot intervals along these lines, two holes were drilled, one vertical and one 30 degrees to the south, with the result that a mineralized block was outlined that extended to a depth of about 50 to 55 feet from the moderately sloping surface. In August a second zone was discovered, west of the first, and diamond drilling was done on it. The geological significance of the mineral zones is not apparent.

In October control of the property was turned over to Metal Mines Limited, who started a diamond-drill programme to check the results of the Torwest drilling. Thirty-four drill-holes put down by Metal Mines Limited on a 50-foot grid pattern are reported to confirm the presence of 350,000 to 400,000 tons of ore grading 0.57 per cent molybdenum sulphide.

Three drills were operated during the year by a contractor who employed an average of 14 men.

Molybdenum

St. Elmo (McKinney Gold Mines Limited)*

(49° 117° S.W.) Company office, 506, 540 Burrard Street, Vancouver 1; field office, Rossland. R. W. Hunstone, president; J. E. R. Wood, vice-president and managing director. This company holds options on the St. Elmo, Golden Queen, Surprise, and Gertrude Crown-granted mineral claims which adjoin the Coxey group of claims held by Torwest Resources (1962) Limited.

Geophysical surveys and soil-sampling were done during the fall. Diamond drilling was started late in 1964, using a hydraulic drill and AX core.

Gold

I.X.L.*—(49° 117° S.W.) J. A. Ruelle and Associates shipped 0.11 ton of high-grade ore from the I.X.L. to the Trail smelter. The I.X.L. Crown-granted mineral claim is 1½ miles west of Rossland.

Gold-Silver-Lead-Zinc

Sunset*

(49° 117° S.W.) This property is owned by Warren Crowe, of Trail, and consists of 22 recorded claims and the Sunset Crown-granted claim, on which most of the work was done. During early 1964, Utica Mines Ltd. had an option on this property. The option was dropped in the spring. The property is on the Canada-United States border, about 1 mile west of Paterson.

In January and February, Utica Mines Ltd. drilled 13 diamond-drill holes on the Sunset, totalling 2,911 feet. After the option was dropped, Mr. Crowe accumulated 7 tons of better-grade ore, which was shipped to the Trail smelter. This ore assayed as follows: Silver, 11.5 ounces per ton; lead, 7.1 per cent; zinc, 23.9 per cent.

* By P. E. Olson.

Mineralization occurs as lenses in steeply dipping fractures which strike east-west and vary in width from several inches to several feet. Later in the year Mr. Crowe had some bulldozer trenching done to the west of known vein outcrops.

TRAIL

Gold

W.D. (Columbia River Mines Ltd.)* (49° 117° S.W.) Company office, Suite 408, 470 Granville Street, Vancouver 2; mine office, Trail. James A. Farrell, president; H. McKenzie, mine manager. Capital: 6,000,000 shares, $1 par value. The property consists of 24 mineral claims situated on the west side of Columbia River, 5 miles south of Trail.

Drifting and crosscutting amounted to 350 feet and diamond drilling amounted to 739 feet in six holes. The No. 1 vein was explored over a length of 130 feet at an elevation of 2,020 feet, and for 125 feet along a sublevel at an elevation of 2,050 feet. Drifting along the No. 2 vein amounted to 25 feet by the end of 1964. Ore shipments to Trail amounted to 110 tons.

From July through to the end of 1964 a crew of four men operated the mine under the supervision of Andy Pompu.

NELSON

Silica

Holmes* (49° 117° S.W.) Bryan's Transfer Company Ltd., of Trail, shipped 107 tons of tailings from the old Ayerton Cohen mill site situated immediately southeast of Grohman Narrows on Kootenay Lake. This property is owned by Capt. W. L. H. Holmes, of Nelson. The tailings contain silica and minor amounts of silver.

YMIR

Gold

Goodenough* (49° 117° S.E.) This property consists of the Goodenough Fraction Crown-granted mineral claim and four recorded claims adjoining, situated on the north side of Wildhorse Creek, 6 miles by road from Ymir. The claims are owned by A. L. Weber, 147, 33—76th Avenue, Flushing, N.Y.

Adits on the Goodenough were retimbered and air and water lines were installed, but no actual mining had been done when operations were suspended due to lack of funds. Four men were employed for 3½ months under the direction of J. L. Hendricks.

SALMO

ERIE CREEK (49° 117° S.E.)

Gold

New Arlington* This property is leased by G. D. Fox, of Trail, from J. Russell, Borrega Springs, Calif. The property is on Rest Creek, 7 miles by road from Salmo. A new drive was put in on the Arlington vein on the Directorate mineral claim for a distance of about 100 feet, 60 feet below the 80 level. A total of 4,168 tons from the old dumps, containing 548 ounces of gold and with a high silica content, was shipped to the Trail smelter.

* By P. E. Olson.

SHEEP CREEK (49° 117° S.E.)

Gold-Silica

Gold Belt*

The Gold Belt mine is a former producer on Sheep Creek, lying north of the Queen and south of the Reno holdings. A. Endersby and sons, of Fruitvale, worked the property and shipped a total of 115 tons of ore grading about 0.58 ounce per ton of gold and containing sufficient silica to cover smelting charges. About 35 tons of ore came from the lower workings and the remainder was removed from a pillar in a surface open cut.

Silica

Kootenay Belle*

The Kootenay Belle mine is on Sheep Creek, 9 miles by road from Salmo. Old dumps which were left when the mine closed down have become commercial because silica is purchased for fluxing at the Trail smelter. The dumps also contain minor amounts of gold. Bryan's Transfer Limited, of Trail, shipped 6,098 tons of dump material to the trail smelter. A front-end loader and tandem trucks were used.

Gold-Silica

Queen*

The Queen mine is situated on the south side of Sheep Creek, about one-half mile southeast of the old town of Sheep Creek. A. Endersby and sons recovered 42 tons of silica-gold ore from the edge of the glory-hole, which they shipped to the Trail smelter.

ASPEN CREEK (49° 117° S.E.)

Lead-Zinc

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

Company office, Trail; mine office, Salmo. D. S. Campbell, property superintendent; R. R. McMichael, mine superintendent; P. Conder, mill superintendent. The H. B. mine is on the west side of Aspen Creek, with the main camp on the north side of Sheep Creek, 7 miles by road from Salmo. The ore occurs as galena-sphalerite-iron replacement of dolomite. About 73 per cent of ore production came from the No. 1 orebody, in which the ore is mined by long-holing from sublevels located on the ore boundaries and is scraped to ore-passes from draw points in scram drifts. The total long-hole footage for the year was 66,703 feet, a drop of 11 per cent from the long-hole footage of 1963. The X-1, X-2, and X-4 orebodies, which are flat-lying offshoots from the No. 1 orebody, produced 27 per cent of the mine production. Mining of these flat orebodies is done with jacklegs, which are used to bench and slash the ore. Weaker zones of mineralization are left for roof support in the flat orebodies. Vertical rib pillars are left between stopes in the No. 1 orebody. These are eventually removed by long-hole methods when stoping is finished. Development footages were as follows:—

	Ft.
Drifting and crosscutting	1,521
Sublevels	2,732
Raising	2,086

Underground diamond drilling was 3,762 feet and surface diamond drilling was 6,802 feet. Development of the Garnet zone of mineralization was started during the year, by raising up from the main haulage level (2800 level).

Of the total consumption of explosives, AN/FO, manufactured at the company plant at Kimberley, amounted to 82 per cent, and regular explosives 18 per cent.

* By P. E. Olson.

Ore production amounted to 477,800 tons, all of which was milled.

A new electrical substation was built on the 2800 level to supply power to the south end of the mine. Development waste was used to backfill some sections of the flat stopes, while the remainder of the waste went to the 2800 level waste dump.

The company entered a mine-rescue team in the West Kootenay Mine Rescue Competition, which was held in Nelson.

The working force at the H.B. mine was 121 men and women, 93 of whom were hourly paid employees.

IRON MOUNTAIN (49° 117° S.E.)

Lead-Zinc

Jersey (Canadian Exploration Limited)*

Head office, 700 Burrard Building, Vancouver; mine office, Salmo. C. E. Brown, mine manager; J. W. Robinson, mine superintendent; B. Wilson, mill superintendent. This company is a wholly owned subsidiary of Placer Development Limited. The property is reached by two roads which leave the Salmo–Creston highway 4 and 6 miles respectively south of Salmo, the north (Emerald) road being the main access road. The lead-zinc concentrator is beside the Salmo–Creston highway, at the junction with the south (Jersey) road. Ore is transported to the mill by a conveyor system from the underground crusher at the mine. The mine, offices, and camp are located on the summit between Sheep Creek and Lost Creek.

All production came from the Jersey lead-zinc mine. The ore occurs in relatively thin, gently dipping beds of dolomite and is a pyrite, galena, and sphalerite replacement type of deposit. Mining is done by conventional room and pillar open stoping, using jacklegs and slushers. Broken ore is loaded and hauled to the crusher pocket by trackless diesel-powered equipment. Mine production totalled 411,605 tons, being 409,018 tons from stoping, 1,735 tons from the open pit, and 852 tons from pillar recovery.

The mill treated 407,062 tons of ore. The lead concentrates and approximately one-third of the zinc concentrates were shipped to the Bunker Hill smelter at Kellogg, Idaho; the balance of the zinc concentrates were shipped to the Trail smelter.

Development consisted of 10,363 feet of drifting and crosscutting, 724 feet of raising, and 17,560 feet of diamond drilling. This programme resulted in increased ore reserves and subsequently the temporary suspension of the pillar-recovery programme.

AN/FO blasting agent constituted 71 per cent of the total explosives used.

During the year 187 persons were employed by the company, 137 of whom were paid by the hour. The company entered a mine-rescue team in the West Kootenay Mine Rescue Competition held in Nelson.

NELWAY

Lead-Zinc

Reeves MacDonald Mines Limited*

(49° 117° S.E.) Company office, 410 Metropolitan Building, 837 West Hastings Street, Vancouver 1; mine office, Remac. L. M. Kinney, general manager; F. R. Thompson, mine manager; W. Pollock, mine superintendent; J. M. McDearmid, mill superintendent. Capital: 3,000,000 shares, $1 par value. The Reeves MacDonald mine is on the north side of the Pend d'Oreille River, on the Nelway–Waneta road, 4 miles west of Nelway. Mineralization consists of galena,

* By P. E. Olson.

sphalerite, and pyrite replacement in the Reeves limestone. Orebodies have been developed by the 1900 level main haulage and internal shafts, the deepest of which nearly reaches sea-level.

The property resumed normal production on January 9th following a strike that lasted most of 1963 and was settled on December 20, 1963.

Most of the ore production comes from long-hole stopes, from which ore is scraped to ore-passes from draw-holes located along scram drifts at the bottom of the stopes. One stoping method employs parallel down-holes drilled from sublevels which are first slashed to ore extremities prior to the long-hole drilling. This method supplies most of the total mine tonnage. Where ground conditions are uncertain, sublevels are driven along the edge of the orebodies and fans of long-holes are drilled from these levels. In both of these techniques a vertical slot is cut across the ore zone to provide a free face for initial stope blasts. In 1964 long-hole drilling amounted to 50,566 feet of 2⅛-inch hole and 24,647 feet of 3-inch hole, using tungsten carbide bits and extension steel driven by percussion machines.

Exploration and development resulted in the advances tabulated hereunder:—

	Ft.
Raising	3,094
Drifts and crosscuts	5,244
Test-hole drilling	4,416
Diamond drilling (underground)	7,050
Diamond drilling (surface)	2,664

A ventilation raise, which was driven parallel to No. 3 shaft, was completed during 1964. This was rendered necessary by a 79-per-cent increase in production from below the 1900 level in 1964.

Mining produced 397,269 tons of ore, all of which was milled in 1964. Lead and zinc concentrates were shipped to the smelter at Kellogg, Idaho. The company employs 117 men, 93 of whom are paid on an hourly basis.

SUMMIT CREEK

Gold

Bayonne (Bayonne Mine Ltd.)*

(49° 116° S.W.) Company office, 404, 409 Granville Street, Vancouver 2. W. E. Garnett, president; W. G. Hainsworth, consulting geologist in charge of operations. The property consists of 25 recorded and 17 Crown-granted mineral claims situated near the head of Bayonne Creek. The mine is reached by 5.6 miles of road that leaves the Creston–Salmo highway 4.7 miles east of the summit.

Some rehabilitation work was done near the portal of No. 8 level on the "A" vein, and underground sampling was done around old stopes in 1964. Surface construction was done, and the bunk-house and fine-ore bins were finished. Six men were employed under the supervision of Maurice Mathieu.

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. J. B. Donald, property superintendent; A. Richardson, mine superintendent; T. F. Walton, mill superintendent. The mine is at Riondel, on a small peninsula on the east shore of Kootenay Lake, 6 miles north of Kootenay Bay. A paved road connects Riondel to the Southern Trans-Provincial highway. The mine is serviced mainly by the No. 1 shaft, inclined at

* By P. E. Olson.

—35 degrees, which is in the footwall of the ore zone. Levels, which are at 150-foot intervals, service the Kootenay Chief zone on the south, with No. 2 and No. 5 levels extending north to the Bluebell and Comfort zones.

Mining is done by open-stope and cut-and-fill methods. The latter employs deslimed tailings which are pumped from the mill to the backfill areas via 4-inch plastic pipes. A total of 78,000 cubic yards of backfill was placed in this manner. The ore, which is a galena-sphalerite-pyrrhotite replacement in limestone and dolomite, is slashed with jacklegs and scraped to mill holes or chutes. The ore zones are irregular and quite rich, so they are mined selectively. All hoisting of ore is done with special skips in the No. 1 shaft.

Total development footages were as follows:—

	Ft.
Comfort zone	1,800
Bluebell zone	5,500
Kootenay Chief zone	5,600
Total	12,900

Thermal conditions are frequently encountered, mainly in development headings, with production of carbon dioxide gas and hot water containing a high percentage of dissolved mineral. These conditions have necessitated the installation of high-capacity pumping-stations and ventilation fans. The Comfort zone ventilation was improved by the installation of a 25,000-cubic-feet-per-minute fan on the surface, which is downcast. A start has been made on a new ventilation system for the north end of the mine. This is to be put into operation in 1965 and will downcast an additional 100,000 cubic feet per minute into the mine. At the end of 1964 the ventilation capacity of the entire mine was about 200,000 cubic feet per minute. Regular tests are made of the mine air, and special additives are put into the mine water to prevent a build-up of scale in the rising mains. Stand-by units can be energized, and ventilation and pumping reactivated, from surface controls in less than 60 seconds. Underground grouting consumed 4,600 sacks of cement and has reduced the flow of carbon dioxide and thermal water on No. 8 level.

Production amounted to 257,871 tons of ore, all of which was milled. Concentrates are loaded onto railway cars, which are transported by barge to Procter and thence by rail to the Trail smelter.

Mine-rescue and first-aid classes are well attended. Two teams competed in the West Kootenay Mine Rescue Competition and placed first and second. The team captained by Ben Ramage came second in the Provincial competition held in Kamloops.

Employment at the operation is as follows: Staff, 40; surface, 32; mill, 15; underground, 129; total, 214.

Silver-Lead-Zinc

Richard First.*—This Crown-granted mineral claim is owned by Richard S. Dean, Box 1358, Rossland, and is situated at Deanshaven, 2 miles north of Kootenay Bay on the east side of Kootenay Lake. Wayne Turley and Terry Bunt, of Nelson, worked the property and shipped 32 tons of sorted ore to the Trail smelter.

* By P. E. Olson.

AINSWORTH (49° 116° N.W.)

Silver-Lead-Zinc

Krao*

The Krao Crown-granted mineral claim is 3 miles west of Ainsworth and is reached by a road that leaves the highway at Ainsworth. The property is under lease to T. Lane, of Ainsworth, who worked it during the summer months with the help of D. Curry. A back-hoe was used to strip a vein which outcrops along Krao Creek about 500 feet south of the Krao mine. Ore shipped to the Trail smelter, totalling 45 tons, assayed: Silver, 6.3 ounces per ton; lead, 8.9 per cent; and zinc, 8.3 per cent.

Black Diamond.*—The Black Diamond Crown-granted mineral claim is 2 miles west of Ainsworth. During the summer of 1964 T. Lane and D. Curry leased the property and shipped 6 tons of ore to the Trail smelter. The shipment assayed: Silver, 55.0 ounces per ton; lead, 26.9 per cent; and zinc, 7.2 per cent.

Triumph (Blue Star Mines Limited)*

Company office, 400, 837 West Hastings Street, Vancouver 2; mine office, Ainsworth. E. L. Borup, managing director; C. Lind, mine manager. The property is situated to the south of Lendrum Creek, about 3 miles by road from the Balfour–Kaslo highway. In 1964, No. 7 level, which is the old Silver Glance adit with portal on Lendrum Creek, was extended 140 feet. No. 6 level, 1,500 feet to the southeast and about 400 feet above No. 7 level, was reopened and prepared for mining. From above the No. 6 level, 2,400 tons of ore was stoped. About 1,300 tons of this ore was shipped to a stockpile near the Yale mill at Ainsworth.

The Yale Lead & Zinc Mines Limited mill was purchased in 1964, and rehabilitation work commenced at the year-end with a view to treating Triumph ore. At the end of 1964 Blue Star Mines Limited employed nine men.

Woodbury Creek (49° 117° N.E.)

Gold-Silver-Lead-Zinc

Scranton (Blue Star Mines Limited)*

The Scranton mine was held under lease by Blue Star Mines Limited. Company office, 400, 837 West Hastings Street, Vancouver 2; mine office, Ainsworth. E. L. Borup, managing director; C. Lind, mine manager. Capital: 3,000,000 shares, no par value; 2,058,000 issued. On the Pontiac 260 feet of drifting was done to extend the lowest level well beneath areas stoped in 1953, but no ore was encountered. On the Scranton 687 feet of diamond drilling was done from the surface. Seven men were employed from July to October.

Silver-Lead-Zinc

Sharon*

The Sharon group of recorded mineral claims is located on the north side of Woodbury Creek, about 3 miles from the Ainsworth–Kaslo highway. These claims are held by T. D. Logan and Associates, of Nelson. A shear zone which crosses the claims strikes approximately north-south and dips steeply to the west and is referred to locally as the " soft lead." A minor amount of surface stripping was done on this property in 1964 and 3 tons of ore was shipped to the Trail smelter.

* By P. E. Olson.

KEEN CREEK

Silver-Lead-Zinc

Cork Province (London Pride Silver Mines Ltd.)* (49° 117° N.E.) Company office, 611, 850 West Hastings Street, Vancouver 1; mine office, Kaslo. J. H. Greenwood, president; H. M. Burns, secretary-treasurer; D. Davidson, mine manager. Capital: 5,000,000 shares, 50 cents par value. The property consists of nine mineral claims situated on the east side of Keen Creek, 6 miles from the Kaslo–New Denver highway. The mine is developed from the No. 3 level, which serves as a main haulage. There are two levels above and five levels below No. 3, those below being serviced by a vertical internal shaft. The property was idle since 1953, and the levels below No. 3 level were flooded during that time. In 1964 London Pride Silver Mines Ltd. obtained an option from Base Metals Mining Corporation Limited to buy the property. The terms of the option are $10,000 per year or 50 cents per ton milled, whichever is greater, over a period of 10 years.

Unwatering of the lower workings began in June, and was completed in early September. General mine sampling was followed immediately by development and stoping, and shortly by milling. The lower parts of the mine were partially developed prior to shut-down in 1953, so very little dead work was necessary in order to start production. Development and stoping were confined to the lower three levels, with most production coming from the 701 and 760 stopes. Development amounted to 297 feet of drifts and crosscuts and 175 feet of raising. Production, which includes development and exploration tonnages, amounted to 5,432 tons, all of which was milled. Tramming on No. 3 level is done with four Granby cars and a diesel locomotive.

The mill produced 171 tons of lead concentrates and 526 tons of zinc concentrates under the direction of Harvey McIntyre, mill superintendent. The concentrates were trucked to the Trail smelter under contract. Forty men were employed by the company, some of whom lived in the camp at the mine.

Zinc

Elna* (49° 116° N.W.) The Elna recorded mineral claim is at the old Canadian Pacific Railway station of Zwicky, near the confluence of Kaslo and Keen Creeks. Wayne Turley, of Nelson, recovered 6 tons of zinc concentrate which had been spilled while being transferred from trucks to Canadian Pacific Railway cars. These concentrates were shipped to the Trail smelter.

KASLO

Silver-Lead-Zinc

Utica (Lamint Mining Corporation Ltd.)* (49° 117° N.E.) Company office, Kaslo. W. W. Tyler, managing director. Lamint Mining Corporation has a lease on the Utica mine from Lajo Mines Limited. The property consists of 17 claims situated near the head of Twelve Mile Creek, about 15 miles west of Kaslo. The property is serviced by a road which leaves the Kaslo–New Denver road 11 miles from Kaslo. Mining commenced on August 16th and terminated on October 31st. The mill was operated on an intermittent basis. During the period of operation 1,590 tons of ore was produced, 1,000 tons of which was old backfill and dump rock. Some stoping was done along the walls of previously mined areas on No. 4 level.

The mill treated the entire mine production and produced 39 tons of lead concentrates and 120 tons of zinc concentrates. Metal content: Gold, 6 ounces;

* By P. E. Olson.

silver, 12,104 ounces; lead, 29,598 pounds; zinc, 133,932 pounds; cadmium, 800 pounds. All concentrates were shipped to the Trail smelter. A crew of nine men operated the mine and mill.

RETALLACK-THREE FORKS

Silver-Lead-Zinc

Charleston (Buchanan Mines Ltd.)*

(50° 117° S.E.) Company office, 15816—112th Avenue, Edmonton. The name of the company was changed from Corean Mines Ltd. to Buchanan Mines Ltd. in 1964. During the summer considerable road work and surface stripping were done with a D-7 bulldozer, mainly on the Charleston Crown-granted mineral claim. This work was followed by 500 feet of diamond drilling which was laid out to intersect known lode structures. Work was terminated early in September.

London, Panama (Vimy Explorations Ltd.)*

(50° 117° S.E.) Company office, 404, 409 Granville Street, Vancouver 2. R. Falkins, secretary; W. G. Hainsworth, consulting geologist. Capital: 5,000,000 shares, 50 cents par value. The property consists of 13 mineral claims on the southeast slope of London Ridge, north of Bear Lake. The access road to the property was cleared and a camp set up at 6,500 feet elevation. This was initially serviced by ground vehicles and later by helicopter as heavy snows closed the road. From a point 82 feet vertically below the original adit, 425 feet of crosscut was driven. This crosscut did not intersect any vein material before the project was shut down due to severe winter conditions, although the drive was only 50 feet from the downward projection of the lode. The work was carried out by a contractor who employed an average of six men.

Jo Jo*

(50° 117° S.E.) The Jo Jo is on the east side of Kane Creek, 3 miles from Three Forks and immediately north of the McAllister mine. Frank Mills and Joe Hambly worked on the property under the direction of Fred Hemsworth and associates, who have an option on the property. The road to the Jo Jo was repaired, the surface buildings reroofed, and the No. 3 portal retimbered. Work was carried out over a three-month period in the summer.

Antoine (Antoine Silver Mines Limited)*

(50° 117° S.E.) Company office, 114 West 15th Street, North Vancouver; mine office, Kaslo. W. Bandeen, president; T. Merrifield, secretary; W. E. Selnes, mine manager, The company was incorporated in the summer of 1964 following completion of an agreement with L. N. Garland, the previous owner. The property consists of the Antoine group of five Crown-granted and three recorded mineral claims. The Soho group of eight Crown-granted mineral claims is held under an option agreement. The property is reached by 9 miles of road, which leaves the Kaslo–New Denver highway 3 miles east of Three Forks. The main camp is at an elevation of 7,000 feet.

Prior to the inception of the public company, L. N. Garland shipped 9 tons of sorted high-grade ore that had been mined during 1963.

Antoine Silver Mines Limited drove 510 feet of drift and crosscut on No. 5 level in 1964, and disclosed one section of ore over a length of 125 feet, 90 feet

* By P. E. Olson.

southeast of the former face of the main crosscut. This oreshoot is called the Ogema vein and lies about 250 feet southwest of the oreshoot on the Antoine vein (*see* Annual Report, 1963, p. 75). The mine was being operated during the winter from a good camp, and six men were employed at the end of the year.

Washington (Larch Mining Limited)*

(50° 117° S.E.) Company office, 509, 626 West Pender Street, Vancouver 2; mine office, New Denver. Alfred Pegg, president and manager. Capital: 100,000 shares, no par value, 44,047 issued. Larch Mining Limited has sub-leased the Washington from Adrian Kesler, who in turn has a four-year lease from Washington Mines Ltd. The property is situated on the south side of McGuigan Creek at an elevation of about 6,000 feet and is serviced by the Rambler–Antoine road that leaves the Kaslo–New Denver highway 3 miles east of Three Forks.

In July a small bulk flotation mill was installed on the property to treat dump material. While operating, the plant treated about 40 tons of ore. Underground sampling was carried out along the perimeter of old stopes between No. 2 and No. 3 levels. The company employed four men during the summer months.

SANDON

Silver-Lead-Zinc

Victor (Violamac Mines Limited)*

(49° 117° N.E.) Company office, 416, 25 Adelaide Street West, Toronto; mine office, New Denver. A. W. White, president; J. C. Black, manager. The Victor mine is 2½ miles by road southeast of Three Forks. During 1964 the operation of the Victor mine was limited to two lessees, J. Stewart and E. Anderson, who mined above No. 4 level, and L. Fried and J. DeRosa, who mined on No. 5 level. Production is shown in the following table:—

	No. 4 Level	No. 5 Level
Crude ore shipped (tons)	19	10
Crude ore milled (tons)	380	132
Gross metal produced—		
Gold (oz.)	10	2
Silver (oz.)	14,292	3,667
Lead (lb.)	95,933	25,092
Zinc (lb.)	73,422	49,001
Cadmium (lb.)	466	310

Milling ore was treated at the Carnegie mill near Sandon, on a custom basis.

Hinckley*

(49° 117° N.E.) The Hinckley Crown-granted mineral claim is situated on the southwest side of Carpenter Creek, about midway between Sandon and Three Forks. During 1964 the property was operated by a syndicate of five local men. W. D. Pengelly was in charge of operations. The lower adit of the Hinckley, which is collared 200 feet east of the eastern claim boundary, was extended 120 feet. Scattered amounts of galena mineralization were encountered in the new work and several tons of shipping ore was accumulated by hand-sorting. Two men were employed for part of the year.

Idaho*

(49° 117° N.E.) The Idaho Crown-granted mineral claim is situated near the peak of Idaho Mountain and is reached by road past the Queen Bess mine. The claim is under lease

* By P. E. Olson.

to M. Tarnowski and J. Nesbitt, of Silverton, who worked the property on a casual basis. In September a shipment of 3 tons of selected high-grade ore was made to the Trail smelter.

Wonderful (Silver Ridge Mining Company Limited)*

(49° 117° N.E.) Company office, 373 Baker Street, Nelson; mine office, Sandon. R. A. Grimes, managing director; Ted Kleim, mine manager. The property is about 1 mile west of Sandon on the Idaho Peak road. The mine is developed by four adits, the first two of which were driven in early days to prospect for the source of high-grade float found on the Wonderful Crown-granted mineral claim. The No. 2 level was extended a further 620 feet during 1964, with no mineralization encountered. The crew consisted of three men, who worked under the direction of Mr. Kleim, of Sandon.

Silversmith, Richmond-Eureka, etc. (Carnegie Mining Corporation Limited)*

(49° 117° N.E.) Company office, 416, 25 Adelaide Street West, Toronto; mine office, New Denver. A. W. White, president; J. C. Black, manager. Capital: 5,000,000 shares, no par value. This company is controlled by Violamac Mines Limited. The property consists of 46 Crown-granted and 6 recorded mineral claims, all situated immediately southwest of Sandon. Subsequent to the cessation of operations by Silmonac Mines Limited, Carnegie Mining Corporation Limited explored below the old Ruth workings. From the inner face of the original No. 5 level a drill station was established at the end of a new crosscut 197 feet long. Some 2,359 feet of diamond drilling done from this point failed to disclose a downward extension of the Ruth lode, and operations were suspended in December.

During 1964 the Carnegie mill treated a total of 1,018 tons of ore on a custom basis under the supervision of K. Gordon, mill superintendent. This ore came from the Silversmith, Slocan Star, and Victor properties.

Rabbitt Paw Section.—E. Perepolkin and J. Irwin, of New Denver, leased an area immediately above No. 10 level. They extracted a total of 455 tons of ore from the old workings. Of this total, 10 tons was shipped to the Trail smelter and the remainder was milled on a custom basis at the Carnegie mill at Sandon. Gross content in ore and concentrates: Gold, 2 ounces; silver, 3,923 ounces; lead, 40,143 pounds; zinc, 58,577 pounds; cadmium, 386 pounds.

Slocan Star Section.—Under lease, L. Fried and E. DeRosa, of New Denver, produced from old dumps and surface stripping 60 tons of mill feed and 7 tons of shipping ore. Gross metal content in ore and concentrates: Gold, 0.5 ounce; silver, 829 ounces; lead, 7,994 pounds; zinc, 21,269 pounds; cadmium, 136 pounds.

Silmonac (Silmonac Mines Limited)†

(49° 117° N.E.) Company office, 808, 602 West Hastings Street, Vancouver 2; mine office, New Denver. Finances for this company are supplied by Oil Participations Incorporated (13.6 per cent), Silver Standard Mines Limited (28.8 per cent), Moneta Porcupine Mines Limited (28.8 per cent), and Violamac Mines Limited (28.8 per cent). Violamac Mines Limited continues to supply direction for Silmonac; J. C. Black, manager. The property consists of 69 Crown-granted claims lying west of Sandon.

Access to the Silmonac workings is through Carnegie-held ground, along the Ruth No. 5 level. This level was extended 1,040 feet during 1964, and 321 feet of raising was done to explore lode strands discovered while drifting. Considerably

* By P. E. Olson.
† By P. E. Olson and M. S. Hedley.

more " porphyry " was encountered than was understood to occur from knowledge of the areal geology. As is the general rule in this part of the Slocan, the lode does not represent a single fissure but appears to result from complex adjustment along a zone of movement. Diamond-drill stations were cut and 5,015 feet of drilling was done to explore the vein structures and look for new mineralized zones. No commercial amounts of ore were located, and the operation was shut down for the winter on December 15th. An average of 10 men was employed. (*See* Ann. Rept., 1963, p. 76.)

Reco (Reco Silver Mines Limited)*

(49° 117° N.E.) Company office, 645 Hornby Street, Vancouver 1; mine office, Sandon. S. E. Cropper, president; S. D. Anfield, secretary. Capital: 5,000,000 shares, $1 par value. The property consists of 26 Crown-granted claims and 5 recorded claims situated immediately northeast of Cody. Work done on the Reco during 1964 includes the rehabilitation of four adit portals, cutting of 18,000 feet of base-line and cross-lines, and the taking of 250 soil samples. The perimeter of the holdings was tied in by survey.

A crew of four men worked for the company for a period of four months, under the direction of W. S. Ellis, engineer in charge.

Deadman*

(49° 117° N.E.) The Deadman lode, part of the Noble Five property at Cody, is held under lease by L. Fried, of New Denver. During 1964, Mr. Fried shipped 9 tons of ore, grading 26 per cent lead and 58 ounces per ton silver, which he hand-sorted from old dumps. Several tons of milling ore was accumulated during the hand-sorting operation.

Shady*

(49° 117° N.E.) The Shady recorded mineral claim is about 1 mile east of Cody, on Carpenter Creek. N. Sibilleau, of Rossland, did some bulldozer stripping, which uncovered boulders of lead-zinc mineralized material. This material was hand-sorted, and 7 tons was shipped to the Trail smelter.

SLOCAN LAKE

Silver-Lead-Zinc

Hecla, Mammoth, Standard (Johnsby Mines Limited)†

(49° 117° N.E.) Company office, 1011, 2200 Yonge Street, Toronto 12; mine office, Silverton. J. C. Byrne, president; R. C. Phillips, mine manager; R. T. Avison, mine superintendent. Capital: 3,500,000 shares, $1 par value. This company was formed in 1962 as a result of an agreement between Western Exploration Company Limited, Rayrock Mines Limited, and Faraday Uranium Mines Limited. Work was confined to the Hecla drift, which is 3,300 feet long on the course of the Standard-Mammoth lode. The drift was not extended, but 4,764 feet of diamond drilling was done to investigate the lode, which had not been followed continuously by the drift. In addition, 960 feet of drifting and crosscutting was done and 250 feet of raising. Three oreshoots, ranging from about 100 to 150 feet long, were encountered, and stopes were started at approximately 700, 1,400, and 1,700 feet east of the portal crosscut. These stopes are down dip from and about 1,000 feet below the lode where it is exposed in the bed and western bank of Emily Creek. The stopes are west of the downward projection of the Monarch and Hecla zones.

* By P. E. Olson.
† By P. E. Olson and M. S. Hedley.

Stoping commenced in August. Heavy timbering and mechanical ventilation were necessary before stoping could be successfully carried out. The mill operated continuously after August on a one-shift-per-day basis and treated 3,033 tons of ore. Production: Silver, 36,908 ounces; lead, 156,969 pounds; zinc, 165,155 pounds.

Twenty-one men were employed during the latter half of 1964.

The company decided to purchase custom ore from small producers in the Silverton area and installed a crusher to permit sampling of small lots. Milling on a custom basis amounted to 1,506 tons.

Hecla Mine Lease.—A. Elsmore and M. Fryters leased the Hecla ore zone on the Mammoth No. 7 level and produced 8 tons of mill-feed and 5 tons of shipping ore. The mill feed was purchased by Johnsby Mines Limited. Total metal production amounted to: Silver, 1,407 ounces; lead, 6,177 pounds; zinc, 3,307 pounds. Fryters and Elsmore operated their lease on week-ends and holidays.

Hewitt*

(49° 117° N.E.) This property is under lease to Frank Pho and Jack Kelly, of Silverton. The mine is on the south side of Silverton Creek, about 3 miles east of Silverton. Early in 1964 Kelly and Pho deepened the internal shaft to No. 12 level and developed the Hewitt oreshoot from No. 12 to No. 11 level. They mined 1,372 tons of mill-feed from the ore zone and then allowed the workings below No. 10 level to flood. The ore was treated at the Standard mill at Silverton and the concentrates were shipped to the Trail smelter. Production: Silver, 35,374 ounces; lead, 105,100 pounds; zinc, 155,878 pounds.

Galena Farm*

(49° 117° N.E.) The Galena Farm is 2½ miles south of Silverton, and is reached by a road that leaves the Slocan–New Denver highway at Silverton. The Galena Farm is under lease to Frank Mills, of Silverton, who worked the mine with the help of Joe Hambly during 1964. Mining was limited to pillar recovery and stoping adjacent to previously mined sections on the footwall of the Noonday vein. Production of 126 tons was treated at the Standard mill at Silverton. Concentrates contained: Silver, 594 ounces; lead, 1,919 pounds; zinc, 26,379 pounds.

Freddy*

(49° 117° N.E.) The Freddy fractional mineral claim is about 3 miles south of Silverton, immediately north of the Galena Farm mine. V. C. Hansen, the owner, and H. Lyon worked the property during the summer months and hand-sorted 16 tons of ore which was shipped to the Trail smelter. An attempt was made to collar a shaft over the vein, but heavy overburden was encountered and the shaft was abandoned.

ENTERPRISE CREEK

Silver-Gold

Jumbo (Vern Mines Limited)*

(49° 117° N.E.) Company office, Nelson. E. F. Reuther, president; J. H. E. Ebert, secretary. This is a private company with a capitalization of 100,000 shares, no par value. The Jumbo group of 10 recorded mineral claims is on the south side of Enterprise Creek, 8.3 miles from the Slocan–New Denver highway. S. Berisoff, of Silverton, the original locator of these claims, sold the property to Vern Mines Limited early in 1964. A bulldozer was used to strip the vein at four

* By P. E. Olson.

points over a length of several hundred feet. Erratic values in gold, silver, and lead are found in small lenses in a large shear within granite of the Nelson batholith. The shear has an east-west strike and is nearly vertical in dip. A sample of ore weighing 1,100 pounds was run through the Kenville mill at Blewett.

Silver

Boomerang and Richmond*

(49° 117° N.E.) The Boomerang and Richmond recorded mineral claims are situated on the south side of Enterprise Creek, about 12 miles from the Slocan City–New Denver highway. The claims were worked by the owners, George Forster and P. A. Ward, of Trail. The workings consist of two adits and a small stope which were worked early in the century. Ward and Forster drifted around the caved stope, but their efforts were hampered by an unexpected break-through into the stope. A compressor was winched up to the workings from the Enterprise Creek road.

SPRINGER CREEK

Silver-Lead-Zinc

White Hope*

(49° 117° N.E.) The White Hope mine is operated by D. F. Bentley and Associates, of Slocan City. The property is immediately east of the Slocan City–New Denver highway, 4 miles north of Slocan City. The property is explored by three adits and several open cuts that explore mineralized fractures in granite. The principal showing is on No. 2 level, which has a total of 500 feet of drifts and crosscuts. A mineralized shear exposed over a length of about 100 feet has an average width of about 10 inches. Ten tons of this material was shipped to the Trail smelter. No. 3 level was reopened and prepared for drifting, which is intended to explore ore located on No. 2 level, some 100 feet vertically above. A crew of four men worked on the property during most of the year.

Silver

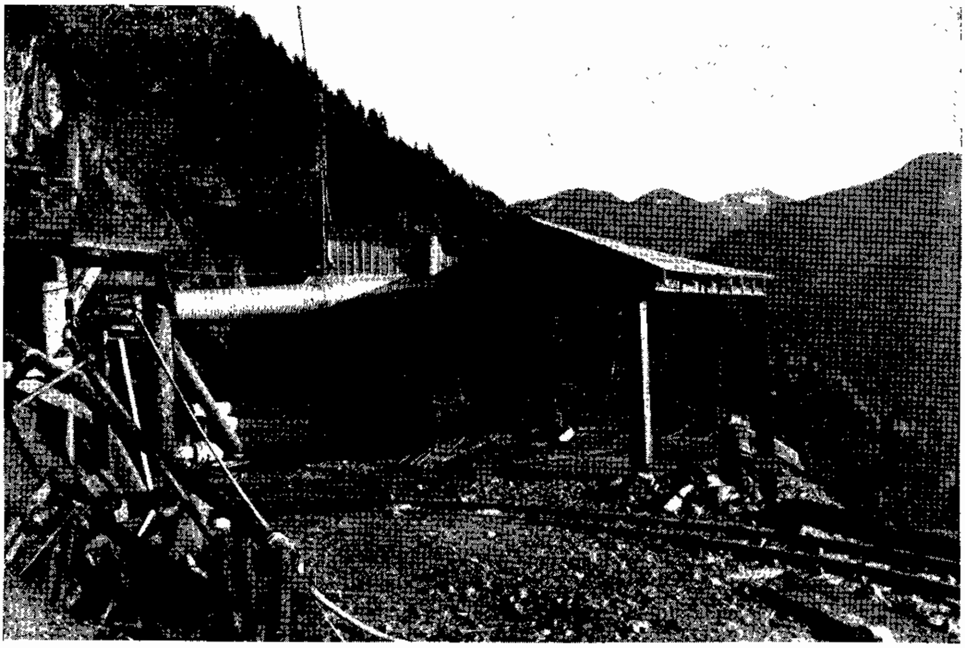
Ottawa (Ottawa Silver Mines Limited)*

(49° 117° N.E.) Company office, Suite 201, 569 Howe Street, Vancouver 1; mine office, Box 75, Slocan City. J. L. Wilson, president and managing director; J. R. McLean, secretary. The mine is 5 miles by good road from Slocan City and the mill is 2½ miles from Slocan City on the same road. The mine operated from January to the end of August, when the operation shut down pending settlement of management disputes and a re-evaluation of the operation. Drifting and crosscutting on No. 9 level amounted to 700 feet, and 125 feet of short raises were driven from these openings. No. 9 level is an exploration drive on the Ottawa vein system that has not been connected to the upper workings. The exploration work done on No. 9 level has located only minor amounts of silver ore, and no stoping has been done in this area.

Raising and drifting between No. 8 and No. 6 levels amounted to 863 feet. Stoping and development ore from this area made up the 6,400 tons trucked to the mill. Concentrates were shipped to the Trail smelter.

Diamond drilling was started near the end of 1964, and 363 feet was done by December 31st. Drilling was confined to the area between the two lowest levels. The company employed 30 men prior to shutting down in August.

* By P. E. Olson.



Johnsby Mines Limited, Silverton. Portal of Hecla adit.

Camp on Big Ledge property, west of Pingston Creek.

Anna (Silver King Mines Limited)*

(49° 117° N.E.) The Anna group of mineral claims is owned by Silver King Mines Limited; mine office, Slocan City. Benjamin Marasek, president and manager. The mine is on the north side of Springer Creek and east of the Ottawa mine. It is reached by 5 miles of road from Slocan City. The mine was worked briefly by Mr. Marasek and son, who drove a crosscut to the west from No. 4 level for about 40 feet. Silver ore was shipped from a mineralized zone on No. 4 level that had been discovered in 1963. The shipment of 3 tons went to the Trail smelter.

Meteor (Cultus Explorations Ltd.)*

(49° 117° N.E.) Company office, 570, One Thornton Court, Edmonton; mine office, Slocan City. J. F. Sullivan, president; Harry Hewat, mine manager. The property consists of 19 Crown-granted and recorded mineral claims and fractions at the head of Tobin Creek, a tributary of Springer Creek. The mine is 9 miles by road from Slocan City. The mine and mill operated fairly continuously until November 6th, when the camp was closed for the winter. Development and exploration work included 600 feet of diamond drilling and 405 feet of raising, drifting, and crosscutting. Stoping and development work produced 1,890 tons of ore, all of which was milled. The flat-lying vein proved very difficult to follow and values were somewhat unpredictable. Steeply dipping normal faults with small displacements were encountered during stoping. All work was confined to an area on and immediately above No. 6 level.

The milling operation was hampered by frequent break-downs and occasional shortages of ore. During 1964, 38 tons of concentrate was produced and shipped to the Trail smelter. Twelve men were employed.

Arlington (Arlington Silver Mines Ltd.)*

(49° 117° N.E.) Company office, 809, 525 Seymour Street, Vancouver 2. B. I. Nesbitt, managing director. The property consists of 16 mineral claims on the north side of Springer Creek, 6.7 miles by road from Slocan City. Capital: 3,000,000 shares, $1 par value. " B " level was driven 310 feet to a point 660 feet from the portal. Mineralized vein material was encountered along this drive. Four men were employed by the contractor.

Shipments of crude ore were made from old dumps, amounting to 123 tons. Some road work and surface stripping were done during the summer.

NAKUSP

Silver

NePe*

(50° 117° S.W.) The NePe consists of eight recorded mineral claims situated on the south side of Slewiskin Creek. The property is reached by 2 miles of fair road that leaves the Nakusp–Needles highway 7 miles south of Nakusp. The claims are owned jointly by P. Hurry, F. H. Jordan, and F. D. Jordan, all of Nakusp.

The property is developed by two levels which are 50 feet vertically apart. The upper level explores a narrow quartz vein which is sparsely mineralized with pyrite and argentiferous tetrahedrite. Some hand-sorting has been done, and the resulting ore stockpiled at the portal. The lower adit intersects the same vein about 90 feet from the portal. Drifting on the vein amounts to nearly 100 feet, but very little mineralization was found. Many faults have stepped the vein off about 2 or 3 feet each to the right.

* By P. E. Olson.

PINGSTON CREEK

Zinc

Big Ledge (The Consolidated Mining and Smelting Company of Canada, Limited)*

(50° 118° N.E.) The Big Ledge property consists of 44 Crown-granted and 25 recorded mineral claims, situated along the north side of Trout Creek, a tributary from the west of Pingston Creek. The property is owned by The Consolidated Mining and Smelting Company of Canada, Limited. Showings of pyrrhotite, pyrite, and sphalerite occur on the claims along a layer, known as the Ledge, of fine- to medium-grained mica schist and quartz mica schist with calcareous lenses. It forms part of a sequence of high-grade metasedimentary rocks of the Shuswap metamorphic complex that includes also quartzite and marble. The Ledge ranges from 75 to 200 feet thick, strikes east, and dips at moderate angles to the south. It has been followed from near Upper Arrow Lake to alpine country west of the lake at elevations of 6,000 to 7,000 feet, a distance of more than 6 miles. Distribution of zinc in the Ledge is erratic, the average grade is low, but some bodies of massive sulphides are relatively high grade.

The showings have been explored in two main periods—one before 1928 and the other, by the Consolidated company, between 1947 and 1953. The early work consisted of trenching, some underground work, and about 3,400 feet of drilling. More than 20,000 feet of drilling was done between 1947 and 1953, as well as geochemical and geological work.

From July through September of 1964, geological mapping, surveying, and drilling were done on the western part of the Ledge, which had not been tested before. A tent camp, established and maintained by helicopter, was made on Iron Lake at the head of Trout Creek at an elevation of 6,000 feet. Drilling amounted to 4,740 feet of AX core in 11 holes spaced at intervals along the Ledge westward from near Iron Lake. Nine men were employed under the direction of J. M. Allen.

NORTH LARDEAU

Silver-Lead-Zinc

Spider (Sunshine Lardeau Mines Limited)†

(50° 117° N.W.) Company office, 401, 1033 Davie Street, Vancouver 5; mine office, Camborne. The company owns the Spider mine on Pool Creek, 2 miles by road from Camborne. The mine has been shut down since May, 1958, when falling metal prices and difficult mining problems resulted in a management decision to suspend operations. By that time all available ore above No. 10 level had been extracted and some underhand stoping had been done below No. 10 level.

In 1964 the mine roads were cleaned out to the No. 10 level portal and an exploration programme was carried out to determine the ore situation below No. 10 level. The programme involved 25 AX diamond-drill holes and approximately 200 feet of drifting. The holes were drilled to intersect the No. 4 vein over a length of 400 feet, and to a depth of 225 feet, below No. 10 level in a 50-foot grid pattern. Seven men were employed during the summer and fall under the direction of K. G. Sanders.

* By J. T. Fyles.
† By P. E. Olson.

Beatrice (Dakota Silver Mines Ltd.)*

(50° 117° N.W.) Company office, Enderby; field office, Beaton. This company owns a group of claims at the head of the east fork of Mohawk Creek at an elevation of 7,000 feet. The main workings, which consist of four adits, are on the Beatrice Crown-granted mineral claim. The company repaired and relocated 4 miles of tractor-road which leaves the Spider mine road about 1½ miles from Beaton. Although this road was used by four-wheel-drive vehicles, it was better suited for use by crawler-type vehicles. The old mine buildings were cleaned and repaired and a few new prefabricated buildings were put up. A minor amount of mine rehabilitation was done by a crew of five men under the direction of John Graham. Work continued through to the year-end by a crew who stayed at the mine.

Teddy Glacier (Sunshine Lardeau Mines Limited)†

(50° 117° N.W.) Company office, 401, 1033 Davie Street, Vancouver 5. L. G. White, president; J. J. Sullivan, consulting engineer. The property consists of a block of 23 claims at the head of the middle fork of Sable Creek, about 10 miles due north of Beaton. The old mine road from Camborne to the Teddy Glacier was repaired and some new road put in under very trying conditions. Upon completion of this work it was possible, on occasion, to service the property with four-wheel-drive vehicles. Considerable service was supplied by helicopter from Revelstoke.

Exploration was confined to the Bell claim group, which covers the main showings. These showings are quartz veins in complexly folded and sheared dark-grey phyllites, grits, and limestones. Two of the larger veins containing galena, sphalerite, pyrite, and chalcopyrite have been explored in the past by an adit at an elevation of 7,800 feet above sea-level (*see* Ann. Rept., 1935, p. E 21). The veins dip steeply, strike north 10 degrees west and north 17 degrees west, and the principal zone of sulphides is close to the point where they meet. Exploration by the present company included 2,176 feet of diamond drilling to test the extensions of these two veins to the south and in depth, but the results were not encouraging.

Road work disclosed the presence of two new mineral showings about 3,000 feet southeast of the main showing. A limited amount of work on these new discoveries indicated that further exploration of them should be done.

Employment averaged about eight men, who worked under the direction of K. G. Sanders. Work began in July and terminated in September when heavy snows arrived.

SOUTH LARDEAU

Lead-Zinc

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

(50° 117° S.W.) The Vin property consists of 10 recorded mineral claims situated immediately south of Glacier Creek. It covers limestone and dolomite of the Badshot Formation on the eastern limb of the Duncan anticline (*see* B.C. Dept. of Mines, Bull. 49, p. 65) and is on the same structure and formation as the Duncan mine a few miles to the northwest. Mineralization consists of pyrite, sphalerite, and galena disseminated in dolomite and siliceous dolomite. A small amount of hand-trenching was done in August by a crew of three men under the direction of G. M. Gibson.

* By P. E. Olson.
† By J. T. Fyles and P. E. Olson.

ROSE PASS

Silver-Lead-Zinc

Humbolt*

(49° 116° N.W.) This property is about 1 mile west of Rose Pass, which is on the summit between Crawford Creek and St. Mary River. It is reached by 15 miles of logging-road that leaves the Kootenay Bay–Creston highway at the Crawford Bay school. During 1964 the property, which consists of two Crown-granted and nine recorded mineral claims, was under option to Glen Champion and Nelson Norton, Kootenay Bay, from E. T. Coleman, of Nelson.

A bulldozer was used to strip a section of the flat-lying vein in the vicinity of previously driven adits. Mineralization consists chiefly of bunches of galena, with minor sphalerite and pyrite in a gangue of milky quartz. A shipment of 6 tons of sorted ore was sent to the Trail smelter.

MOYIE

Gold-Silver

Midway (Calix Gold Mines Ltd.)†

(49° 115° N.W.) This property is adjacent to the No. 3 highway, 5 miles southwest of Moyie, and was optioned by the present company in 1963 for exploration. It is an old property, and a description has been given in past Annual Reports. The surface area at the mine was rehabilitated in 1964, and a new entrance was made to the portal of the lower tunnel to straighten the drift. Two new buildings were erected, one of which will be used as a wash-house and the other for housing a compressor. The work was done by contract. It started November 9th and was continued during the winter months. A crew of five men was employed.

KIMBERLEY

Silver-Lead-Zinc

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

(49° 115° N.W.) Company office, Box 1510, Station B, Montreal 2; W. S. Kirkpatrick, chairman and president. Western headquarters, Trail; D. D. Morris, vice-president and general manager. Sullivan mine office, Kimberley; S. M. Rothman, general superintendent; R. M. Porter, assistant manager of mines; H. J. Chalmers, superintendent, Sullivan concentrator. 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 1964, about 2,700,000 tons of Sullivan ore were treated at the concentrator, 7% of which came from the open pit, 62% from above the 3900 level and 31% from below the 3900 level.

" The total development footage was approximately 29,000 feet.

" Backfill placed totalled 650,000 cubic yards made up of cave, float rock and development waste.

" The ventilation system supplied and exhausted about 950,000 c.f.m. of air. A new forced-air intake (No. 41 shaft) to supplement 3900-level ventilation circuits was driven and will be ready for operation in 1965. Underground development work was commenced to provide for revision of the major ventilation circuits so that they will not conflict with hanging wall subsidence.

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* By P. E. Olson.

† By D. R. Morgan.

" Experimental work on development ventilation resulted in the regular use of six-inch auxiliary ducting to bring fresh air right to the work face; significant reduction in drilling dust-counts can be attained.

" In 1964 the Sullivan mine had 20 lost-time accidents including two fatalities. There were six lost-time accidents at the Sullivan concentrator. Accident frequency at the mine was 15.75 accidents per 1,000,000 man-hours worked, and 11.06 at the concentrator. The severity rate was 1209.0 calendar days on compensation per 1,000,000 man-hours worked at the mine, and 770.1 at the concentrator.

" Fourteen Sullivan mine and concentrator employees obtained or renewed their Industrial First-Aid certificates, and 114 employees passed their St. John's first-aid examinations. A Sullivan mine team won the East Kootenay Mine Safety Association's senior men's first-aid competition. This team also won the Provincial men's first-aid competition.

" Fourteen Sullivan employees obtained their mine-rescue certificates, making a total of 315 since training first started there late in 1929. A team from the Sullivan mine won the East Kootenay Mine Safety Association's mine-rescue competition. This team also won the Provincial mine-rescue competition held in 1964 at Kamloops.

" The concentrator operated 258 days during 1964 at an average rate of 10,500 tons per day. Employees at the year-end totalled 716 at the mine and 291 at the concentrator."

Lead-Zinc

Western Exploration (Reeves MacDonald Mines Limited)*

(49° 115° N.W.) Head office, 410 Metropolitan Building, 836 West Hastings Street, Vancouver 1; mine office, Remac. L. M. Kinney, general manager, Metaline Falls, Wash.; F. R. Thompson, superintendent. This property is located between the headwaters of the east fork of Mark Creek and Mather Creek. It is 10 miles north of Kimberley, and can be reached by means of an old forestry road leading from the open-pit area of the Sullivan mine. The property comprises 110 Crown-granted claims which have been optioned from Western Exploration Company Limited, of Silverton, and six recorded claims located at the north end of the property.

A small crew conducted a geophysical survey on the property during the summer of 1964. The work was under the direction of Roy Anderson, chief engineer of Pend Oreille Mines and Metals Company, of Metaline Falls, Wash.

WASA

Silver-Lead-Zinc

Estella (Copper Soo Mining Company Limited)*

(49° 115° N.W.) Executive office, Osoyoos; mine office, Cranbrook. T. G. Wilson, managing director; A. G. Ditto, superintendent; H. Hill & L. Starck & Associates Ltd., consulting engineers. This property is in a basin at the head of Tracey Creek, approximately 5 miles east of Wasa and 11 miles north of Fort Steele. The property is at an elevation of over 6,000 feet and is reached by an 18-mile road leading from Wasa. It was formerly operated by the United Estella Mines Limited, but was abandoned in 1955 when that company went into liquidation. The present company purchased the property in 1962, staked and recorded 42 additional claims, and has conducted a fairly extensive exploration since that time. Six claims have been relinquished, and the present property consists of

* By D. R. Morgan.

12 Crown-granted and 42 mineral claims held by record. A detailed description of the property is given in the 1963 Annual Report.

Activities in 1964 included 2,150 feet of drifting, raising, and crosscutting. Four diamond-drill holes totalling 1,385 feet were drilled from the surface to test the possible extension of the mine orebody and eight other diamond-drill holes totalling 604 feet were drilled in the mine. Most of the work in the mine was directed to the exploration and development of the 6250 (Rover) and 6464 levels in the upper part of the workings. The levels were driven a distance of 300 feet, and two raises were started during the latter part of 1964 to explore the continuation of the orebody between the two levels. Further exploration was also done in the No. 2 (Rover) shaft. Two sublevels were driven to explore the southeastern extension of the orebody, and another was driven in a northwesterly direction. The ore in most parts was 2 to 3 feet wide and it appeared fairly constant.

All the development ore was dumped into a number of ore-passes from the 6100 (Estella) level for future loading, and there were no shipments of ore in 1964. A crew of eight men was employed for a period of nine months. The men stayed in a trailer camp near the portal of the 6100 (Estella) level.

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. J. R. Pyper, president; J. S. McIntosh, managing director; J. B. Magee, resident manager. This mine is at Toby Creek, 28 miles southwest of Athalmer. It is reached by a good road leading from near Wilmer. The workings are in a mountain ridge between Toby and Jumbo Creeks. They are entered by four levels, of which Nos. 2, 3, and 7 have been driven at various elevations from the Toby Creek side, and No. 9 level, the lowest, from the Jumbo Creek side. There are four intermediate levels which do not extend to the surface. The mine is operated by the open-stope method, and the workings are in four irregular-shaped orebodies known as the "A," "B," "C," and "D" zones. The property comprises 23 Crown-granted and 17 recorded claims. A detailed description of the property is given in the 1959 and 1962 Annual Reports.

The mine produced 183,971 tons of lead-zinc ore during 1964, most of the ore being mined from a number of stopes above No. 3 level. The remainder was produced during development. Total development included 2,783 feet of drifting, 1,063 feet of raising, and 37,490 feet of diamond drilling. The newer development was mainly in the lower levels, and diamond drilling below No. 9 level has indicated the continuation of the limestone with some good ore intersections. A decision was made in December to sink a production shaft to this point, and work to this end is now progressing. There was no production of barite during 1964.

The mine is ventilated by mechanical and natural means. Approximately 30,000 cubic feet of air per minute is exhausted from the workings, and of this quantity 18,000 cubic feet per minute is supplied by a 15-horsepower electrically driven fan located in the No. 2 intake airway. This quantity was found to be sufficient for the requirements of the workings.

The concentrator operated throughout the year and produced 3,467 tons of lead concentrates grading 65.46 per cent lead and 12,019 tons of zinc concentrates grading 55.84 per cent zinc. The concentrates were trucked to Invermere for ship-

* By D. R. Morgan.

ment by rail. The average number of men employed was 97, of whom 56 were employed underground.

Paradise (Sheep Cheek Mines Limited)*

Company office, 6, 490 Baker Street, Nelson; mine office, Toby Creek. J. R. Pyper, president; J. S. McIntosh, managing director; J. B. Magee, resident manager. This property is at the headwaters of Springs Creek, a tributary of Toby Creek, and is 20 miles by road west of Athalmer. The property is at an elevation of 7,800 feet. It has been mined for many years but, with the exception of a short period in 1960, has been inactive since 1955. A description of the property has been given in past Annual Reports.

Several cuts were made along the outcrops of known orebodies for a period of two months during the summer of 1964, and 931 tons of ore was loaded and trucked to the concentrator at the Mineral King mine for treatment. A minor amount of drilling was done, and a crew of three men employed.

Silver-Lead

Delphine (Western Beaver Lodge Mines Ltd.)*

Registered office, Suite 303, 1075 Melville Street, Vancouver 5. D. F. Farris, president. This property is on the north side of Delphine Creek, a tributary of Toby Creek, and is approximately 22 miles southwest of Athalmer. It consists of the Delphine and two other Crown-granted claims, one mineral lease, and two recorded claims. The property is at an elevation of 6,200 feet, and a detailed description of it is included in the 1915 Annual Report. The present company acquired the property in the fall of 1963.

Some geological mapping was done in 1964, and a crew of three men drove a new adit for a distance of 325 feet, approximately 100 feet below the old Delphine tunnel. One diamond-drill hole totalling 125 feet was also drilled ahead of the drift. The formation was mainly a siliceous limestone, and some mineralization was encountered, but the vein was very narrow and scattered. Further exploration was suspended in July. The work was under the direction of R. Renshaw, consulting engineer.

HORSETHIEF CREEK (50° 116° N.E.)

Silver

Ptarmigan (Union Carbide Exploration Limited)*

Head office, 805 Davenport Road, Toronto 4. A. E. Buller, manager. This property is at an elevation of 8,600 feet at the headwaters of Red Line Creek, a tributary of McDonald Creek, which in turn is a tributary of Horsethief Creek. It can be reached by a 29-mile dirt road leading from Wilmer or a new 26-mile logging-road that was completed from Radium Junction in 1964. The property is an old one and records of it go back to the turn of the century. It is presently owned by Selkirk Ptarmigan Mines Limited, and was optioned by Belle Tahsis Mines Ltd. in 1963. The present company made an agreement with the Belle Tahsis Mines Ltd. to explore the property in 1964. A detailed description has been given in past Annual Reports.

Some geological mapping was done in 1964, and a crew of four men drilled 13 diamond-drill holes totalling 1,250 feet in the lower level of the mine between July 7th and August 25th. The work was under the direction P. E. Geisterfer, geologist.

* By D. R. Morgan.

REVELSTOKE

Lead-Zinc

Roseberry and A & E*

(51° 118° S.E.) The Roseberry property is on the ridge between Carnes Creek and Kelly Creek, the north fork of Carnes Creek. The A & E property is on the south side of the upper part of the east fork of Kelly Creek, called Burke Creek. During 1964 work on the properties was done as a joint effort by Westairs Mines Limited, East Ventures Limited, and Stairs Exploration & Mining Company Limited, all with head office at Bathhurst, N.B. Work began on May 7th and was suspended October 12th. It consisted of geological mapping, prospecting, trenching, underground exploration, and 1,004 feet of diamond drilling.

The geological mapping was under the general direction of Joe Sullivan, consulting geologist of Vancouver, and was done by contract. An area surrounding the two properties about 10 miles long in a northwesterly direction parallel to the regional strike of the rocks and 4 miles wide was mapped on a scale of 400 feet to the inch using air photographs and a specially prepared topographic base.

North of the Roseberry property a new crosscut 320 feet long was made on the east side of Burke Creek less than half a mile above Kelly Creek. It was driven in graphitic schist on strike from the old showings on the Roseberry property but did not encounter significant mineralization.

An old adit on the A & E property at an elevation of about 6,000 feet was extended 265 feet, and a mineralized zone was diamond drilled from this adit. The mineralized zone consists of fine-grained pyrite, sphalerite, and galena in contorted sericite schist interlayered with limestone.

All men and equipment were moved by helicopter from a base camp on Burke Creek near the adit north of the Roseberry property. An average crew of 13 men was employed under the direction of J. E. McKinney.

[References: *Geol. Surv., Canada,* Sum. Rept., 1928, Pt. A, pp. 159, 171; *Geol. Surv., Canada,* Paper 64-32, pp. 31–33; *Minister of Mines, B.C.,* Ann. Rept., 1933, pp. 211–212.]

SKAGIT RIVER

Copper

A.M. (Giant Explorations Limited)†

(49° 121° S.E.) Company office, 1825, 355 Burrard Street, Vancouver 1. W. Clarke Gibson, president; L. P. Starck, general manager. This company is a wholly owned subsidiary of Giant Mascot Mines Limited which has concluded an option agreement with Canam Copper Company, Ltd. to carry out exploration and development on the company's property near the western boundary of Manning Park. The property consists of eight Crown-granted claims and 59 recorded claims, and is about 4 miles by road southerly from Mile 30 on the Hope–Princeton highway. From 1930, when the property was first located, to 1963 a considerable amount of underground exploration has been carried out from nine adit levels, from No. 3 at 5,850 feet elevation to No. 15 at 4,300 feet elevation. A camp has been established near No. 15 level portal.

Detailed descriptions of the geology of the property have been given in previous Annual Reports. The mineralization occurs in a pipe-like zone of brecciated sediments which has a known vertical range of 1,500 to 1,800 feet and a width of about 400 feet; the principal ore mineral is chalcopyrite. At the end of 1961 Canam Copper Company estimated reserves of potential ore at 2,069,500 tons grading 1.49 per cent copper, 0.026 ounce of gold, and 1.00 ounce of silver per ton.

* By J. T. Fyles and W. C. Robinson.
† By A. R. C. James.

The present company began work on June 15th and continued to the end of 1964. Nos. 10 and 15 level were rehabilitated. A 280-foot raise was driven into the footwall side of the orebody from No. 15 level, and a 275-foot raise was driven in the footwall from No. 10 level. Five diamond-drill stations were established in these raises for the purpose of exploring the east and west limbs and the nose of the main orebody between 4,335 feet and 5,475 feet elevations. Fifty-six holes were diamond drilled, totalling 10,706 feet. A crew of 16 men was employed under the supervision of R. W. Foster. (*See* Annual Reports, 1959, pp. 122–124; 1954, pp. 152–159; 1949, pp. 210–213.)

HOPE

Nickel-Silver-Copper

Mammoth (Foundation Mines Limited)* (49° 121° S.E.) Company office, 202, 736 Granville Street, Vancouver 2. R. J. MacKinnon, chairman and property manager; N. Mussallem, president. Capital: 3,500,000 shares, no par value. The company holds 55 recorded claims, including the Mammoth, Diamond, B.B., Star, Ruby, and Heart groups. These are at the old "23-mile camp" near the confluence of the Sumallo and Skagit Rivers, 23 miles by road from Hope.

Recent work has been concentrated on the Mammoth No. 1 and 2 claims. These are on the north side of the Sumallo River, close to the Hope–Princeton highway. Mineralization was discovered here in 1911, and the claims have been held by the present company since 1955. Some diamond drilling was done in 1955 and 1962. The claims are underlain mainly by altered volcanic and sedimentary rocks of the Hozameen Group. A zone believed to consist of ultrabasic rocks contains pyrrhotite, and samples and drill cores of this material have indicated a low nickel, silver, and copper content. According to samples taken by the company, the nickel content of the mineralized zone is usually within the range 0.02 to 0.70 per cent.

In 1964 two additional holes were diamond drilled from a drill-station 250 feet northwesterly from the previous sites. No. 1 hole was drilled 410 feet and No. 2 hole was drilled 507 feet. The object of this work was to test the continuity of the mineralized structure in this direction. Limited stripping and open cutting was also done.

Nickel-Copper

Pride of Emory (Giant Mascot Mines Limited)† (49° 121° S.W.) Company office, 1825, 355 Burrard Street, Vancouver 1; mine office, P. O. Box 820, Hope. W. Clarke Gibson, president; L. P. Starck, general manager; F. Holland, resident manager; K. Dahlke, mine superintendent; C. Coffey, mill superintendent; O. C. Gilroy, plant 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 Trans-Canada Highway 10 miles north of Hope, a good gravel road 5.1 miles long leads up Stulkawhits Creek valley to the mill and surface buildings at the 2600 adit portal.

The ore occurs in as many as 12 separate orebodies; in 1964 the major production (81 per cent) was from the Brunswick No. 2, Pride of Emory, and the 1600. The remainder of the production came from the Brunswick No. 1 and No. 5, 2663, 1500, 1400, and Dolly ore zones. The orebodies are steeply plunging pipe-like deposits and occur in an irregular stock-like intrusion of ultramafic rocks approxi-

* By A. R. C. James.
† By A. R. C. James and G. E. P. Eastwood.

mately 1½ square miles in area. They comprise disseminated and massive sulphides, of which pyrrhotite, pentlandite, and chalcopyrite are the most common.

The mine is developed from two adit levels—the 3550 level, with portals on both west and east sides of the ridge, and the 2600 level, which is the main haulage level (*see* Fig. 13). Levels are designated by nominal elevation above sea-level. An ore-pass and internal inclined shaft join the two adit levels. Three other levels at 3,400, 3,250, and 2,950 feet elevation respectively have been developed from the inclined shaft. Workings above the 3550 level are reached by various raises. Two other workings are unconnected with these main workings—the No. 2 or Chinaman adit and a short adit and raise on the Dolly claim.

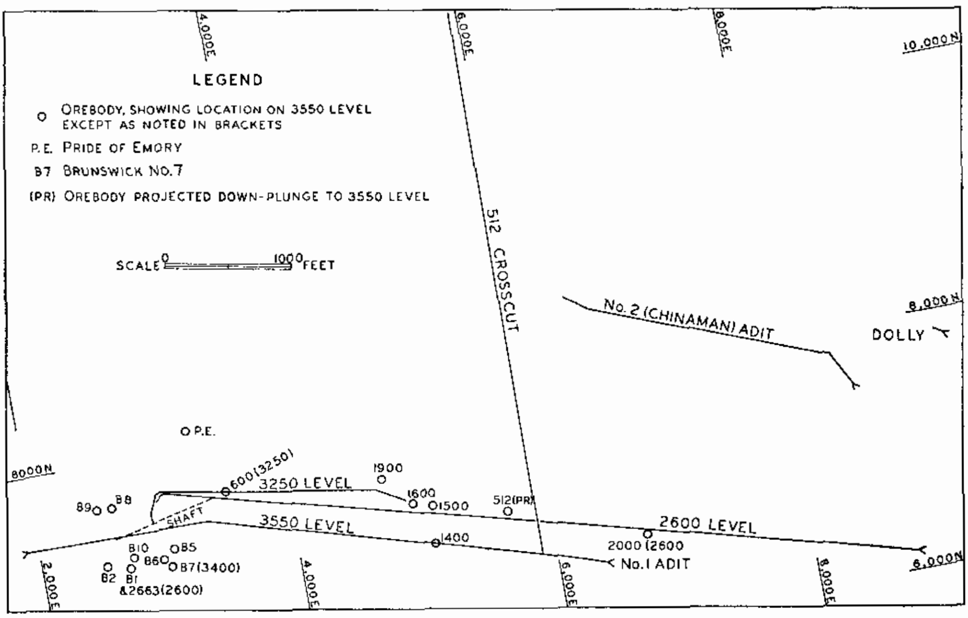


Figure 13. Giant Mascot Mines Limited. Positions of orebodies.

The ore is mined by horizontal and vertical longhole blasting. Gardner-Denver D.H. 123 drills are used, and 2-inch holes are drilled with 1400 series equipment; Hard Metals rods and 2-inch Wickalloy bits are used. The long blast-holes are usually loaded with a commercial form of AN/FO. The bulk of the primary muck from the stopes is loaded into cars at mucking-machine draw points. Six Atlas Copco LM 56 loaders, one Eimco 24, and two Eimco 21 loaders are in use. At the 2600 level the ore is loaded from the ore-pass into 6-ton Granby cars and hauled to the mill by trolley locomotive.

The following is a summary of mining and development in 1964:—

	Ft.
Drifting and crosscutting	3,170
Raising	5,438
Diamond drilling	41,040
Blast-hole drilling	206,669

Principal development work done in 1964 was as follows:—

(1) On the 3250 level the Pride of Emory B, C, and D zones were fully developed and brought into production.

(2) The Brunswick No. 2 orebody between 2800 and 2950 levels was developed and brought into production. This block would appear to be the final remaining reserve of this large orebody.
(3) Further development was done on the 1400 orebody above 3,700 feet elevation, and at year-end an access and service raise for the 1400 and 1500 orebodies was being driven. This raise is planned to go to 4,000 feet elevation.
(4) A crosscut was driven 200 feet to the 1500 orebody on the 3550 level. Diamond drilling to outline the orebody was completed and two raises were driven to 3,750 feet elevation in preparation for mining.
(5) The 3254 crosscut was driven to a point 2,500 feet east of the shaft in preparation for development and mining.
(6) A most significant development was the discovery and exploration of the 600 orebody on the 3250 level approximately 700 feet northeast of the shaft. A drift was driven 200 feet to the north in ore and an exploration raise was driven to 3,550 feet elevation. Further development and diamond drilling are in progress.
(7) A crosscut was driven 200 feet to the north of the main 3254 crosscut to the 1900 orebody and a raise is being driven through to the 3550 level.
(8) A new access raise was driven to the 2770 sublevel in the 2663 orebody above 2600 level.

In the company's annual report dated December 21st, ore reserves are described as 1,014,840 tons grading 0.93 per cent nickel and 0.38 per cent copper; these figures are comparable to those for 1962 and 1963.

The mill continued to produce a bulk nickel-copper concentrate which is supplied to the Sumitomo Metal Mining Company Ltd. The concentrates are trucked from the property to Vancouver Wharves Ltd. bulk-loading plant in North Vancouver by truck-trailer units. In 1964 a total of 319,801 dry tons of ore was milled. A total of 19,100 tons of bulk concentrate was shipped, containing 3,862,000 pounds of nickel and 1,952,000 pounds of copper. The crew in December comprised 161 men (including staff), of whom 91 were employed underground.

General Geology

The geology of the property has been described in papers and reports by Aho, Bacon, Cairnes, Cockfield and Walker, and Horwood, which are referenced below. The deposits are in a roughly triangular mass of mafic and ultramafic rocks, approximately 1½ square miles in area, largely enclosed by diorite and related rocks. The mafic and ultramafic rocks include peridotite, pyroxenite, hornblendic pyroxenite, fine-grained and very coarse-grained hornblendite, norite, gabbros or diorites, and various hornblendic dykes. Schists are reported to occur extensively southeast of the mass and to be of sedimentary origin. Schists locally developed near the 1600 orebody, described briefly below, are believed to have had a different origin.

The various mafic and ultramafic rocks appear to be irregularly distributed. Peridotite tends to form bodies isolated in pyroxenite and hornblendite. Norite and diorite (or gabbro) tend to occur as irregularly tabular bodies in pyroxenite and hornblendite, but it is far from certain that they have actually intruded the ultramafic rocks.

In 1964, studies were largely confined to the vicinities of the 1400, 1600, and 600 orebodies, and petrographic work was not done. Therefore only brief notes can be added to the published information.

The peridotite is dark grey to black, fine grained, and is not easy to recognize. It grades outward through olivine pyroxenite to pyroxenite and hornblende pyroxenite. The pyroxenites consist largely of dark-brown bronzite and are commonly medium grained. The hornblendites are greenish-black to black, and include both fine-grained and coarse-grained to pegmatitic masses, in addition to two ages of dykes. Contacts between pyroxenite and coarse-grained hornblendite appear gradational.

The feldspar-bearing rocks are characterized either by brown bronzite or greenish-black hornblende. The plagioclase was not determined in the present work; Aho's studies indicated a wide variation, from oligoclase to labradorite and even bytownite. For convenience in this report the bronzitic rocks are called norite and the hornblendic rocks are called diorite, even though these designations may not be strictly correct in all cases. The norite is slightly but uniformly gneissic, whereas the diorite is partly gneissic and partly massive. The plagioclase is fine grained, glassy, and pale brown to pale pink in colour. It is not everywhere uniformly distributed, but in the norite and part of the diorite it tends rather to form ragged bands a few millimetres thick, giving the rock its somewhat gneissic structure.

This plagioclase is thought to be introduced, and the norite and the gneissic diorite are thought to be hybrid rocks, for the following reasons:—

(1) The dark minerals of the rock are those of the ultramafic with which it is in contact. If the ultramafic is brown pyroxenite, as west of the 1400 orebody on 3550 level, the feldspathic rock is norite. If the ultramafic is hornblendite, the feldspathic rock is diorite.

(2) Many of the bronzite grains in norite are isolated in feldspar and rounded as if by corrosion.

(3) At several contacts fingers of feldspar were seen to extend for half an inch or so into pyroxenite, and the pyroxenite is increasingly broken up by plagioclase over a contact zone of about an inch.

(4) The ragged plagioclase bands are not strings of single crystals, but are many crystals wide. This fabric and the fine grain size would suggest later introduction at a temperature little above that of crystallization of plagioclase, rather than interstitial crystallization from the primary ultramafic magma.

The diorites that are not gneissic may have had other origins. Granitoid diorite near the 1600 orebody on the 3250 level shows rather sharp contacts with hornblendic pyroxenite and may be a separate intrusion. West and south of the 1600 orebody, fine-grained diorite is closely associated with fine-grained hornblendite, and the apparent difference between them may be largely a function of the difficulty of detecting very fine-grained plagioclase in mine walls. In any case, it seems doubtful that the fine-grained hornblendite and diorite are either differentiates of the ultramafic complex or significantly hybrid rocks. Sparing interstitial plagioclase in some parts of the coarse-grained hornblendite appears to have crystallized as a part of the rock rather than to have been introduced later.

Visible alteration of these rocks is confined to talcose zones adjacent to the 1600 orebody and to local crumbly areas in pyroxenite and peridotite. Around the bottom part of the 1600 orebody, on 3250 level, hornblendic pyroxenite is extensively and variably altered to talc. Where the alteration is total, the talc rock contains masses of very coarse biotite and chlorite. A similar alteration is reported to occur around the top of the orebody, but on the 3550 level talc alteration is confined to a 4-inch band along part of a slip, well outside the orebody itself. Conspicuous crumbly areas lie adjacent to the 1600 orebody on 3550 level and to the 600 orebody on 3250 level. They are not definite zones, in that they are about as wide as they are long and cannot be traced for any considerable distance. Along the edge of one zone, crumbling seems to take place principally on a series of indistinct shear surfaces dipping 60 to 80 degrees southeast or east. Aho ascribed this crumbling to incipient serpentinization.

Structures include simple fractures, slips, shear zones, and gouge and breccia zones. The simple fractures comprise scattered short joints and at least one zone of sheeting. Most of the joints are steep, but a few are nearly flat, and they show no preferred strike. The sheeting dips 40 to 45 degrees northeast and southeast. The slips are characterized by polished walls of serpentine, and some contain lenses of chlorite, calcite veinlets, and rarely a little quartz. They appear to be very numerous; where they were exhaustively mapped adjacent to the 1400 orebody, there are 57 slips in 220 feet of working. Most of them are short, and as a group they show little preferred orientation. Several are vertical, but there is a continuous variation in dips down to 25 degrees.

The shear zones are much less common, but some are far more persistent than the slips. They are from 1 to 6 inches thick and consist of sheared, altered wall-rock, some also containing narrow hornblendite dykes, lenses of quartz, and locally sulphides. Short shear zones dip steeply and show no preferred orientation; they may perhaps be regarded as slips widened by further movement rather than typical shear zones. The somewhat more common persistent type dips gently, mostly between 10 and 20 degrees, and tends to show a definite pattern of strike. East and south of the 1400 orebody the shear zones strike within 10 degrees of north, but as the orebody is approached they curve to a westerly and then a northwesterly strike. This is shown not merely by the shear zones as a group, but by individual shears. The longest observed shear zone was traced for 160 feet through most of the S-curve. Through the orebody it splits into two parallel zones about 2 feet apart. In and near the 1600 orebody the attitude of shear zones is more variable, and the distinctions between shear zones and slips and between shear zones and gouge and breccia zones are less clear cut.

The gouge and breccia zones are from 1 to 24 inches thick, and consist of mud and rock fragments. They tend to shun the 1400 and 1600 orebodies, but are specially common 100 to 150 feet east of the 1400. Most of them strike north to northeast and dip moderately to steeply east or southeast. One large zone which cuts through the lower part of the 1600 orebody on 3250 level contains both sheared rock and gouge. It appears to offset the bottom part of the orebody, but it also contains lenses of sulphides. It strikes north 35 degrees east and dips 13 degrees southeast, splitting up-dip into two narrower zones.

Movement on the slips and shear zones ranges from a few inches to a foot or two, and on the gouge and breccia zones it is of the order of a few feet. The shear zones both displace slips and are displaced by them, and it seems likely that movement on the shears is of at least two different ages. The gouge and breccia zones commonly displace the other structures.

Mineralization

The principal sulphides are nickeliferous pyrrhotite, pentlandite, and chalcopyrite. Pentlandite is not visible to the naked eye, but has been identified under the microscope by previous investigators. Minor pyrite, linnaeite, covellite, chalcocite, violarite, melanterite, and morenosite were seen by Horwood or Aho.

Four different sulphide textures were noted in the section of mine studied:—

(1) Disseminated grains.
(2) Clots, ellipsoidal in form and consisting of many sulphide grains.
(3) Intergranular laceworks.
(4) Veins and veinlets, partly along slips and shear zones.

Disseminated sulphides are rather widely but sparingly distributed through the ultramafic rocks, and to some extent are also scattered through norite and diorite. The clots are scattered through certain areas of ultramafic rocks and norite. They are commonly about the size of a fingerprint, but are generally too thinly scattered to make ore at current metal prices. In part the clot-bearing areas are adjacent to orebodies, possibly suggesting that they are a weak manifestation of the same mineralizing process, and in part they are isolated.

The sulphide laceworks are typical of the orebodies studied. In their simplest form a sulphide grain 1 or 2 millimetres across, which is probably an aggregate of several crystals, lies between several silicate crystals and sends out filmy arms along the crystal boundaries. In a more developed form the arms connect with other similar sulphide grains, enclosing silicate crystals or aggregates of silicate crystals and forming the typical lacework. In a still more developed form the arms are thickened, the silicate crystals are isolated and corroded by replacement, and the mineralized rock approaches a replacement pseudo-breccia.

Veins and veinlets of sulphides are largely, but not entirely, restricted to the orebodies. There they occur along almost any surface of weakness in the rock, but outside the orebodies only a very few structures contain sulphides. Veins in shear zones stop where the laceworks stop, even though the shear zones continue through rock containing scattered clots and sparsely disseminated sulphides. An exception is the large shear and gouge zone through the bottom of the 1600 orebody; it contains almost no sulphides where it passes through the orebody, but contains lenses of them to the southeast. The veins are generally lensy, and the maximum thickness rarely exceeds 2 inches.

Generally there is little difference in the occurrence of pyrrhotite and chalcopyrite, except that pyrrhotite is much more common and chalcopyrite tends to occupy a subsidiary or peripheral position, as if it were introduced into newly available sites or sites left unoccupied by pyrrhotite.

The orebodies appear to be distinct geologic entities, with fairly sharp boundaries. They are characterized by the relative abundance and the texture of the sulphides, although the boundaries generally do not coincide with rock contacts or with other structures. The contrast between ore and surrounding weakly mineralized rock is readily visible. Aho noted a tendency for the orebodies to be in or associated with cores of dunite, peridotite, or olivine pyroxenite. This appears generally true of the 1600 and 1400 orebodies, but the relationship is not precise; not all of the olivine-bearing rock is included with the orebody, and in places the orebody extends into pyroxenite. The 600 orebody as exposed on the 3250 level appears to be largely in pyroxenic hornblendite. The orebodies are roughly pipe-like in form and plunge steeply west or north.

It does not seem that geologic structures have had much effect on the mineralizing process. Rather, the localization of ore appears to have been controlled largely by the chemistry and physical chemistry of the rocks and of the processes to which they have been subjected.

[References: Aho, A. E., *Econ. Geol.,* Vol. 51, 1956, pp. 444–481; Bacon, W. R., *Minister of Mines, B.C.,* Ann. Rept., 1954, pp. 161–163; Cairnes, C. E., *Geol. Surv., Canada,* Sum. Rept., 1924, Pt. A, pp. 100–106; Cockfield, W. E., and Walker, J. F., *Geol. Surv., Canada,* Sum. Rept., 1933, Pt. A, pp. 62–68; Horwood, H. C., *Geol. Surv., Canada,* Mem. 190, 1936.]

Silver-Lead-Copper

Murphy (Union Bar Mines Ltd.)* (49° 121° S.W.) Company office, 209, 615 West Pender Street, Vancouver 2. Dr. Gordon W. Robertson, president. The property comprises Lot 27, a very old Crown-granted claim, and 26 recorded claims, and is on the west side of the Fraser River about 3 miles north of Hope. The Crown-granted claim is 1,500 feet northwest of the river and 2,800 feet southeast of the Trans-Canada Highway at Lake of the Woods. Access is by a road which leaves the highway at the north end of Lake of the Woods.

The Murphy property is believed to be one of the earliest hard-rock workings in the Province. The earliest work was reportedly done by the Murphy brothers in 1858, who sank a shallow shaft called the Greenwood shaft on a quartz vein mineralized with pyrite, pyrrhotite, chalcopyrite, and galena. An open cut was also made near the shaft, and it is reported that some high-grade silver-lead ore was shipped to Swansea, South Wales. The Murphy claim was Mining Licence No. 1 under the Mineral Ordinance, 1869. Prior to 1879 an adit was driven from a point just east of the present Canadian Pacific Railway tracks in an easterly direction for a distance of 800 feet. Later this adit was extended to 960 feet, cutting the Crown-granted claim at a depth of approximately 200 feet. The last work on the adit was done in 1924. There was renewed interest in the property in 1963, and a predecessor of the present company, Patray Explorations, did some exploration work in 1964. Six holes were diamond drilled, totalling 1,000 feet, some stripping was done, and the old shaft was cleaned out. Toward the end of the year, after many months of negotiation with the Canadian Pacific Railway over a crossing, the present company began construction of a road from the main highway down to the old portal. It is intended to reopen this adit and carry out further underground exploration. (*See* Annual Report, 1915, pp. 259–260.)

HARRISON LAKE

Molybdenum

Gem (Gem Explorations Limited)* (49° 121° N.W.) Company office, 1272 West Pender Street, Vancouver 1; registered office, 850 West Hastings Street, Vancouver 1. R. W. Caskey, president; J. A. McAskill, exploration manager. Capital: 5,000,000 shares, 50 cents par value. The property comprises 72 mineral claims and 4 fractional claims held by record. Eight other claims are held under option, and an interest is held in an additional 18 claims. The property is situated between 2,500 and 5,000 feet elevation near the crest of the Lillooet Range at the head of Clear Creek, a tributary of Big Silver Creek. Big Silver Creek flows into Harrison Lake, 20 miles north of Harrison Hot Springs. The property has been serviced by helicopter from Harrison Hot Springs, but may now be reached by four-wheel-drive vehicle over logging-roads up the east side of Harrison Lake and by a company road to the headwaters of Clear Creek.

A description of the general geology and the principal showings on the property was given in the 1963 Annual Report. At the end of that year an adit was collared on the southeast side of Clear Creek and was driven several hundred feet on a quartz molybdenite vein 1 to 3 feet wide which strikes north 12 degrees east and dips 65 degrees westward. In 1964 this adit was driven to a distance of 500 feet from the portal. In June construction was started on a 5½-mile road to link the property with existing logging-roads in the vicinity of Big Silver Creek. This construction

* By A. R. C. James.

proved somewhat slow due to excessive rock work, but by December 22nd the camp on the property was reached. In addition to this work the property was geologically mapped, an induced polarization survey was carried out, and some soil-sampling was done. An agreement was concluded with Utah Construction & Mining Co. for the further exploration of the property. A crew ranging from 6 to 14 men was employed.

HOWE SOUND

Copper-Zinc

Britannia (The Anaconda Company (Canada) Ltd.)*

(49° 123° N.E.) Head office, Eighth Street, New Toronto; mine office, Britannia Beach. J. Van Der Ploeg, president; J. D. Knaebel, general manager; B. B. Greenlee, mine manager; J. C. S. Moore, mine superintendent; V. Gladman, mill superintendent. The property is on the east side of Howe Sound, 40 miles by road from Britannia.

This old and well-known mine was closed at the end of September, only one year and eight months after it had been purchased from the Howe Sound Company by The Anaconda Company (Canada) Ltd. The Britannia Local of the Mine, Mill, and Smelter Workers Union called a strike on August 11th after failure to reach agreement with the company over contract negotiations. Efforts at conciliation by outside parties were made without success. In spite of a relatively narrow field of disagreement and a market situation characterized by rising copper prices, the company finally decided to close down the mine.

The first discovery at Britannia is said to have been made in 1888, but the first claims were not staked until 1898. A large iron-stained bluff attracted the attention of prospectors, and this proved to be the outcrop of one of a number of orebodies that ranged in elevation up to 4,300 feet. Development was started in 1902, and some production was obtained by 1905. The first main adit was driven at the 1050 level to develop the Jane orebody at 3,300 feet elevation. However, the mine did not become an important producer until about 1911, when G. B. Schley, of New York, was able to finance development on a larger scale. In the succeeding years several new orebodies were opened up along the 5-mile length of the Britannia shear structure; these included the Bluff, Fairview, Empress, Victoria, and No. 8. Several long adits were driven in at various levels. The longest of these, the 4100 level, was the final main haulage level and extended from the mill level at Britannia Beach for a distance of 4 miles along the shear zone. At the time of closure the workings in No. 8 mine extended to well over 1,000 feet below sea-level.

The first mill for the treatment of Britannia ores was erected in 1904 and had a capacity of 200 tons a day, which was increased gradually to 600 tons a day by 1916. In 1916 it was replaced by a new concentrator, which reached a daily capacity of 2,000 tons a day by 1921. In that year a disastrous fire and flood occurred at Britannia Beach, and the mill was destroyed. A new 3,000-ton concentrator was built and was completed early in 1923. The years from 1923 to 1957 were the most productive years at the Britannia property. The highest production was achieved in 1930, when 2,215,600 tons of ore was produced, yielding, in concentrate, 45,188,466 pounds of copper. In the post-war years, production never exceeded 20,000,000 pounds of copper annually, and in 1957, as a result of declining copper prices, the Howe Sound Company proposed to cease operations. This was averted for a time by a direct government subsidy, but on March 12, 1958, the property was closed down and the company went into voluntary liquidation.

* By A. R. C. James.

A new company was formed and the mine was reopened in January, 1959, production being resumed on a reduced scale. This continued until January, 1963, when the mine was purchased by the Anaconda Company, who immediately stepped up production, development, and exploration.

Total production for the mine since 1905 is as follows: Ore mined, 47,488,038 tons. Metal content in concentrates: Gold, 478,430 ounces; silver, 5,207,882 ounces; copper, 1,017,526,737 pounds; lead, 33,934,200 pounds; zinc, 268,498,072 pounds.

Production in 1964 was as follows: Ore mined, 444,757 tons; copper concentrate, 18,900 tons; zinc concentrate, 3,516 tons; copper precipitate, 456 tons. Metals contained in concentrates (and precipitate): Gold, 8,854 ounces; silver, 45,249 ounces; copper, 11,983,236 pounds; zinc, 4,236,654 pounds; cadmium, 20,984 pounds.

A summary of development work completed in 1964 is as follows:—

	Ft.
Drifting	10,327
Raising	2,523
Diamond drilling	45,904

A total crew of 333 men was employed at the time of closure.

At the beginning of the strike on August 11th, there were a number of pre-loaded blast-holes in the blast-hole stope zones of No. 8 mine containing a total of 30,900 pounds of explosives. Most of these pre-loaded holes were in the 49-054 stope zone, where there was a total of 1,400 holes loaded with 26,850 pounds of explosives. The holes were drilled to blast the crown pillar immediately below the 4800 level and a small pillar above the level, together containing a total of 50,000 tons of ore. After the closure of the mine was announced, it became imperative to prime and blast all pre-loaded holes, and this was done in November, the major blast in the 49-054 stope being detonated on November 9th. The results of the latter blast appeared to be quite satisfactory. The 49-054 stope was filled with broken ore estimated at about 70,000 tons; this included 20,000 tons of broken ore previously in the stope and 50,000 tons blasted from the crown pillar. There was no evidence of backfill having broken through from the adjoining 053 or 060 stopes. Although this may break through in the future, it is not considered that there would be any large loss of ore in the event of a resumption of operations.

Copper-Molybdenum

Anaconda American Brass Limited* (49° 122° N.W.) Western Exploration Division office, Britannia Beach. Glenn C. Waterman, chief geologist. This company prospected in the Indian River area over a large number of claims held by The Anaconda Company (Canada) Ltd. as part of the Britannia property and on claim groups optioned from Falconbridge Nickel Mines Limited.

Geochemical sampling and geological mapping were carried out and four holes totalling 3,027 feet were diamond drilled. The crew of four or five men was serviced by helicopter from Britannia Beach.

* By A. R. C. James.

Copper-Lead-Zinc

McVicar (Anaconda American Brass Limited)*

(49° 122° N.W.) Western Exploration Division office, Britannia Beach. Glenn C. Waterman, chief geologist. This property, comprising 12 Crown-granted claims and fractions and 35 recorded claims held by option agreement, is situated northeast of Indian River on the north slope of Mount Baldwin near the headwaters of Raffuse Creek. The showings are reported to consist of quartz and sulphide stringers and veins containing low-grade copper, lead, and zinc mineralization occurring in sheared volcanics. A crew of four or five men was employed in September and October. Work done included a considerable amount of geological mapping, geochemical sampling, and some induced polarization geophysical surveys.

ALTA LAKE

Copper

London (New Jersey Zinc Exploration Company (Canada) Ltd.)*

(50° 122° S.W.) Company office, 905, 525 Seymour Street, Vancouver 2. The London group comprises Mineral Lease M 9, which includes six formerly Crown-granted mineral claims and one fractional claim and five recorded claims. It is on the southwest side of Fitzsimmons Creek about 4 miles from Alta Lake. A jeep-road connects the property with the Squamish–Pemberton road.

The property was described in some detail in the 1963 Annual Report. In 1964 work was begun in June and continued to the end of the year. Access roads to drill-sites totalling 1½ miles were built. The drill-sites are in rugged terrain at an elevation of about 4,700 to 5,000 feet. Four vertical holes totalling 3,660 feet were diamond drilled. A small combination core-house and bunk-house was erected. A crew of from 2 to 10 men was employed. J. B. Seaton was resident geologist. (*See* Annual Reports, 1910, pp. 147–149; 1930, p. 312; 1963, p. 94.)

Copper

Azure (The Mining Corporation of Canada, Limited)*

(50° 122° S.W.) Company office, 44 King Street West, Toronto; consulting geologist, J. S. Scott, 402 West Pender Street, Vancouver 1. The property, comprising 98 located claims, covers the valley of Fitzsimmons Creek for a distance of about 4 miles southeasterly from Green Lake. The showings were described in the 1963 Annual Report, and consist of disseminated chalcopyrite and pyrite in a schistose host rock.

In May and June an induced polarization survey was made of some 3,000 acres of the property. The company reports that this survey was successful in indicating zones of anomalous disseminated sulphide content. From June 15th to December 21st a total of 7,025 feet of diamond drilling was done in nine holes. A maximum crew of 16 men was employed.

TEXADA ISLAND

Iron-Copper

Texada Mines Ltd.†

(49° 124° N.W.) Registered office, 626 West Pender Street, Vancouver 2; mine office, Box 10, Gillies Bay. A. D. Christensen, San Francisco, president; A. M. Walker, general manager. This company holds 53 recorded claims, 8 Crown-

* By A. R. C. James.
† By A. Sutherland Brown and J. E. Merrett.

granted claims, and 1 mineral lease east and southeast of Welcome Bay on Texada Island. An additional four mineral claims and a mineral lease are held in the vicinity of Priest Lake, 3½ miles north of the mine, and nine claims west of Pocahontas Bay, 6 miles east of the mine.

Open-pit mining continued in the Prescott, North Paxton, and Lake pits but was completed by the end of October. During this period 464,310 tons of iron ore and 224,794 cubic yards of waste were removed. This terminated 12½ years of open-pit mining, which produced 8.3 million tons of ore.

Production of ore from underground began in April at a rate of 1,000 tons per working-day. This rate was gradually increased to 4,000 tons per day, when production from the open pits ceased. By the end of the year 434,407 tons of ore had been produced underground by longhole mining methods in the Midway and Main Yellow Kid workings.

The combined tonnage of open-pit and underground ore milled was 1,013,488 tons. This produced 576,962 tons of iron concentrate and 5,441 tons of copper concentrate.

Development work completed underground comprised 7,987 feet of drifting, 3,180 feet of raising, and 560,753 feet of 2-inch-diameter longhole drilling. The drift mining was done mostly on development of the orebodies for longhole drilling and slushing but 1,437 feet was completed on exploration, principally on a drive from the North Yellow Kid zone to the Lake zone.

A total of 39,316 feet of diamond drilling was completed in 259 holes in both surface and underground drilling.

An extensive increase was made in the milling circuit by the addition of a larger regrind mill together with extra flotation and magnetic separation equipment. The new equipment not only permits increased capacity for the processing of normal ore but provides improved facilities for the treatment of iron-copper ore.

The major construction items completed in 1964 were the extension of the main dock to double its berthing capacity and the reconstruction of the concentrate loading facilities. The dock was extended in a seaward direction as well as lengthened in order to provide a minimum water depth of 45 feet for ships of more than 50,000 tons capacity.

The former concentrate loading tower and boom were replaced by two retractable loading towers with attached loading booms having a travel of 76½ feet. The booms are capable of being raised or lowered, or swung from side to side, to facilitate the distribution of concentrate during ship-loading. Both loading towers may be used simultaneously when necessary.

The iron-concentrate storage area was extended, and a second reclaiming tunnel equipped with four feeders was constructed under the stockpile. The speed of the reclaiming conveyors was increased, and where necessary belt sizes were increased.

The number of persons employed was 245, of whom 107 were underground.

Geology

The iron oxide-copper sulphide orebodies of Texada Mines have been repeatedly studied and may with some justice be considered typical of metasomatic replacement deposits of the coastal region. McConnell (1914), Swanson (1925), Bacon (1952, 1956), Skerl (1960), and a recent unpublished thesis by Sangster (1964) have described and analysed the deposits in considerable detail. However, little has been published about the geology revealed by recent underground developments.

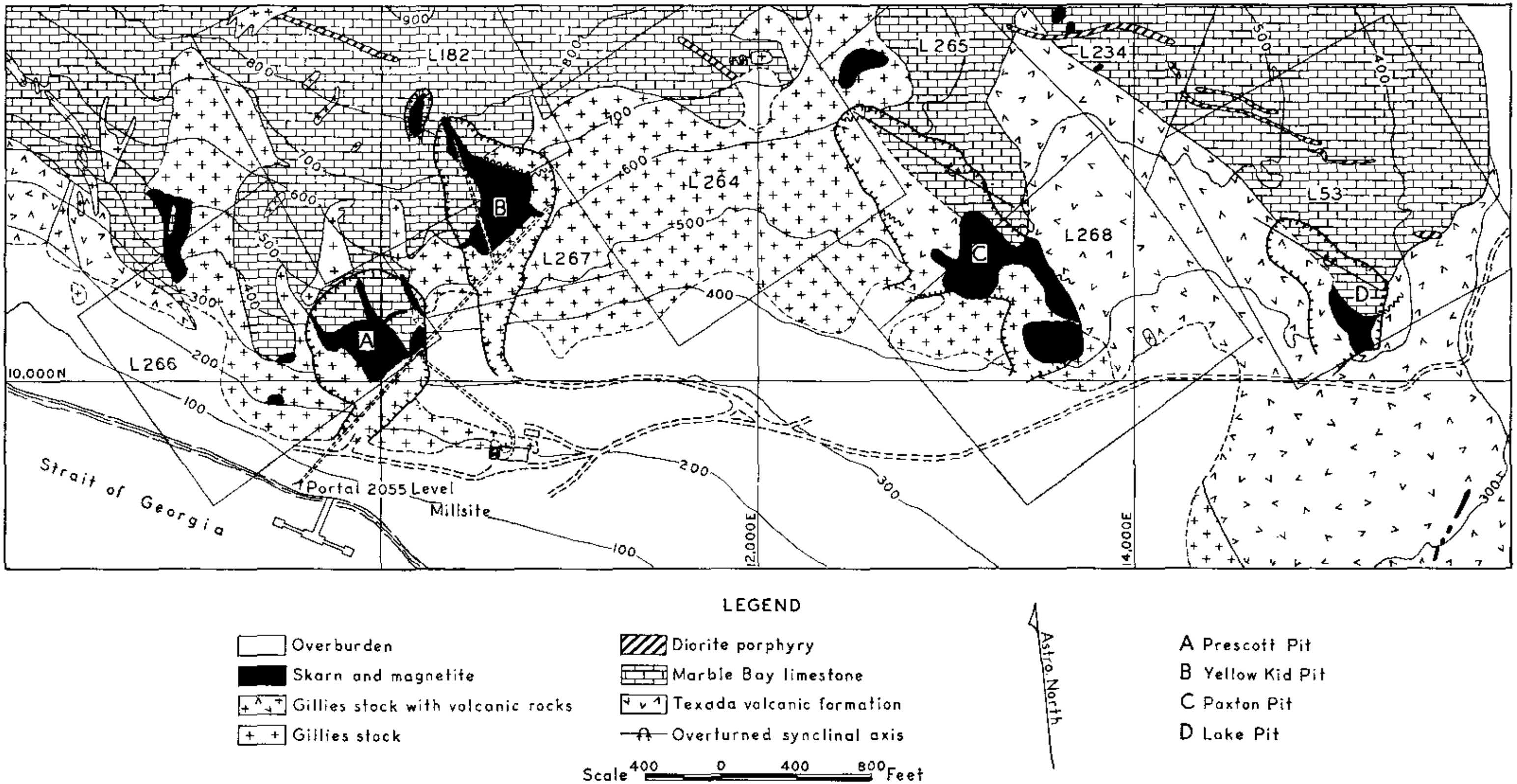


Figure 14. Texada Mines Ltd. Geology of mine area.

This note is based primarily on the mapping of company geologists and Dr. Skerl, who are not necessarily responsible for the following ideas.

Figure 14 shows the surface geology based on maps by McConnell and Bacon and revised to show the present (final ?) pit outlines and location of the shaft and main (2055) level. The known orebodies are clustered about a salient at the north end of the Gillies stock, the Lake and Paxton on the east, and the Prescott, Midway, and Yellow Kid on the west. The orebodies can be considered in two groups because of their geographic separation, but more particularly because the orebodies of the west (Prescott, Midway, Yellow Kid), though of similar mineralogy and with similar host rocks as those of the east (Paxton and Lake and their extensions), are in quite different structural settings.

The stratigraphic units of Texada Island are directly correlated with those of Vancouver Island and in fact are nearly identical. The oldest rocks of the mine area are basalts of the Texada Formation, which is the correlative of the pre-Middle Karnian Karmutsen Formation of Vancouver Island. Conformably overlying the basalts is the thick Marble Bay Limestone, the correlative of the Late Triassic Quatsino Limestone. The intrusive rocks, both the minor porphyries and main Gillies stock, are equivalent to similar rocks adjacent to magnetite deposits on Vancouver Island.

The rocks of the Gillies stock are slightly variable, but the commonest phase is a grey equigranular, medium-grained, mafic-rich pyroxene-bearing granodiorite to quartz diorite which contains occasional pyroxene phenocrysts. The pre-ore diorite porphyries are variable appearing plagioclase-hornblende porphyries with a stony looking dark grey-green fine-grained matrix; in hand specimen the feldspars appear to have vague gradational boundaries with the matrix. Garnet-actinolite-pyroxene-epidote skarn and magnetite-sulphide bodies may replace basalt, limestone, Gillies stock, or diorite porphyry. Post-ore rocks in the vicinity are limited to large tabular dykes of grey feldspar porphyry that has fewer phenocrysts than the pre-ore porphyries, and to small late grey-green andesite dykes with rare hornblende phenocrysts. In the past there has been some difference of opinion about the porphyries; some believed they were pre-ore and some post-ore, but few considered that porphyries of both ages were present.

The Lake and Paxton orebodies replace limestone, basalts, and minor amounts of quartz diorite at the keels of compressed overturned synclines which plunge gently westward and are sharply overturned toward the northeast. The strike of the limestone-volcanic contact of the upper limb is about north 40 degrees west, but the axes strike more nearly north 60 degrees west. The position, orientation, and rarity of these overturned folds in the whole area of northern Texada Island indicate that they may have been produced by lateral thrusting during emplacement of the stock. Figure 15 shows sections through both orebodies which occur at the keels of the limestone, within an envelope of skarn that replaces limestone and greenstone and, in the Paxton, some diorite which intrudes the volcanic rocks. Post-ore porphyry dykes are prominent, and pre-ore dykes are not definitely recognized. Whether or not the upper limbs of these folds are thrusts, the keels are loci of small steep faults, some of which may be pre-ore.

The underground workings which develop the western orebodies include four main levels at 200 feet intervals: the 2055 level, an adit level with a portal about 25 feet above sea-level, the 1855, 1655, and 1455 levels, a connecting three-compartment shaft with friction hoist, ore-passes, and primary crusher just below 1455 level, and a conveyor raise to the shaft pockets. The plans of the four main levels are shown in Figure 16.

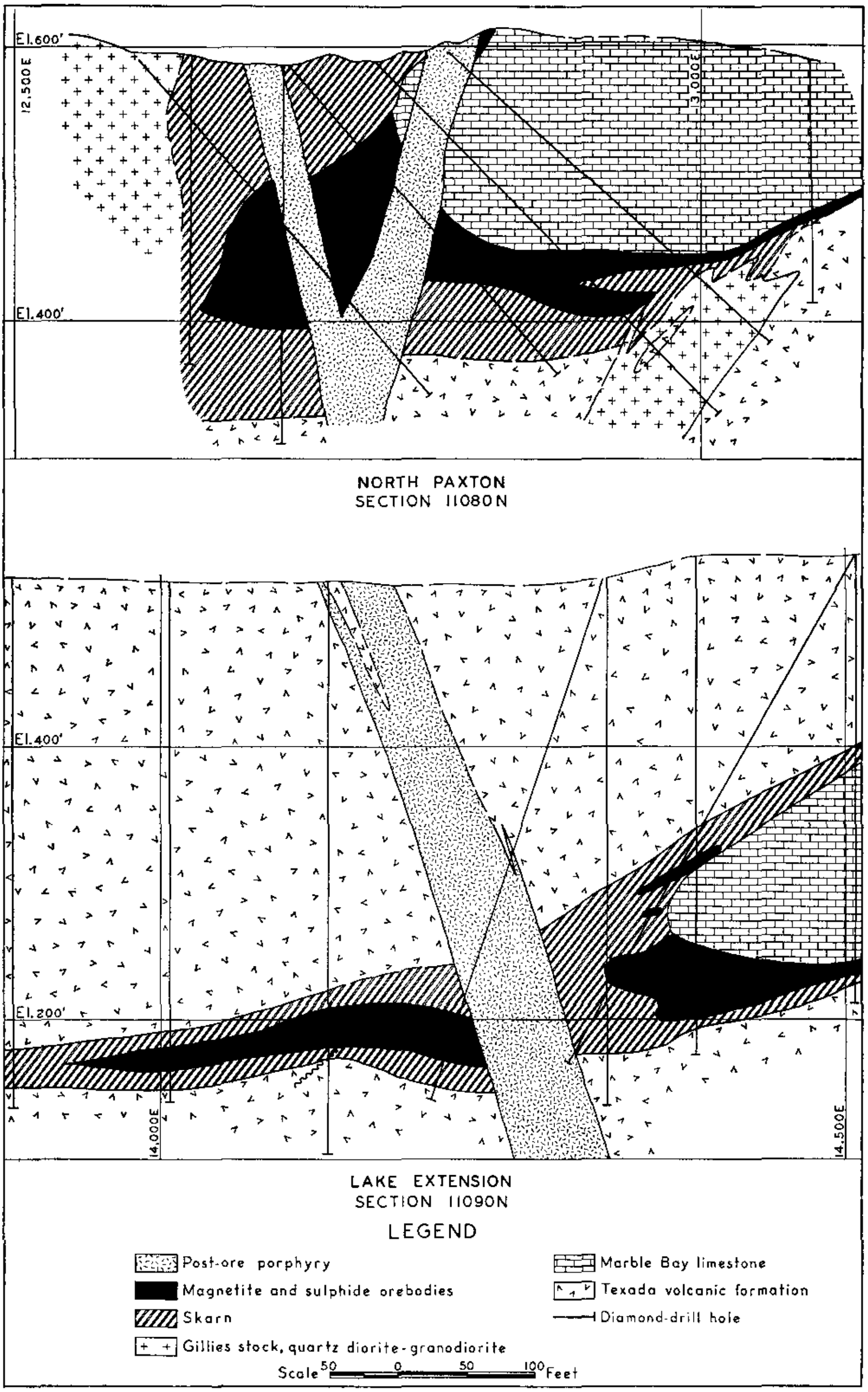


Figure 15. Texada Mines Ltd. Cross-sections of Paxton and Lake orebodies.

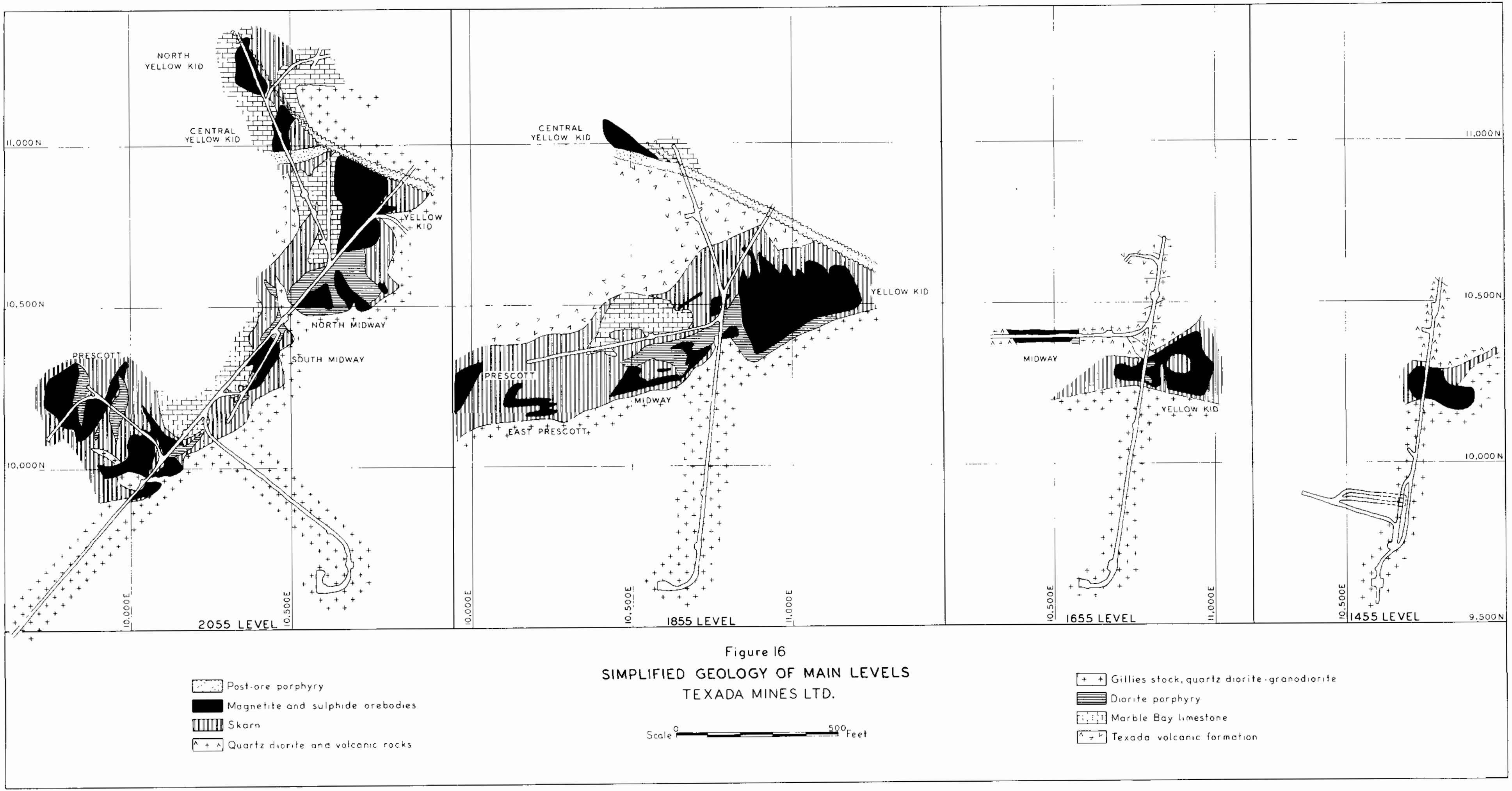


Figure 16

SIMPLIFIED GEOLOGY OF MAIN LEVELS
TEXADA MINES LTD.

The structural setting of the western orebodies is quite different from that of the Lake and Paxton. The most striking feature is that the orebodies branch upward so that in three dimension they crudely resemble a tree, the thick stem of which is found at the lowest levels (1455–1655) at or near the east-west contact of the stock with the Texada volcanics. At upper levels the contact of the stock warps to the east and overhangs the older rocks on the lower levels. The Marble Bay limestone in general dips at moderate attitudes southward. It, or skarn developed from it, is in contact with the stock down to the 1800 level, but there are only volcanic and plutonic rocks below. The orebodies branch and blossom out upon reaching the " limestone " and follow the warped contact of diorite, limestone, and volcanics in the upper levels.

The distribution of pre-ore porphyry is important in the western orebodies, as is evidence of brecciation. The pre-ore porphyries are rarely seen in the open pits or much above the 2055 level; on the 2055 and 1855 levels they are prominent, but only in the ore zones; and on the 1655 and 1455 levels they occur to a minor degree in the ore zone. The porphyry masses are irregular and discontinuous, because of their original form and because they have been replaced by skarn and truncated by the main granodiorite. Many of the upper orebodies have textures that appear to mimic breccia textures, with " fragments " of magnetite and filling of coarse calcite. In the orebodies below the limestone, breccia textures are more clearly revealed, both in unreplaced and in replaced mimetic form. Intrusion breccias of volcanic fragments in diorite are common throughout the contact area. In the west drift on 1655 level, magnetite replaces the volcanic rock and quartz and chalcopyrite replace the diorite matrix. In addition, in some ore zones there is indication of a later brecciation, with quartz and sulphides filling interstices and with quartz crystal faces common. In summary, the orebodies form an upwardly branching system that follows a contact zone in which irregular porphyry bodies and breccia are important. Where the system reaches the limestone, both porphyry and orebodies blossom out. It is at least likely that the whole was a breccia pipe system before it was largely replaced by skarn and magnetite.

[References: Bacon, W. R., *Minister of Mines, B.C.*, Ann. Rept., 1952, pp. 217–221; Ann. Rept., 1956, pp. 5–7; McConnell, R. G., *Geol. Surv., Canada,* Mem. 58, 1914; Sangster, D. F., unpublished Ph.D. thesis, *U.B.C.*, 1964; Skerl, A. C., *Geol. Soc. Am.*, Bull., 1960, p. 2076; Swanson, C. O., *Geol. Surv., Canada,* Sum. Rept., 1924, pp. 106–144.]

QUADRA ISLAND

Copper

Copper Road* (50° 125° S.E.) This property comprises 15 recorded mineral claims held by E. H., John, Blanche, and Antoinette Adams, all of Campbell River, and 19 recorded mineral claims held by Robert I. Bennett, of Heriot Bay. The Adams' claims are leased to Mr. Bennett. It is on the west side of Quadra Island about 2 miles northeast of Deepwater Bay and is connected by road to the ferry terminus at Quathiaski Cove. At about 9 miles north of Heriot Bay a steep logging-road leads one-half mile west and north to the principal showing, which is at the east end of the property.

Two men built 1,500 feet of new road to by-pass a very steep section, repaired and reballasted 1.8 miles of road to Deepwater Bay where a 43- by 100-foot barge-loading grid was constructed. In addition, construction was started on a water-storage dam and flotation mill.

* By J. E. Merrett.

Copper-Silver

Baron, Star, etc. (New Ainsworth Base Metals Limited)*

(50° 125° S.E.) Company office, 8, 425 Howe Street, Vancouver 1. Wm. Inverarity, president. This company holds 24 mineral claims north of Garrow Bay at the north extension of Gowlland Harbour on the west side of Quadra Island. The property covers in part that which was held in 1953 by Dodge Copper Mines Limited and was described in the Annual Report for that year. A bulldozer and a crew of seven men stripped the overburden from a 1-acre area approximately three-quarters of a mile north of Garrow Bay. A shipment of 371 tons of ore contained 11,106 pounds of copper and 82 ounces of silver.

VANCOUVER ISLAND

SAYWARD (50° 125° S.W.)

Iron

Iron Mike (Orecan Mines Ltd.)*

Company office, 613, 744 West Hastings Street, Vancouver 1. A. E. Upton, president. Inter-Can Development Company Ltd. was reorganized late in 1964 to form the present company. The company has under lease the Iron Mike (Hartt) property, 4 miles southwest of Sayward and 3 miles west of the junction of the Salmon and White Rivers. A crew of eight men constructed 3,000 feet of road, did 1,224 feet of diamond drilling in 14 holes, and completed the excavations for the crushing sections of the mill. A considerable amount of ore dressing testing was done in order to establish a satisfactory mill flowsheet.

BENSON RIVER (50° 127° S.E.)

Iron

Empire Development Company Limited*

Company office, 1012, 736 Granville Street, Vancouver 2; mine office, Port McNeill. E. C. Oates, general manager; P. W. Billwiller, mine manager. The Empire mine open pit is at an elevation of 2,500 feet on the west side of the Benson River valley approximately 2 miles south of Benson Lake and on the east slope of Merry Widow Mountain. The adit is at an elevation of 1,911 feet and the camp at 800 feet. A 3-mile tote-road connects the adit and camp and 25 miles of gravel road provides access to the camp from Port McNeill on the east coast of Vancouver Island.

The major portion of the construction work has been completed on an aerial tram-line, 3,000 feet in length, connecting the adit level to the mill ore stockpile. The installation is of jig-back design having two 5-ton-capacity skips, a loading tower, a central supporting tower, and a dump tower. A coarse-ore bin was erected on the dump between the adit and upper tram terminal.

A total of 1,913 feet of drifting and crosscutting and 1,172 feet of raising was completed. This work extended the Kingfisher adit to a total length of 1,650 feet to the Merry Widow ore zone, where three raises were being driven to develop the zone. In addition, it included the mucking-machine crosscuts to the bottoms of the three raises and interconnecting sublevels between the raises.

The crew, comprising 11 men in April, was increased to 52 by November, but because of a heavy snowfall in December was reduced to a skeleton staff. When work was being done underground, approximately 18 miners were employed. A shipment was made of concentrates produced in 1963.

* By J. E. Merrett.

Iron-Copper

Old Sport (Coast Copper Company Limited)*

Company office, Tadanac; mine office, Port McNeill. The Consolidated Mining and Smelting Company of Canada, Limited, is the principal shareholder and manages the operation. H. G. Barker, property superintendent; R. T. Trenaman, mine superintendent; J. L. McCrea, mill superintendent. The property comprises 48 Crown-granted claims, 5 recorded claims, and 1 mineral lease extending southward from Benson Lake on the west side of Benson River, and adjoins the Empire property on the north and east. Access is by way of a 26-mile gravel road from Port McNeill, where an employee residence townsite is located.

In addition to the rehabilitation of 5,262 feet of old drift, 2,807 feet of drifting and crosscutting was completed. Most of this work was done on the 5300 level in extending the east and west drifts, and on the west end of the 5500 level. An additional 440 feet of shaft in the No. 2 winze was retimbered and brought into service, thus extending the operating section length to 890 feet. Raising done for stope servicing and ventilation was 6,719 feet, while 17,489 feet of exploration diamond drilling was completed. The crew of 196 men, of whom 105 were employed underground, mined and milled 306,132 tons of ore. Copper concentrate and, after the beginning of March, iron concentrate from the iron-recovery plant completed at that time, were trucked to the Port McNeill loading terminal for shipment to Japan.

ZEBALLOS (50° 126° S.W.)

Iron

F.L., Ridge, Cordova (Zeballos Iron Mines Limited)†

Company office, 504, 1112 West Pender Street, Vancouver 1. P. N. Pitcher, president; C. E. Gordon Brown, manager. The property comprises 13 Crown-granted and 15 recorded claims and is 4 miles north of Zeballos. A high-grade magnetite orebody outcrops on the west side of Zeballos River valley at an elevation of approximately 2,600 feet. The outcrop of magnetite extends in a north-south direction for 1,500 feet, averaging 70 feet thick, and the body dips westward at about 40 degrees. The hangingwall is a complex of tuff, intrusive andesite, diorite, and granodiorite, locally altered to skarn, and the footwall is composed of grey Quatsino limestone.

The present company commenced work on the property in 1959. Open-pit mining began in 1962, and by the end of that year 250,397 tons of iron concentrate had been shipped. On February 27, 1963, the property was closed down. After a complete reorganization of the company and change of control, the property was reopened on November 1, 1963, and prepared for renewed production as an underground mine. All underground development work and production was carried out under contract. A main-haulage adit level was established at 2,280 feet elevation, and subsequently two further adit levels were driven at 2,375 and 2,440 feet elevations respectively. The system of mining is longhole blasting with mucking-machine draw points. The following is a summary of underground development work completed in 1964:—

	Ft.
Drifting	3,884
Crosscutting	1,139
Raising	1,691
Diamond drilling	1,877

A limited amount of open-pit mining was done near the main-adit portal.

* By J. E. Merrett.
† By A. R. C. James.

The first production under the reorganized company was in July. Total production of iron concentrates in 1964 was 92,727 tons.

The ore is trucked from the mine to the primary crusher at 2,100 feet elevation. It then passes through a secondary crusher and into a 100-ton surge bin. From there it is withdrawn in 9-ton steel skips which descend over a standard-gauge triple-track surface tram to the crude-ore stockpile just above the mill. The surface tram-line is 2,500 feet long and extends from elevation 1,900 feet to the mill horizon of 1,200 feet. At the mill the ore is beneficiated by magnetic separation. It is then trucked to a loading dock at the head of Zeballos Inlet, where a stacker conveyor delivers the ore to a stockpile which may contain up to 80,000 tons. An underground conveyor system removes ore from this stockpile and loads directly into the holds of ocean-going freighters. A total crew of 90 men was employed, 52 being employed underground. (*See* Annual Report, 1962, pp. 100–103.)

Copper

Privateer (New Privateer Mines Limited)*

Company office, 514, 193 East Hastings Street, Vancouver. E. K. Pinkerton, president. Capital: 3,000,000 shares, no par value. The company holds the old Privateer property and, by option, the Uebel group of claims situated near the confluence of Spud Creek and Zeballos River.

In 1961 the company drilled on the Uebel claims and reported finding significant copper mineralization. The company stated that the diamond drilling so far done indicated a reserve of 161,000 tons grading 2 per cent copper. At the beginning of July, 1964, the company resumed work in this area. Nine packsack holes were drilled, and in the latter part of September a diamond drill was brought onto the property. It is not known what footage or how many holes were drilled, as no information was forthcoming from the company, but the writer believes that not more than two or three holes were drilled. Work on the property was concluded in December. A crew of four men was employed under the supervision of C. Leighton.

Holberg Inlet (50° 128° N.E.)

Copper

Holberg Mines Ltd.†

Company office, 103, 709 Dunsmuir Street, Vancouver 1. P. F. Wishart, president. The property, comprising 113 recorded mineral claims, is on the north slope of Mount Hansen and about the head of Holberg Inlet, Quatsino Sound. The camp is about 2½ miles by road from Holberg. A crew of three men constructed a 12- by 16-foot core-storage building and, with the aid of a bulldozer, built 1,200 feet of access road to three diamond-drilling sites. A total of 1,545 feet of diamond drilling was done in 10 holes at eight separate locations.

Quatsino (50° 127° S.W.)

Copper

Yreka (Teeta River Mining Co. Ltd.)†

Company office, 311, 543 Granville Street, Vancouver 1; mine office, Jeune Landing. J. R. Billingsley, manager. This company, jointly owned by Mitsubishi International Corporation and Noranda Exploration Company, Limited, reopened in November the Yreka property on the west shore

* By A. R. C. James.
† By J. E. Merrett.

of Neroutsos Inlet about 2 miles south of Pender Point, Quatsino Sound. A crew of four men built a landing-float adjacent to the existing wharf, began the construction of four bunk-houses, and cleared approximately 1,000 feet of right-of-way along the line of a proposed aerial tramway to link the mine to the beach concentrator. While this was being done, metallurgical tests were made on the ore and work started on the mill design.

HERBERT INLET (49° 125° S.W.)

Copper

Catface Copper Mines Limited* This company is wholly owned by Falconbridge Nickel Mines Limited (British Columbia office, 504, 1112 West Pender Street, Vancouver 1; Alex. Smith, exploration manager). The property, comprising 131 recorded claims on Catface Range, is on a peninsula between Bedwell Sound and Herbert Inlet and is about 8 miles north of Tofino.

The range rises rapidly to a maximum elevation of about 3,000 feet, and the principal showings occur on a southwestward-facing cliff which rises for many hundreds of feet from its base at about 1,600 feet elevation. The showings comprise disseminated chalcopyrite and bornite mineralization with extensive malachite staining in quartz monzonite. These showings, together with the local geology, were described in the 1963 Annual Report.

In 1964 work was started in early February and continued until the end of October. A crew of six men under H. S. Lazenby carried out geological mapping and geophysical work, and drilled 45 packsack diamond-drill holes totalling 3,512 feet.

TSOLUM RIVER (49° 125° N.E.)

Copper

Domineer (Mount Washington Milling Company Ltd.)* Company office, 204, 569 Howe Street, Vancouver 1; mine office, Box 1809, Courtenay. C. W. S. Tremaine, manager. In the spring of 1964 an agreement was concluded between Mt. Washington Copper Co. Ltd. and Consolidated Woodgreen Mines Limited for a joint development of the Mount Washington property above the 4,000-foot level. (The mineral claims below this level were at that time under option to The Consolidated Mining and Smelting Company of Canada, Limited.) As part of the agreement, Consolidated Woodgreen Mines Limited (since renamed Cumberland Mining Ltd.) undertook to dismantle its 1,000-ton mill at the Motherlode property near Greenwood and rebuild it at the Mount Washington property. A new operating company was formed, named the Mount Washington Milling Company Ltd., and, under the agreement, profits are to be divided between the two original companies.

The Mount Washington property falls within the old Esquimalt and Nanaimo Railway Grant, and the area which comes within the above-mentioned agreement is defined as "a rectangle of 284 acres above the 4,000-foot elevation measuring 4,500 feet north and south and 2,750 feet east and west, and measuring 2,000 feet west and 750 feet east of the portal of the adit tunnel and 2,000 feet north and 2,500 feet south of the same." In this area the gold and silver rights are held by right of location under the *Mineral Act,* and the base-metal rights are held by concession. The defined area includes four Crown-granted claims, the Domineer Nos. 1, 3, 4, and 6. The geology of the property has been described in some detail in the Annual Reports for 1959, 1960, and 1963. Exploration work began in 1956

* By A. R. C. James.

and has been fairly continuous since that date; it has included stripping, shallow diamond drilling, and an adit. The main showings at about 4,400 feet elevation consist of flat-lying quartz veins mineralized with chalcopyrite, bornite, and other minerals. The mineralization also extends into adjacent rocks, which consist of Cretaceous sediments and intrusive porphyry and breccia. Access to the property is through the Crown Zellerbach tree-farm licence area to the northwest of Courtenay; the distance to the mine is about 18 miles.

In July improvements were carried out on the upper section of the mine road, and in August a start was made in stripping waste in preparation for open-pit mining. Open-pit mining of ore began in September, under contract. By the end of the year a total of 90,929 tons of ore had been stock-piled at the mill-site and 134,621 tons of waste had been moved. Equipment at the mine includes three air track drills, two 1½-cubic-yard shovels, a 600-cubic-foot-per-minute air compressor, two D-8 bulldozers, and 15 trucks. A machine repair-shop and office building was erected at the mine.

The mill-site was chosen at a point 4½ miles by road from the mine, at an elevation of 2,400 feet. Work on the preparation of the site and the erection of the mill continued throughout the summer and fall, and the official opening took place on December 5, 1964. The mill, comprising a crushing, grinding, and flotation plant, operated on a tune-up basis throughout December; it is expected that it will shortly be treating 750 tons of ore per day. The total crew employed at the end of the year was 55; this included 25 men at the mine, 20 men at the mill, and 10 staff. Earlier in the year a crew of up to 80 men was employed on the mill construction. (*See* Annual Report, 1963, pp. 103–105.)

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

Exploration office, 508 Marine Building, Vancouver 1. E. H. Caldwell, western district superintendent. The Consolidated Mining and Smelting Company of Canada, Limited, retained its option on the Mount Washington property below the 4,000-foot level throughout the 1964 season. The property comprises about 195 recorded claims. The geology of the area was described in some detail in the 1963 Annual Report. In 1964 the lower mineral showings in the Murex Creek area were investigated. These consist of scattered chalcopyrite and pyrrhotite stringers in biotite-altered volcanic rocks. Three holes, totalling 2,003 feet, were diamond drilled, and a magnetometer survey and some geological mapping were carried out. The work was begun on May 10th and concluded on August 24th. A crew of four men was employed under the supervision of A. C. N. de Voogd. The option was relinquished at the end of 1964.

Della Lake (49° 125° S.W.)

Copper

Big Interior (The Big 'I' Mines Ltd.)*

Company office, 605, 1030 West Georgia Street, Vancouver 5. A. Robertson, president; G. L. Mill, manager. Capital: 5,000,000 shares, no par value. This company controls 8 Crown-granted claims and 16 recorded claims in the Big Interior Mountain area in Strathcona Park on Vancouver Island. The Big 'I' Crown-granted claims cover a cirque near the summit and part of the summit of the range at an elevation of 6,000 feet. The history and geology of the property are described in the publications referred to at the end of this note.

* By A. R. C. James.

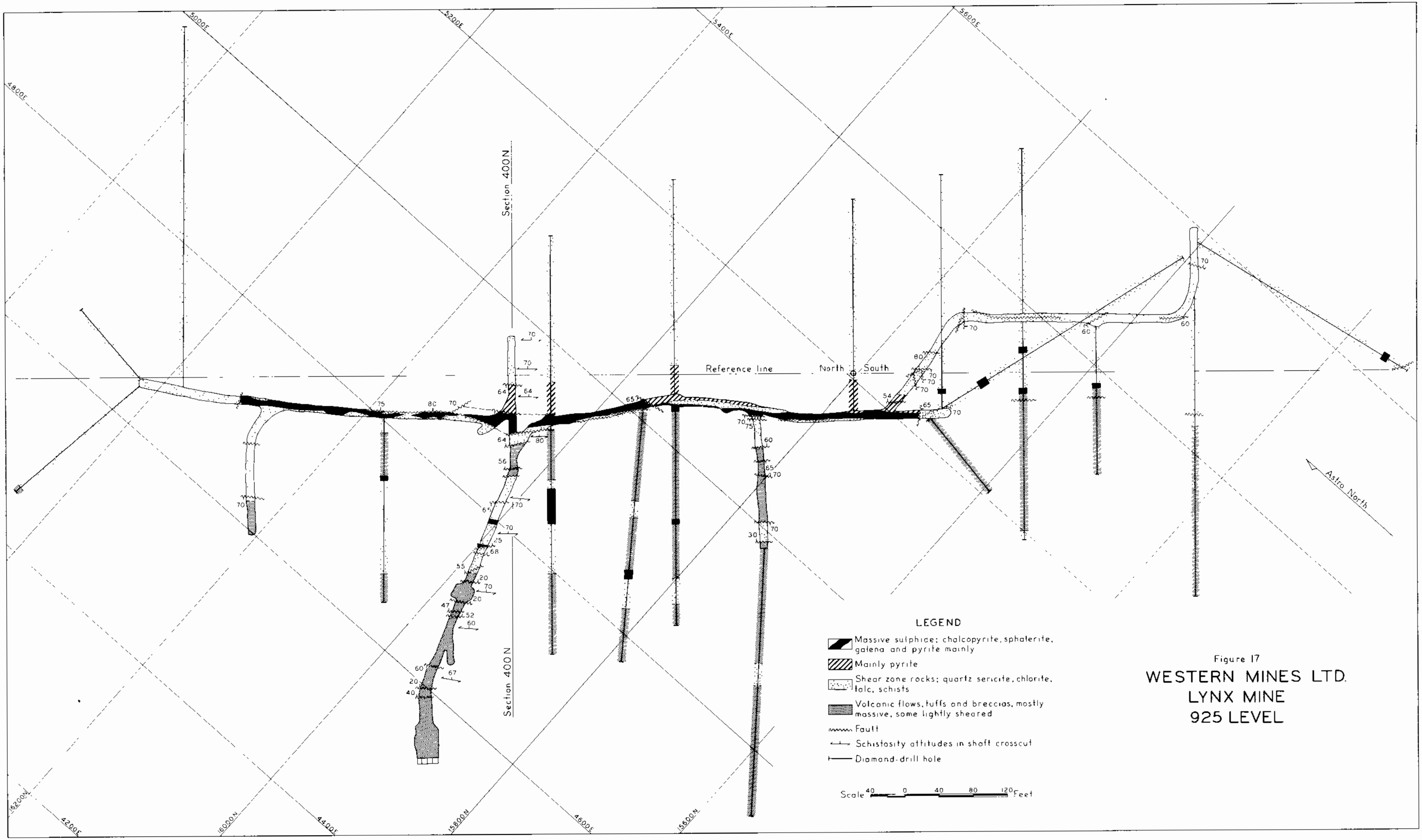


Figure 17

WESTERN MINES LTD.
LYNX MINE
925 LEVEL

In 1964 a total of 779 feet of diamond drilling was completed with a packsack drill and 4,039 feet (seven holes) with AXT size core. The work was started on July 16th and terminated on November 15th. A crew of 10 men was employed.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1916, pp. 314–317; 1960, pp. 110–111; *B.C. Dept. of Mines,* Bull. No. 13, 1941, pp. 61–79.]

Della (Della Mines Ltd.)*

Company office, 605, 1030 West Georgia Street, Vancouver 5. A. M. McPherson, president; G. L. Mill, manager. Capital: 5,000,000 shares, no par value. The company controls the Minnie, Della, and Helen Crown-granted claims and eight recorded claims. The property is on the east shore of Della Lake near Big Interior Mountain at the southern end of Strathcona Park. The history and geology of the property is described in the Annual Report for 1916, and in Bulletin No. 13 (Supplementary Report on the Bedwell River Area). In 1964 four holes were diamond drilled totalling 209 feet. A crew of three men was employed.

Buttle Lake (49° 125° N.W.)

Gold-Silver-Copper-Lead-Zinc

Lynx, Paramount, Price (Western Mines Limited)†

Company office, 802, 850 West Hastings Street, Vancouver 1; mine office, Box 8000, Campbell River. C. M. Campbell, Jr., general manager. Western Mines Limited, together with the wholly owned subsidiaries, Myra Falls Mines Ltd. and Price Creek Mines Ltd., now holds a total of 23 Crown-granted mineral claims, 2 claims held by mineral leases, and 144 recorded claims, of which 15 are held by option. The area is reached by road from Campbell River to Buttle Lake in central Vancouver Island, and then by boat for 20 miles to the head of the lake.

The Lynx mine is reached by a road 2½ miles up Myra Creek from the head of Buttle Lake. All work completed in 1964 was concentrated on the development of the Lynx property, where a total of 834 feet of crosscutting and drifting was done. This total included work done on all levels from the 925 level to the 1500 level. Interconnecting raises completed for ore transfer or ventilation purposes totalled 632 feet. Shaft-sinking recommenced in December and during that month 91 feet was completed. Underground development below the 1225 or main adit level was curtailed for a considerable portion of the year while an 84- by 54-inch Nordberg double-drum hoist and 250-horsepower electric-drive motor were being installed on that level. While this installation was being made, test stope preparation work was being done on the 1225 level. A total of 13,428 feet of underground diamond drilling was done.

On the surface, land-clearing for a permanent camp was continued and a survey made for the possible installation of a hydro plant on Tennent Creek, an upstream tributary of Myra Creek.

The average number of men employed was 73, of whom 35 were employed underground.

The regional setting of the deposits has been described in the Annual Reports for 1962 and 1963. At the Lynx mine the 1964 development described above showed that the mineralization continued in depth. The company's annual report states that as of September 30, 1964, the ore reserves, including a dilution factor of

* By A. R. C. James.
† By W. G. Jeffery.

20 per cent, consisted of assured and possible ore that totalled 1,500,200 tons with the following average grade: Gold, 0.063 ounce per ton; silver, 2.91 ounces per ton; copper, 2.19 per cent; lead, 1.21 per cent; zinc, 10.49 per cent.

The following geological description is given with acknowledgments to mine geologists A. H. Manifold and E. P. Sheppard, with whom the writer has had many interesting discussions.

Geology

Rock Types.—The Lynx orebodies are enclosed by a variety of volcanic rocks. The primary rocks consist of andesite flows, massive tuffs, volcanic breccias, and thin-bedded green and yellow tuffs. The secondary rocks derived from the primary rocks are green, buff, and grey schists. Some of the schists have remnant textures similar to those seen in the primary rocks. The greater part of the underground workings expose rocks of the shear zone with which the orebodies are associated.

The flow rocks are dark green, mottled, fine grained and have the composition of a pyroxene andesite with scattered feldspar phenocrysts. Jasper occurs as lenses and masses, such that the jasper may originally have formed rare persistent beds approximately 3 to 6 inches thick. The types of jasper observed underground varied in colour from purple to brick-red and brown. Microscopically the jaspers appeared as a glassy to cryptocrystalline aggregate, dusted with iron oxides. One specimen of brick-red jasper was composed of iron-stained quartz with scattered hematite-filled cavities. A chocolate-brown jasper showed fine banding developed mainly by different dust contents of the layers. These jasper occurrences, all of which are disrupted in underground exposures, may represent original chert beds or perhaps vitric tuffs.

Massive tuff is mostly shades of green with a large range of fragment size and in places gradational bedding. On the 1075 level the main crosscut close to the shaft station exposes well-bedded fine-grained green and yellow tuffs. Rarely, grey to black thin-bedded sediments are seen that may be reworked tuffs. Mostly the tuffs have a siliceous appearance and a cherty conchoidal fracture, and grade to discernably fragmental rocks in some places.

The volcanic breccia rocks contain lithic fragments up to 2 feet across. A very distinctive breccia type contains purple fragments in a dark-green matrix. The purple colour persists and can be seen in mottled purple and green schists where the purple fragments have been stretched and elongated in an altered dark-green chloritic and micaceous matrix. Whether there is more than one bed of purple fragmental rocks is unknown

In the mine the majority of exposures are yellow, green, grey, buff, and brown schistose rocks. The schists are composed of chlorite, sericite, talc, other micaceous minerals, and quartz, and have varying degrees of foliation. The rock colour has a slight relationship to the mineral composition, in that chlorite-rich rocks tend to be darker green, but much of the chlorite is a pale-green low-iron variety that is not readily distinguished. Talcose schists are evident by inspection and tend to be yellowish to pale brown.

Some schists, not necessarily those closest to massive sulphide, contain anhedral porphyroblasts of unstressed clear quartz. These quartz bodies have fretted edges to the micaceous foliation and are similar to those textures described in the Annual Report for 1963 from rocks enclosed by massive sulphides.

Various dykes can be observed underground. Fragments of a fine-grained dark-green dyke surrounded by massive sulphide are composed of a mosaic of quartz and chlorite with limited sericite and rare scattered aggregates of quartz and coarser chlorite. Another dyke cutting a pyrite zone is dominantly composed of chlorite and micaceous minerals with lesser quartz. Feldspar porphyry dyke rock observed in the cores of diamond-drill holes contained approximately 15 per cent plagioclase feldspars. This rock is not abundant and was not seen exposed in the underground workings.

Structure.—The Lynx mine is developed by adits at the 1500, 1375, and 1225 levels, the latter being the main entry. An internal vertical shaft from the 1225 level provides access to the 1075 and 925 levels, and deep drilling from the bottom level has probed to about 675 feet below that level.

This underground development has shown that the over-all mine structure is a steeply dipping zone of schistose rocks with concordant discontinuous massive sulphide bodies contained within the zone. The steep dips of the foliation in sheared rocks proven over a vertical distance of at least 1,250 feet are in contrast to the regional picture of the geology in which essentially massive volcanic pyroclastic rocks occur in faulted open folds with dips of the order of 30 to 40 degrees on the limbs. Axial lines of the regional folds trend north-northwest, whereas the shear zone at the Lynx mine trends northwest. The southwest wall of the schist zone is well known through mine development and the known orebodies occur close to this contact. The northeast boundary of the shear zone is undefined as yet, but the zone is at least 500 feet wide in the vicinity of the mine workings.

From the surface to approximately the 925 level the southwest wall of the shear zone has an over-all southwest dip of about 65 degrees, forming the hangingwall of the zone (*see* Fig. 18). In detail this dip ranges from near vertical to 30 degrees southwest. There is a bulge in the hangingwall that persists along strike at about the 1075 level. Below the 925 level limited evidence suggests that the dip of the southwest wall of the shear zone is reversed and the dip changes to the northeast.

The hangingwall rocks are massive or in places lightly sheared, and the contact between them and the quartz sericite chlorite schists of the shear zone is mostly either sharp or rapidly gradational. The upper levels of the mine have exposed the shear zone together with dyke rocks and sulphides. Below the 1075 level there are zones of massive purple volcanic breccia within the shear zone distinctly separated by schists from similar purple breccia rock in the main hangingwall. The tops of these masses are near horizontal along strike. The structure of these bodies of massive volcanic rocks is uncertain; there are three possibilities.

The first possibility is that they represent competent layers of breccia originally interfingered with rocks that were more subject to shearing and conversion to schists. This is considered unlikely because there are schists with remnant breccia and tuffaceous textures, and there are purple schists that clearly were derived from the purple breccias.

The second possibility is that the massive rocks are crestal parts of a folded purple breccia horizon. There is no direct evidence of folding in these rocks. Indirect indications of fold structures are seen in the 925 level shaft crosscut. From shaft to ore zone one passes from massive hangingwall rocks to sheared rocks with a steeply dipping northeast foliation. The schistosity increases in intensity and the rocks become talcose and very crumpled so that heavy timbering has been necessary. Also in this part of the crosscut an unusual amount of low angle strike faulting with dips of 20 degrees to the northeast is evident. Nearer to the ore zone the degree of schistosity decreases and the foliation changes to a steep dip to the southwest before entering a zone of weakly schistose purple breccias. Apart from possible complications due to the faults, the crosscut exposures suggest a cross-section through a fold structure.

The third possibility is that these volcanic breccia masses are merely " horses " left within the shear zone, and this is considered the most likely structure.

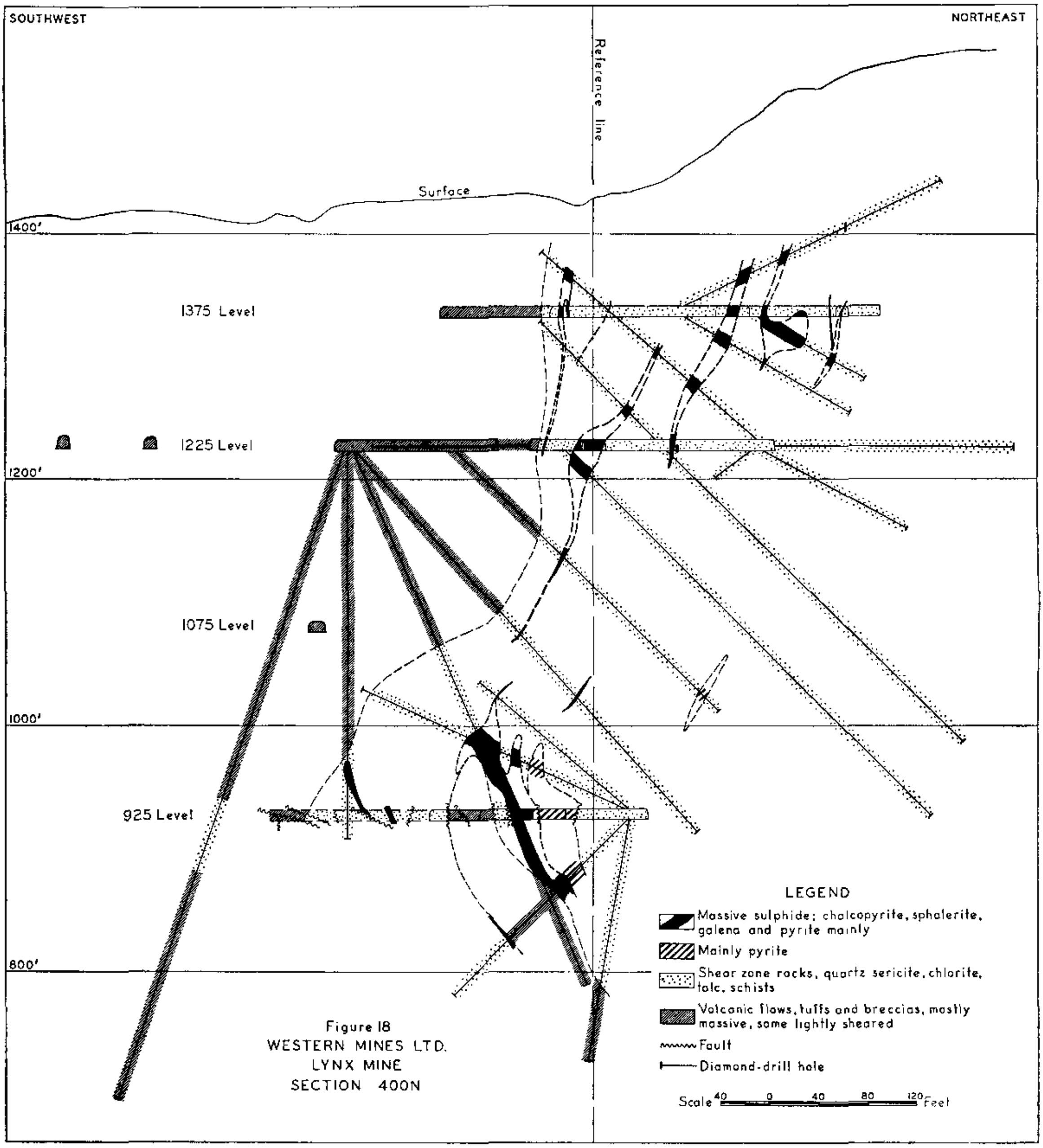


Figure 18. Western Mines Limited. Section through Lynx mine.

The structure of these masses is important as their position and configuration may play a part in ore localization.

Folds can be seen in the schists, though they are not common and in places would not be seen unless the exposures were very clean. Plunges of the axes are gentle, no more than 20 degrees, mostly to the northwest, except in one instance observed by the writer. So far there is no clear pattern of folding discernible, and the directions of movement on a few dragfolds do not appear to be consistent. Such dragfolds may eventually provide a pattern to larger fold structures within the shear zone.

Faults are widespread throughout the Lynx mine.

Numerous strike faults occur parallel to the foliation of the shear zone. Many of these faults contain gouge along parts of their length, and some lie close to the walls of orebodies but have not been seen cutting ore. Cross-faults, often containing soft clay gouge, cut the ore, and in places they displace the ore zone by apparent movements up to tens of feet. The cutoff by such faults is frequently very sharp, and in places the fault-ore relationships are debatable. For example, at a point approximately 80 feet south on the 925 level faint sulphide banding can be observed parallel to a steeply dipping gouge-filled cross-fault, and with no trace of slickensides on the smooth massive sulphide wall of the fault. Low angle faults with evidence of thrusting are seen less commonly than the other faults, and in the 925 crosscut a low angle fault displaces and drags the sulphides. This fault also cuts a steeply dipping strike fault.

At the Paramount mine, limited evidence from underground development indicates that north-striking faults displace the ore approximately 500 feet.

Ore Deposits

Shape and Size of Orebodies.—At the Lynx mine the ore occurs as massive sulphide bodies composed of pyrite, chalcopyrite, sphalerite, and galena with minor bornite. The orebody walls are sharp, with an abrupt change from massive high-grade ore to wallrock schist. Disseminated sulphide in the host rock sufficient to constitute ore is very limited.

The massive ore occurs in the form of discrete lenses, masses, and vein-like bodies, contained by the sheared host rocks and broadly concordant in attitude with the shear zone. The dimensions of the orebodies may vary considerably over short distances, and continuity between widely spaced exposures is not assured. Ore widths are up to 40 feet and some ore has a continuous length of 800 feet, though a number of the orebodies have strike and dip dimensions of the order of 100 feet. Sulphide situated adjacent to or near the main hangingwall of the shear zone is more consistent than in the orebodies farther from the hangingwall.

The ore has contacts that in places are near horizontal, and as a rule the contacts are parallel to surfaces that clearly indicate that the schist itself is folded. In greater detail, tight fold structures occur within massive banded sulphide, and this banding is described in more detail below.

An uncommon observation is for sharp contacts of massive sulphide to cut cleanly across the schistosity of the host rocks. One occurrence of this nature showed an intervening zone of white quartz and disseminated sulphide.

In the upper two levels of the mine, ore lying close to the hangingwall appears to be fairly persistent, but it fades down dip at about the 1075 level, where there is a change in dip of the hangingwall.

In the deeper levels, sulphide occurs on both walls and near the top of the " horses " described previously (*see* Fig. 18).

Structural Controls of Ore Deposition.—There is enough field evidence to postulate three structural features that may be ore-deposition controls.

(1) The form of the hangingwall contact of the shear zone may be one control. The mine sections and plans suggest that bulges in the hangingwall or marked changes in dip have affected the adjacent shear zone rocks so as to create favourable zones for sulphide deposition, though the relationship is not very definite.

(2) Folded schist structures within the shear zone are probable zones for ore deposition. The fold axes are near horizontal or plunge gently to the northwest or southeast, and the axial planes are approximately concordant with the shear zone. The ore dimensions are limited by the size of the fold structure and the ore tapers away on the dip. They appear to be dragfold structures, but no systematic fold pattern has been determined and the replacement by sulphide appears to be erratic. Without further knowledge such ore zones can only be located by closely spaced diamond drilling.

(3) Ore occurs along the flanks, or perhaps only the upper flanks, and in the vicinity of the tops of masses of unsheared rock contained within the shear zone. If this is in fact an ore control, the discovery by drilling of such structures could aid in siting further diamond-drill holes aimed at quite small target areas. There may be a connection between ore distribution and the plunge or any change in plunge of the tops of these structures. The underground development indicates that such plunges are of the order of a few degrees only.

In summary, the above suggested ore controls, in particular the last two, indicate the reason why the orebodies tend to have a strike length that is equal to or greater than the dip dimension. The influence of the shape of the main hangingwall is more uncertain until a larger pattern develops.

Some of the ore zones contained within the shear zone have faults along or close to one wall. The faults in places contain gouge and develop weak broken walls to ore, but also appear to extend along strike beyond ore limits. There is no direct indication whether these faults are related to ore or perhaps to the fold structures that in turn control ore.

Other ore controls may exist and be discovered with further development and investigation.

Description of the Ore Minerals.—The ore minerals are dominantly chalcopyrite and sphalerite which, with pyrite, form massive medium- to fine-grained sulphide aggregates. The sphalerite to chalcopyrite ratio is approximately 3:1. Galena and bornite can be seen in hand specimens in various places. In addition, microscopic examination of the ore has revealed small amounts of tennantite, covellite, digenite, and stromeyerite. Apart from one reported occurrence of stromeyerite $(Ag, Cu)_2S$, no silver or gold minerals have been seen, and the nature of the distribution of these two metals in the ore remains unknown.

The gangue consists mainly of quartz sericite chlorite talc schist with calcite and barite. Barite is not widespread and tends to occur in pockets and lenses rather than to be regularly distributed throughout the orebodies. Of all the gangue minerals, only barite is associated solely with the sulphides.

The distribution of pyrite merits attention, as there is a pattern distinct from that of the other sulphide minerals. Pyrite forms an integral part of the orebodies, and is distributed throughout the other sulphides as angular anhedral grains with a wide range of size. Pyrite may also occur concentrated in bands within the banded ores that are described below. Apart from being a constituent of the ore, pyrite also occurs as discrete masses or disseminations by itself, or in places with sufficient disseminated chalcopyrite to make ore of marginal grade. The pyrite zones have been discovered on the 1075 and 925 levels of the mine; their shape broadly resembles that of the orebodies. On the 925 level the pyrite zone is massive in the shaft crosscut but becomes a wide disseminated zone with well-formed crystals scattered through quartz sericite schist to the southeast. Slickensides can be seen on the pyrite where it is smeared along some of the foliation. Normally the pyrite zone is distinct from the orebody that contains other sulphides and pyrite, and, apart from detailed banded textures, the orebody is not normally zoned into further mineral groups. One exception to this occurs on the 925 level in exposures at approximately 50 feet south of the reference point (*see* Fig. 17). Across the shear zone from northeast to southwest there is in turn:—

(1) Barren quartz sericite schist.
(2) Disseminated pyrite, with minor chalcopyrite in quartz sericite schist.
(3) Massive pyrite.
(4) Massive pyrite and chalcopyrite.
(5) Sphalerite, with very minor chalcopyrite and disseminated quartz.
(6) A narrow schistose fault wall with gouge.
(7) Massive volcanic breccia.

Such a zoning of minerals has not been observed elsewhere in the Lynx mine.

The cumulative evidence from mineral distribution, fractures, boudinage structures, cataclastic and flowage textures seen in mine exposures and specimens is that pyrite or some of the pyrite was earlier in age than the other sulphides.

The other ore sulphides have mutual textures that imply only one period or pulse of mineralization.

The main texture of the ore is the pronounced banding of the sulphides observed in many places. The bands are composed of sphalerite or chalcopyrite or pyrite, although pyrite may also be disseminated as an even granular constituent through ore that has sphalerite and chalcopyrite bands. The bands range in width from about one thirty-second inch to about 1 inch, though the broader bands are more sparse and variable. The bands are not purely one mineral but are a concentration of one sulphide mineral with minor amounts of others and there may be streaks of one mineral within a broader zone of another mineral. The boundaries between the bands are sharply transitional and are intergrown on a microscopic scale. Broadly, this banding in the sulphides is parallel to the adjacent schistosity. However, in a few places the banding cuts cleanly across the schistosity.

As a rule the sulphide banding has a strike and dip roughly concordant with the shear zone but in places there are curving flowage textures. In a few places the banding exhibits closed fold structures that are of interest when considering the origin of the banding. The folding is of similar type and there is crestal thickening of the same mineral bands that form the limbs. One polished slab shows chalcopyrite in lenses cutting across the banding in attitudes that correspond in position to the axial plane of the fold, and also in fine cracks that cut across the fold.

Classification and Origin.—The orebodies of the Lynx mine are massive sulphide deposits. One explanation of their origin is that they are replacement deposits in a favourable shear zone and that the ore is banded due to fluctuating concentration of metals and selective replacement of the schists, and that depositional controls were structural where there tended to be zones of least pressure within the shear zone. The origin of the metals would then lie at unknown depths, probably related to the granitic rocks that are exposed 2 miles to the west of the mine.

However, this leaves a number of features unexplained. The origin of the banding remains in doubt, and this is the conclusion of many papers that have described similar banded sulphide ores. There are few or no gradational stages between waste and massive sulphide ore. The ore banding cuts across schistosity in places. Unless obscured by later alteration, the changes in the host rock appear too coarse to account for the delicate banding. The granitic batholith 2 miles to the west shows no other sign of mineralization, although it does to the south, and there is a possibility that the relationship of intrusion and mineralization is a matter of the level of original granite emplacement. Evidence of the fold structures in massive banded ore is not conclusive for either pre- or post-folding replacement. However, post-ore folding would appear unlikely in such a massive competent material surrounded by weak incompetent schists; rather, faulting and fracturing in the ore would be expected.

The orebodies of the Lynx mine have many features that classify them as conformable pyritic orebodies, and these include (Stanton, *C.I.M.*, Trans. 63, 1960, p. 22):—

(1) Pyritic sphalerite-galena-chalcopyrite ore.
(2) Lack of pyrrhotite, dominance of sphalerite.
(3) Banding parallel or sub-parallel to bedding and (or) schistosity of the enclosing rock.
(4) Lack of veins of ore sulphides.
(5) Association with pyroclastic rocks.
(6) Pale low-iron chlorite in the gangue.

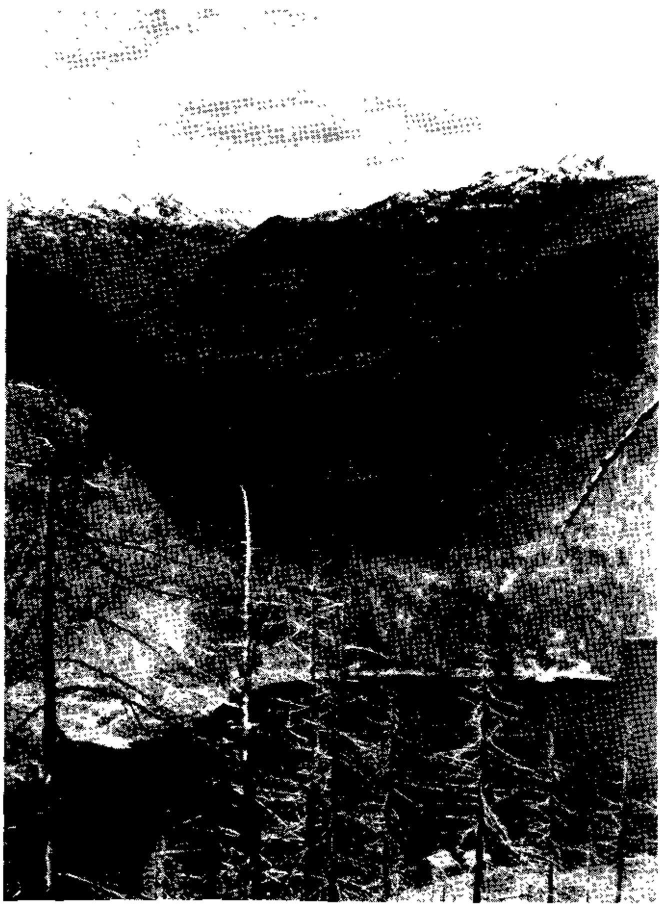
The postulated origin for such orebodies is that the minerals were concentrated from volcanic sources, perhaps deposited in shallow water sediments, and the banded texture is due to slow segregation in situ during compaction, folding, and regional metamorphism.

There is no evidence to suggest that the schists were originally shallow water sediments, and the over-all structure is discordant to the regional geology. There is little disseminated mineralization associated with the Lynx orebodies. The type conformable pyritic orebodies are supposedly not connected to local structures, and yet there is evidence at the Lynx mine to point to local structural controls being important. The transgression of schistosity by banding is another problem in that it implies post-schist mineralization. The formation of the banding by metamorphic segregation could be an acceptable explanation, but the folds then imply that there was post-ore folding on a very tight local scale.

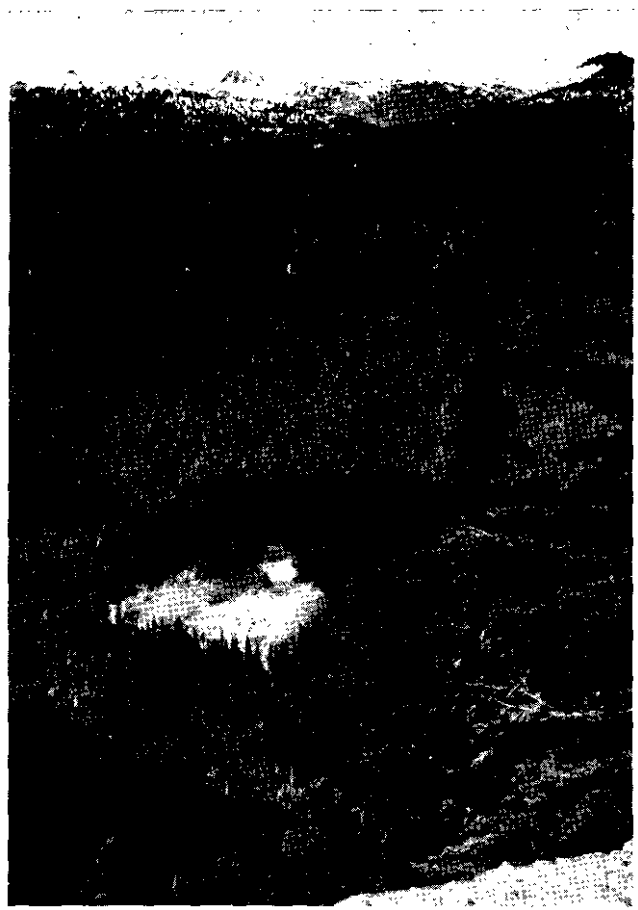
The separation of pyrite in situation and time from other sulphides is a feature of some ore deposits. One postulated genesis is the formation of pyrite from volcanic emanations during original sedimentation, and the migration of other metals from the host rock to the pyrite bodies during subsequent metamorphism.

Apart from the possibility of a volcanic origin for the metals, there are two possible igneous sources that can be considered. There is the granitic batholith west of the Lynx mine. Copper and gold mineralization occurs in association with this batholith several miles to the south. Gunning (1930) has noted copper occurrences in the limestone rocks west of the Lynx property. These are small mineralized zones along the margins of basic dykes and sills that are earlier in age than the granitic rocks. Similar rocks occur as sills throughout the upper part of the Lower Permian succession and are believed to be associated with the overlying Upper Triassic volcanic rocks. No copper mineralization has been noted with these rocks away from the margins of the granitic batholith.

In conclusion it will be seen that there is much conflicting evidence concerning the genesis of the massive sulphide ores of the Lynx mine. Regional geology points to the host rock being a shear zone, and not a specific member of the local stratigraphic sequence that has been rendered schistose by severe folding. Subsequent to formation of the shear zone, a development that could fit many apparently conflicting observations is as follows. The shear zone was initially a broad zone of failure, but subsequent movements along it were concentrated on or near fault zones along which the schist was further intensely deformed, crumpled, dragfolded, and in



Myra Creek valley and south end of Buttle Lake. Photo taken from 2,300 feet elevation above lake.



Looking across Myra Creek. Lynx mine clearing, Western Mines Limited. Photo taken from 2,800 feet elevation above clearing.

part converted to clay gouge. These fault zones became sites for the deposition of sulphides brought in by hydrothermal solutions. The sulphides were localized by structures within the faults such as dragfolds. In addition, it would be expected that the fault zones themselves would be localized by the structure of the initial broad shear zone, such as the shape of the hangingwall and included " horses " of massive rock. Flexures in the fault zones could have become sites for ore deposition. Therefore, there may be an indirect and perhaps tenuous structural control of ore location through the shape and nature of the shear zone. For the time being the sulphide banding is taken to represent a replacement of the schistose rocks within the local fault zones, from consideration of the small closed folds seen in the sulphide banding. This hypothesis takes into account such features as:—

(1) Lack of disseminated ore.
(2) Partial transgressions of schistosity and sulphide.
(3) Localization of ore by folds.
(4) A weak localization of ore by the main hangingwall structure and massive " horses " of the broad shear zone, in so far as these features originally controlled the position of the subsequent strike faults.
(5) The common presence of faults and clay gouge on the walls of orebodies.

The Lynx massive sulphide orebodies are classified on present evidence as hydrothermal deposits that replace crumpled schists within a shear zone.

[References: Gunning, H. C., *Geol. Surv., Canada,* Sum. Rept., Pt. A, 1930, p. 56; Stanton, R. L., *C.I.M. Trans. LXIII,* 1960, p. 22; *Minister of Mines, B.C.,* Ann. Repts., 1962, 1963; Preliminary Geological Map, Buttle Lake Area, 1964, *B.C. Dept. of Mines.*]

The Buttle Lake Mining Company Limited*

(49° 125° N.W.) Company office, 1824 Marine Building, Vancouver 1. H. H. Huestis, president. This company holds 34 recorded claims in the Buttle Lake area. Seventeen claims adjoin the Western Mines Limited property on the northwest and 17 adjoin the same property on the southeast. A crew of five men, employed for a period of two months, made a soil-sample survey on a 200-foot grid pattern over an area of two-thirds of a square mile. In addition, 86 pits were drilled, blasted, and sampled.

Gold

TRANQUIL INLET (49° 125° S.W.)

Fandora and Gold Flake (Tofino Gold Mines Ltd.)†

The key claims of this property comprise five Crown-granted claims situated on the northwest side of Tranquil Creek about 2 miles from the head of Tranquil Inlet. From a beach camp near the mouth of Tranquil Creek, a jeep-road 2 miles long follows the valley of the creek to a point from which a steep trail and light tram-line lead to the mine and camp-sites at an elevation of 1,500 feet. The property, owned by Moneta Porcupine Mines, Limited, has in recent years been leased to W. E. McArthur, Sr. From March, 1963, to the end of July, 1964, New Hamil Silver Lead Mines Ltd. attempted to operate the property on a larger scale as a milling operation. This proved unsuccessful due mainly to inadequate reserves of ore of a suitable grade.

The gold-quartz veins were discovered in the late 1930's when surface work disclosed the veins in a shear zone adjacent to an andesite dyke. The property has been developed intermittently since 1946, and some small shipments have been made. Four adit levels have been driven at 1,500, 1,700, 1,900, and 2,100 feet

* By J. E. Merrett.
† By A. R. C. James.

elevation respectively. The quartz veins are commonly narrow and strike north 70 degrees west and dip about 75 degrees to the north.

In 1964 the 15-12 raise was driven through to 1700 level, making a connection from 1500 to 1700 level. Stoping was done at various points in the vein from 1500 level and to a small extent from 1700 level. A crew ranging from 14 to 17 men was employed under the general supervision of Ian McMillan. A 35-ton mill, installed in 1963, began production in February, 1964. Approximately 930 tons of ore was milled. The mill ceased production on July 19th, but a clean-up was made by W. E. McArthur, Jr., in September and small shipments were made to the Tacoma and Trail smelters. Total recovery of precious metals in 1964 was: Gold, 734 ounces; silver, 103 ounces.

KENNEDY LAKE

Iron

Brynnor Mines Limited* (49° 125° S.E.) Company office, Room 1700, Bank of Nova Scotia Building, 44 King Street West, Toronto 1; British Columbia office, Suite 105, 2256 West 12th Avenue, Vancouver 9; mine office, Ucluelet. R. V. Porritt, president; T. R. Wearing, manager; D. W. Burns, pit superintendent; A. M. Cormie, underground superintendent; A. W. Hagerty, mill superintendent. This company is a wholly owned subsidiary of Noranda Mines, Limited.

The mine is situated about 2½ miles southeast of Kennedy Lake, near the headwaters of Draw Creek. Access is by the Alberni–Tofino road as far as Kennedy Lake and by a logging-road from there to the mine. Ore is trucked from the crushing plant to the mill and loading dock at Toquart Bay, a distance of 8 miles. Here the magnetite is loaded from a large storage pile into ocean-going ore-carriers for shipment to Japan.

The geology of the mine and the surrounding area has been described at some length in the Annual Reports for 1962 and 1963. All the ore produced up to the present time has been mined by open-pit methods. The open pit is worked by standard benching methods, the benches being approximately 30 feet apart. Down holes are drilled with a 9-inch Bucyrus-Erie 40-R and a 6-inch C.I.R. Drillmaster rotary drill and are loaded with AN/FO in conjunction with M.2 and M.4 aluminum-T.N.T. slurry explosives. Lifter holes are drilled with air-tracks and are loaded with conventional explosives. Muck is loaded by two Dominion and one Bucyrus-Erie shovels into Dart end-dump trucks and hauled to the crusher or waste dump. By the end of the year, operations were confined to the north section of the pit; the south end is worked out and is now being used as a water sump.

Preliminary excavations were begun in August, 1963, for the sinking of a three-compartment shaft to give access to deeper extensions of the orebody. By the end of 1963 this shaft, called the Brynnor No. 1, had been sunk 102 feet. The sinking, carried out by Fry & Associates (Western) Ltd., was continued in 1964, and by the end of the year was completed to a depth of 856 feet. Stations were cut out at the 400-, 600-, and 750-foot levels. An 8-foot-diameter double-drum electrically driven hoist was installed, together with a 2,000-cubic-feet-per-minute air compressor. In December, work was proceeding on the erection of a steel headframe.

The following is a summary of development work done in 1964:—

	Ft.
Shaft-sinking	754
Crosscutting (stations)	140

* By A. R. C. James.

Waste removal (open pit), 1,895,668 net tons. The total amount of ore mined was 1,017,343 tons, and this yielded 753,732 tons of concentrate. The number of men employed was 164. (*See* Annual Reports, 1961, pp. 104–110; 1962, pp. 111–124; 1963, pp. 117–121.)

Nanaimo Lakes (49° 124° S.E.)

Gold

Vulcan (Sileurian Chieftain Mining Company Limited)*

Company office, 850 West Hastings Street, Vancouver 1. Walter Eilers, president. The property consists of three claims in the vicinity of Deadhorse Creek on the west slope of Mount de Cosmos, 5 miles northwest of Nanaimo Lakes. Access to the property is by the Nanaimo Lakes road and by logging-roads within the Nanaimo Lakes operations of Crown Zellerbach Canada Limited.

The Vulcan property is described in some detail in the Annual Report for 1937. The mineralization, which is reported to contain values in gold and minor values in silver, occurs in a strong shear zone in altered volcanic rocks. A shaft, believed to be 105 feet deep, was sunk many years ago, and a drift 138 feet long was driven northeastward from a point 16 feet below the collar of the shaft. In 1963 the present company drove an adit from surface and completed 100 feet of drifting and crosscutting, making contact with the shaft at a point 20 feet below the collar. This work was continued in 1964, when a further 95 feet of drifting and 264 feet of diamond drilling were done. In March, work was discontinued.

Nitinat (48° 124° N.W.)

Copper

Mal (Marshall Creek Copper Co. Ltd.)†

Company office, 205, 702 Fort Street, Victoria. James M. McNulty, president. This company has 32 recorded claims on Marchand Creek, which flows westward into Nitinat Lake 5½ miles from the head of the lake. Access is by logging-roads, either from Port Alberni or from Lake Cowichan, to the head of Nitinat Lake, and from there by boat to the property. A crew of nine men stripped the main surface outcrop over a distance of 350 feet and drilled a series of short diamond-drill holes along the outcrop. This showing consists of a ramifying shear zone that trends about north 35 degrees west, dips 85 degrees northeast, and is filled with sulphides with widths up to 1 to 2 feet, but mostly less. A detailed geological survey was made of the area surrounding the main mineral occurrence and a geological reconnaissance survey was made of the whole property. A total of 828 soil samples was taken, and six other mineralized outcrops were located and exposed by stripping.

Duncan (48° 123° N.W.)

Copper

Lenora‡

Wm. Howden, 1132 West Georgia Street, Vancouver 5, obtained a lease on this old property on Mount Sicker from the owner, Vancouver Island Base Metals Limited, a subsidiary of Base Metals Mining Corporation. Three men began working on the property during the summer and continued until mid-December, when a 14-foot snowfall suspended operations. The surface stripping and removal of a crown

* By A. R. C. James.
† By J. E. Merrett and A. Sutherland Brown.
‡ By J. E. Merrett.

pillar of an old stope on the Lenora claim produced 167 tons of ore, which was shipped to the Tacoma smelter. No. 2 adit was reopened and retimbered for a distance of 350 feet to provide access to an old stope, in which it was reported that some ore remained in the stope pillars.

JORDAN RIVER (48° 124° S.E.)

Copper

Sunloch and Gabbro (Cowichan Copper Co. Ltd.)* Company office, 620 Howe Street, Vancouver 1; mine office, River Jordan. Oswood G. MacDonald, president. This property is on the Jordan River about 1 mile upstream from its mouth and is connected by road to the Victoria highway about one-half mile east of the River Jordan Post Office. An operating lease was obtained by Cowichan Copper Co. Ltd. from Sunro Mines Limited (controlled by The Consolidated Mining and Smelting Company of Canada, Limited) to remove ore from 18 claims, which include the Cave, Central, and River ore zones.

The flooding of the mine in 1963, brought about by the caving of the B stope through to the bed of the Jordan River, continued until the last of seven bulkheads was installed in the B stope. Access to the underground workings was made by way of the ventilation raise extending to the surface at the 6000 level.

Early in January, 1964, the 5100 level adit was blocked by a cave to surface at a point 1,700 feet from the portal. It would appear that the strong flow of water through the adit had washed out supporting timbers at a greenstone-gabbro contact where there was some fracturing. The unsupported area caved and plugged the adit, whereupon water with a head roughly equivalent to the height of B stope welled up through the fractured ground and issued through gravel at the surface. It was not long before this water began to erode the gravels covering bedrock, and a serious washout occurred between the 5100 portal and camp, taking with it the portal area, trestle, tracks, two locomotives, the concentrate loading shed, and a storage shed. It was estimated that a total of 500,000 cubic yards of gravel was washed into the river below the camp.

Figure 19 shows in diagrammatic form the situations of the caving of B stope that closed the mine on December 5, 1963, and of the cave in the adit which led to the serious washout on January 6, 1964. The flood water later was diverted west to the river in order to protect the portal area from further damage.

A crew of 42 men, most of whom were employed underground, was engaged in reopening the 5100 level adit as far as the caved area, and in reconditioning the machinery and electrical equipment in the mill and crushing-plant areas. A more complete description of the flooding and caving is contained in the dangerous occurrences section in this Annual Report.

Early in January, 1965, the attempt to reopen the 5100 level through the caved area was abandoned and a by-pass was driven on the east side of the tunnel.

* By J. E. Merrett.

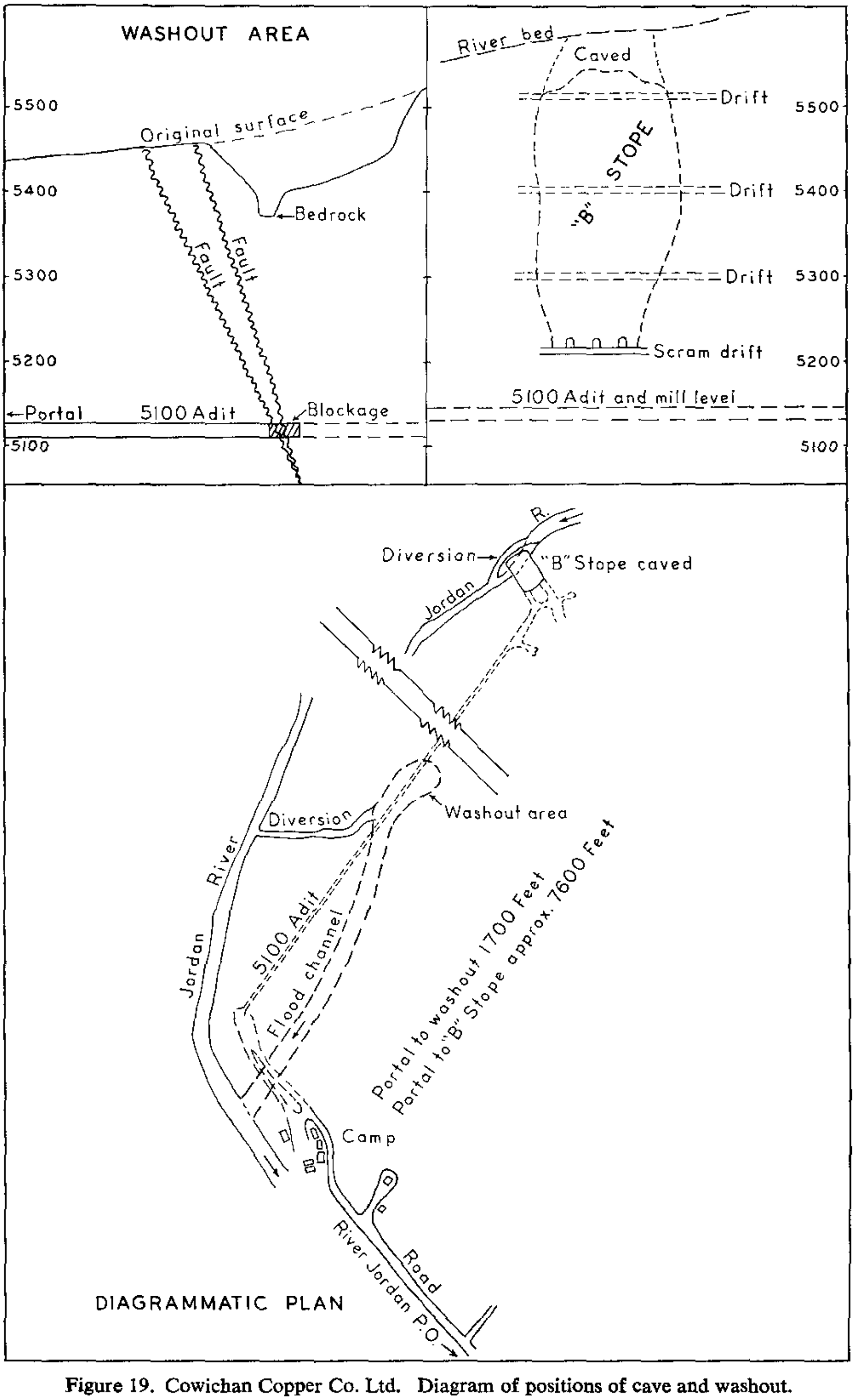


Figure 19. Cowichan Copper Co. Ltd. Diagram of positions of cave and washout.

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 17, 1947, and reports on geochemical surveys accepted since April 6, 1951, are listed in the Annual Report for 1958. Starting with 1959, each Annual Report lists the reports accepted during the current calendar year. A copy of each report may be examined in the office of the Mining Recorder for the mining division in which the property is located. A second copy of each report is filed in the office of the Chief of the Mineralogical Branch, Department of Mines and Petroleum Resources, 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.

The co-ordinate given for each report is the southeast corner of the 1-degree quadrilateral within which the property lies.

REPORTS CREDITED FOR ASSESSMENT, 1964

Geographic Position		Property Owner or Principal Author of Report Date of Submission of Report	Report No.	Kind of Work		
1° Quadr.	Quarter			Geological	Geophysical	Geochemical
48° 124°	N.E.	Pogo Nos. 1–4 E. M. Wilson. E. M. Wilson. September 28, 1964.	566	×	—	—
48° 124°	S.E.	Ext Group Macsan Exploration Ltd. D. C. Malcolm. February 19, 1964.	544	×	—	—
48° 124°	S.E.	Ren Group Newconex Exploration Ltd. Richard R. Culbert. April 29, 1964.	549	×	×	×
49° 118°	N.W.	Ruth E.6–E.13 Value Line Mining Ltd. Earl F. Elstone. December 10, 1964.	615	—	×	—
49° 118°	S.E.	Skylark Group Prudential Petroleums Ltd. Alfred R. Allen. February 14, 1964.	542	—	×	—
49° 118°	S.W.	Copper Coin Group H. H. Shear and J. M. MacLean. H. H. Shear. April 17, 1964.	562	—	×	×
49° 120°	N.W.	FRM Nos. 26–45 Fort Reliance Minerals Ltd. A. D. Wilmot and E. W. Johnson. October 28, 1964.	575	—	×	×
49° 121°	N.W.	Whipsaw Claim Group Dome Exploration (Canada) Ltd. R. H. Seraphim. June 9, 1964.	561	—	×	×
49° 125°	N.W.	Gam Claims Mastodon-Highland Bell Mines Ltd. W. R. Bacon. July 2, 1964.	560	×	×	—

REPORTS CREDITED FOR ASSESSMENT, 1964—*Continued*

Geographic Position		Property / Owner or Principal / Author of Report / Date of Submission of Report	Report No.	Kind of Work		
1° Quadr.	Quarter			Geological	Geophysical	Geochemical
49° 125°	S.W.	Catface Claims Catface Copper Mines Ltd. *Dr. A. Smith and H. S. Lazenby.* March 6, 1964.	540	—	—	×
49° 125°	S.W.	Catface Claims Catface Copper Mines Ltd. A. Smith, D. J. Salt, and H. S. Lazenby. *February 19, 1964.*	541	—	×	—
49° 125°	S.W.	Catface Claims Catface Copper Mines Ltd. H. S. Lazenby. November 13, 1964.	580	—	—	×
50° 117°	S.E.	AG Nos. 49–56 McIntyre Porcupine Mines Ltd. J. W. MacLeod. May 15, 1964.	553	—	—	×
50° 117°	S.E.	Art, Try, and L.R. Groups Leonard Root. James A. Mitchell. July 23, 1964.	564	×	—	—
50° 117°	S.E.	Kat Claims Mastodon-Highland Bell Mines Ltd. D. W. Smellie. September 30, 1964.	573	—	×	×
50° 118°	N.E.	Bell Nos. 1–15 Sunshine Lardeau Mines Ltd. Joseph P. Sullivan. February 20, 1964.	546, 547	×	—	—
50° 118°	N.W.	Kingfisher and Bright Star Trio Groups John Ens, D. M. Mills, W. C. Rotar, and The Consolidated Mining and Smelting Company of Canada, Limited. R. G. Gifford and J. Richardson. November 19, 1964.	578	—	×	—
50° 118°	N.W.	Kingfisher and Bright Star Trio Groups John Ens, W. C. Rotar, and The Consolidated Mining and Smelting Company of Canada, Limited. *J. Richardson* November 19, 1964.	579	×	—	—
50° 120°	S.E.	Kan Claims Canex Aerial Exploration Limited. Andrew R. Dodds. October 29, 1964.	582	—	×	—
50° 120°	S.W.	MLM Claims G. J. Saarse. D. W. Smellie. September 17, 1964.	572	—	×	—
50° 120°	N.E.	Sally Nos. 1–4 Copper Lake Exploration Co. Ltd. Alfred R. Allen. July 9, 1964.	577	—	—	×
50° 121°	N.E.	Nel Nos. 1–20 Donald W. Smellie. Donald W. Smellie. November 5, 1964.	576	—	×	—
50° 121°	S.E.	Alamo Claims Earlcrest Resources Ltd. R. B. Stokes. April 23, 1964.	550	—	×	—
50° 127°	N.W.	Ace No. 6 Fr. J. M. Black. J. M. Black. November 26, 1964.	602	×	×	—
50° 127°	N.E.	Trey Nos. 1 and 2 M. C. D. Hobbs. J. M. Black. September 10, 1964.	567	×	×	—

REPORTS CREDITED FOR ASSESSMENT, 1964—*Continued*

Geographic Position		Property	Report No.	Kind of Work		
1° Quadr.	Quarter	Owner or Principal Author of Report Date of Submission of Report		Geological	Geophysical	Geochemical
51° 118°	S.E.	Robina Nos. 1-12 Great West Mining Corporation Ltd. F. L. Price. September 13, 1963.	539	—	×	—
51° 123°	S.W.	Chita Claims Phelps Dodge Corporation of Canada, Limited. H. W. Agnew. April 30, 1964.	551	—	—	×
51° 123°	S.E.	Cirque Group Phelps Dodge Corporation of Canada, Limited. H. W. Agnew. April 30, 1964.	552	×	—	×
51° 123°	S.E.	Taseka Groups Kennco Explorations, (Western) Limited. Philip G. Hallof. July 29, 1964.	556	—	×	—
52° 122°	S.E.	Xaire Nos. 1 and 2 Malabar Mining Co. Ltd. Alfred R. Allen. August 19, 1964.	571	—	—	×
53° 124°	N.W.	Do Fo Jo Group Coast Exploration Ltd. J. Sullivan. May 12, 1964.	548	—	—	×
54° 121°	N.W.	Copper Canyon Nos. 5 and 6 Hurley River Mines Ltd. D. L. Hings. December 14, 1964.	613	—	×	—
54° 125°	N.W.	Al Nos. 1 and 2 Frs. Jodee Explorations Ltd. Franklin L. C. Price. March 23, 1964.	558	—	—	×
54° 125°	S.E.	AX, BX, and AB Claims New Indian Mines Limited. F. J. Hemsworth. August 13, 1964.	555	—	—	×
54° 125°	S.E.	Bell Claims Julian Mining Co. Ltd. Roderick Macrae and Leon A. Hansen. January 24, 1964.	538	—	—	×
54° 125°	N.W.	Bill Nos. 1-20 Skeena Silver Mines Ltd. Franklin L. C. Price. September 10, 1964.	583	—	—	×
54° 125°	N.W.	McC Nos. 39-42, 78-79 Jodee Explorations Ltd. Franklin L. C. Price. March 23, 1964.	557	—	—	×
54° 125°	S.E.	MS Nos. 1-9 New Indian Mines Limited. F. J. Hemsworth. June 11, 1964.	559	—	—	×
54° 125°	S.E.	Pat Claims Endako Mines Ltd. L. Adie, R. E. Cribbs, and D. C. Rotherham. July 3, 1964.	568	—	×	×
54° 127°	N.E.	M Nos. 1-23 and 69 Climax Molybdenum (B.C.) Ltd. R. E. Anderson. January 17, 1964.	545	—	×	—
56° 125° and 56° 126°	S.W. S.E.	Jane Claims Croydon Mines Ltd. L. B. Gatenby. June 24, 1964.	554	—	×	—

REPORTS CREDITED FOR ASSESSMENT, 1964—*Continued*

Geographic Position: 1° Quadr.	Geographic Position: Quarter	Property / Owner or Principal / *Author of Report* / Date of Submission of Report	Report No.	Kind of Work: Geological	Kind of Work: Geophysical	Kind of Work: Geochemical
56° 127°	S.W.	Kay, Trudy, Sandy, and Nonie Groups Glen Huck. *W. D. Thompson.* September 3, 1964.	574	—	—	×
56° 130°	N.E.	Lyn, Ray Y Fr., and Ray Groups Granduc Mines Ltd. *G. W. H. Norman.* September 10, 1964.	569	—	×	—
56° 130°	N.E.	Shan Nos. 1–20 Newmont Mining Corporation of Canada Ltd. *G. W. H. Norman.* September 9, 1964.	570	—	×	—
57° 131°	S.E.	Goat and Kim Claims Kennco Explorations, (Western) Limited. *G. H. Rayner and C. S. Ney.* September 11, 1964.	565	×	—	×
58° 129°	S.E.	Joy Nos. 1–32 Kennco Explorations, (Western) Limited. *Philip G. Hallof, A. Panteleyev, and C. S. Ney.* October 15, 1964.	585	×	×	×
58° 133°	N.W.	Sil and Apex Claims Terratest Co. Ltd. *Gordon Bernius.* March 19, 1964.	543	×	—	—
59° 134°	S.E.	Butte Claim Group The Consolidated Mining and Smelting Company of Canada, Limited. *J. Richardson and R. G. Gifford.* May 29, 1964.	563	—	×	—

Placer

CONTENTS

CARIBOO*

HIXON CREEK (53° 122° S.W.)

Chilco Explorations, Ltd.—Company office, 202, 1201 West Pender Street, Vancouver 1. H. B. Mills, president and engineer in charge of property. This company holds 14 placer leases on Hixon Creek under option from Hixon Placers Incorporated, of Seattle. Work in 1964 included installation of 1,800 feet of hydraulic pipe-line, repairs to the existing pipe-line, construction of sluice-boxes, and installation of a No. 6 monitor in preparation for hydraulicking. A crew averaging 16 men was employed between July 15th and November 15th.

WILLOW RIVER (53° 121° S.W.)

Tregillus Creek.—Eric North hydraulicked gravel on his leases from June 1st to August 15th.

Mosquito Creek.—Jack Gunn continued hydraulicking on his lease on the upper part of Mosquito Creek.

WILLIAMS CREEK (53° 121° S.W.)

Lowhee Creek.—Russell MacDougall and two men hydraulicked gravel near the headwaters of Lowhee Creek.

* By W. C. Robinson.

ANTLER CREEK (53° 121° S.E.)

China Creek.—John Kelly did some testing on his lease.

California Gulch.—Wilkinson, Kellogg, and Larsen hydraulicked ground on California Creek.

Grouse Creek.—Ike and Lambert Koopmans hydraulicked and sluiced gravel on Grouse Creek. A pump, with rated capacity of 1,000 gallons per minute, supplied water for two small monitors.

Andrew McGuire worked on his lease on Grouse Creek.

Grouse Creek Mines Ltd. Company office, 501, 615 West Pender Street, Vancouver 2. D. G. McCrae, president; E. E. Mason, consulting engineer. This company holds seven leases in the vicinity of Grouse Creek. The objective of this company is to discover and mine the downstream extension of a rich channel worked by the Heron Company almost a century ago. During 1963 seismic surveying and churn drilling indicated the presence of a deep gutter. During 1964 a camp was established near the operation, a water-drainage tunnel 114 feet long was completed, and a two-compartment shaft was sunk to a depth of approximately 80 feet. A level was established at a depth of 68 feet and 37 feet of crosscutting, mostly in bedrock, and approximately 120 feet of drifting along the channel was done. An average crew of six men was employed from January to December under the supervision of Gilles Bolduc.

LIGHTNING CREEK (53° 122° S.E.)

Wingdam & Lightning Creek Mining Co. Ltd. Company office, 204, 569 Howe Street, Vancouver 1; mine office, Wingdam. R. A. Brossard, president. This company controls leases along Lightning Creek at Wingdam, 30 miles by road from Quesnel. The company's objective was to reopen the old Melvin workings and resume mining in the deep lead gravels of Lightning Creek. Rehabilitation of the underground workings in the Melvin shaft area was continued until September 1, 1964, when work ceased and the mine was allowed to flood. (*See* Annual Report, 1961, pp. 131–132.)

QUESNEL RIVER (52° 121° N.W.)

McMartin Explorations Ltd.—Company office, 1232 Flury Road, Richmond. N. Pentecost, president. This company holds ground on Little Lake Creek, a tributary of Morehead Creek. During 1964 preparations were made to start a hydraulic pit above the old " Morehead " pit.

Spanish Placers Ltd.—Registered office, 703, 470 Granville Street, Vancouver 2; mine office, Likely. D. R. Harris, president. In 1964 D. R. Harris and F. P. Clark continued to operate a hydraulic pit on the south bank of the Cariboo River about 1 mile below Spanish Creek. A slide, occurring in June, buried the sluice-boxes and interrupted this hydraulic operation.

KEITHLEY CREEK (52° 121° N.E.)

Keithley Creek Ernest Lang worked with two men on his lease 1,700 feet below the confluence of Snowshoe and Keithley Creeks. A new 4- by 6-foot shaft has been sunk to a depth of 25 feet. At the time of the writer's visit in July approximately 20 feet of drifting had been done from the bottom of the shaft in an attempt to locate the centre of the old channel of Keithley Creek.

Little Snowshoe Creek.—Tom Kinvig did some road repairs and worked on his lease about 1½ miles upstream from the mouth of the creek.

Harvey Creek Mines Ltd. Company office, 203, 955 West Hastings Street, Vancouver 1. Austin C. Taylor, president. This company holds seven leases on Nigger Creek. During 1964 gravel was hydraulicked along a 200-foot section of the creek. A crew of four men was employed under the supervision of Barney Boe.

CRANBROOK*

Monilee (49° 116° N.W.) This lease is below the falls on the Moyie River, 14 miles southwest of Cranbrook. It is held by D. J. Oscarson, of Kimberley, and operated by two parties of workmen who subleased the property in 1958. The work is done on week-ends, and the main activities are directed to the driving of two adit drifts toward and below an old course of the river.

T. O. Bloomer and partner completed a raise that was being driven from the No. 1 adit to the gravel, and extended the drift another 35 feet. There was no recovery of gold.

P. Kotush and partner drove the No. 2 adit a further 45 feet in gravel. There was no recovery of gold.

FORT STEELE*

Mountain Copper Company of California Limited (49° 115° N.W.) Head office, 100 Mococo Road, Martinez, Calif.; Wm. McClung, president. In 1964 this company optioned the four placer leases held by the Pundata Mining Limited at the confluence of Fisher Creek and Wildhorse River, 5 miles northeast of Fort Steele. Most of the activities were on the west side of the river. Between March 17th and May 6th seven churn-drill holes, totalling 272 feet, were put down in the gravel banks. Most of the holes reached bedrock. Further exploration was suspended following the drilling, and the drilling equipment has since been removed from the property. There were five men employed. The work was under the supervision of A. D. Clements, field engineer.

Veezay Minerals Exploration Registered office, 1143–17th Avenue Southwest, Calgary, Alta. This company, a subsidiary of V. Zay Smith Associates Limited, holds six placer leases located near the foot of Lone Mountain, 3 miles east of Fort Steele. The leases are believed to be on an old channel. Between May 6th and 29th a crew of six men put down four churn-drill holes, totalling 377 feet. The work was under the direction of Angus G. MacKenzie, mining engineer.

Maus Creek (49° 115° N.W.)

Maus Minerals Ltd. Registered office, 209 British Canadian Trust Building, Lethbridge, Alta. G. R. Castles, president. This company, formed in 1964, holds a controlling interest in four placer leases on Maus Creek, 4 miles east of Fort Steele. The

* By P. E. Olson.

leases were formerly held and prospected by G. R. Castles, of Lethbridge. During 1964 a crew of four men for a period of five weeks continued sinking a small shaft near the creek.

KIMBERLEY*

Perry Creek (49° 115° N.W.)

Mountain Copper Company of California Limited

Head office, 100 Mococo Road, Martinez, Calif. Wm. McClung, president; A. D. Clements, field engineer. During the autumn of 1964 this company staked and recorded 10 placer leases near the confluence of Perry and Paris Creeks. The property is 10 miles southeast of Kimberley and may be reached by road from Wycliffe. A crew of five men drilled six holes, totalling 132 feet, with a churn drill between October 21st and November 7th. All the holes were drilled to bedrock, and were on the west side of Perry Creek.

Lisbon Creek (49° 115° N.W.)

R. E. Williams and W. Kludash, of Kimberley, made a few cuts and started a new adit on their placer lease near the confluence of Perry and Lisbon Creeks. The work was done on week-ends.

COLUMBIA RIVER†

Kirbyville Creek (51° 118° N.W.)

Columbia Gold Ltd.

Company office, 342 Lawrence Avenue, Kelowna. W. A. Mitchell, manager; L. G. White, consulting engineer. This property is on the west side of the Columbia River at the mouth of Kirbyville Creek. Work commenced in May and was completed during October by a crew of three men. The company reports that a 6- by 9-foot shaft was sunk to a depth of 45 feet during 1964. The property is serviced by a boat and high line across the Columbia River. The property was not visited.

* By P. E. Olson.
† By W. C. Robinson.

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. J. D. Christian, president; J. G. Berry, general superintendent. The property is 86 miles by road southwesterly from Mile 648.8 on the Alaska Highway. The mine is on Mount McDame at an elevation of approximately 6,000 feet. The mill and townsite are in Troutline Creek valley at 3,500 feet elevation. The property has been described in the 1960 Annual Report.

During 1964 ore was mined from benches at elevations 6,080, 6,050, 6,020, and 5,990 feet in the open pit. Totals of 713,982 tons of ore and 3,500,080 tons of waste were broken. The rock reject plant at the mine treated 349,632 tons of ore and rejected 118,112 tons of waste. The mill operated for 320 days to process 587,820 tons of ore, which yielded 66,896 tons of fibre.

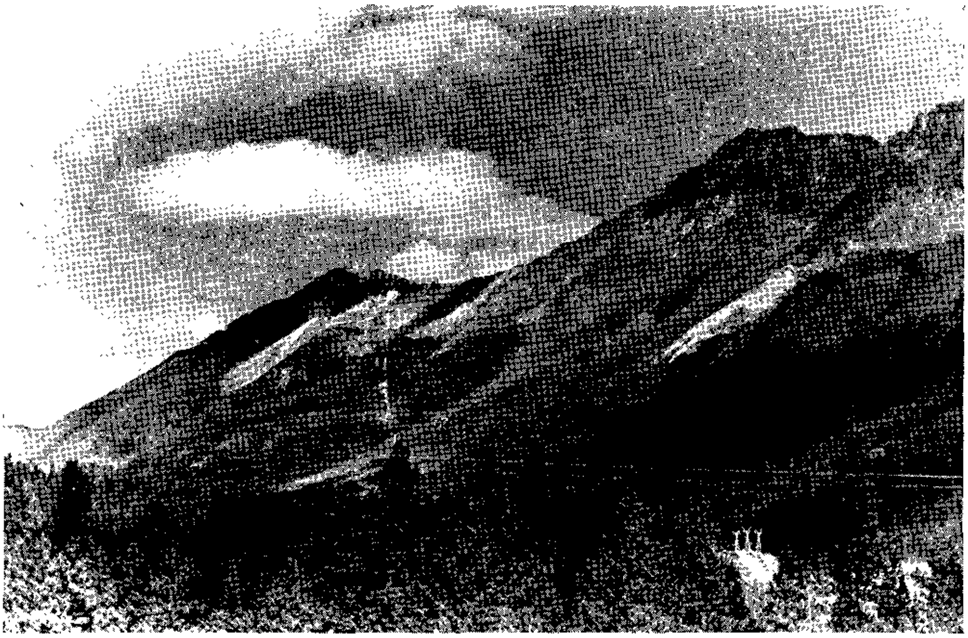
Plant construction included installation of a drier at the mine and additional equipment in the mill.

BARITE†

Mountain Minerals Limited

Company office, P.O. Box 700, 529 Sixth Street South, Lethbridge, Alta.; quarry office, Brisco. R. A. Thrall, managing director; William McPherson, superintendent. The two barite operations owned by this company at Brisco (50° 116° N.E.) and Parson (51° 116° S.W.), and described in past Annual Reports,

*By W. C. Robinson.
† By D. R. Morgan.



Cassiar Asbestos Corporation Limited. Aerial tram leading to open pit in saddle.

Cassiar Asbestos Corporation Limited. Open pit and head of tram, left.

were inactive during 1964 owing to the depressed state of the market for barite. Shipments of crude barite made during 1964 included 1,685 tons from a stockpile at Brisco and 900 tons from a stockpile at Parson. There were three men employed.

Baroid of Canada, Ltd. (50° 116° N.E.) Company office, 44 King Street West, Toronto, Ont. J. A. Martino, president; H. K. Beggs, plant superintendent. This company operates the old Giant Mascot lead and zinc property at Spillimacheen, south of Golden, for the purpose of mining barite. The property was purchased in 1960, and since that time most of the activities have been directed to the recovery of barite from a large tailings dump left by the former operator. The tailings are trucked to the mill, crushed, and separated by a number of new units that were installed in 1960. The barite concentrate is then trucked to a railway siding on the Kootenay Central Railway at Spillimacheen for shipment by rail to the company processing plant at Onoway, Alta.

Mining of the tailings and hauling of the concentrates were done by contract. The plant operated four months, and was shut down at the end of October for the winter months. Three men were kept until the end of November loading and trucking tailings to a stockpile near the plant, to enable an early start to be made next spring. A watchman is kept at the plant during the winter months. A crew of nine men treated and recovered 7,500 tons of barite concentrates in 1964.

BUILDING-STONE

International Marble & Stone Company Limited* Sirdar (49° 116° S.W.). Company office, 1316 Centre Street North, Calgary, Alta.; plant office, Sirdar. W. R. Rookes, president; Henry Rennich, manager. Capital: 3,000,000 shares, 50 cents par value. This company owns a crushing and bagging plant, which is 2 miles north of Sirdar on the Kootenay Bay–Creston highway. During 1964 the company operated quarries at Sirdar (490 tons of granite) and Crawford Creek (3,263 tons of dolomite).

The granite is crushed and bagged, the bulk of production being marketed as poultry grit. The dolomite is trucked from the quarry and stockpiled at the Sirdar plant. Most of the dolomite is sold as stucco and roofing chips. The company also handled on a commission basis 200 tons of quartzite facing-stone, from a deposit at Porcupine Creek near Ymir.

All products were sold in Alberta. About eight men were employed throughout the year.

Riverside*.—(49° 117° S.E.) A. Endersby, of Fruitvale, produced and sold 35 tons of decorative facing-stone which was quarried from the Riverside Crown-granted mineral claim on Sheep Creek, near Salmo. All production was sold in the Nelson District.

Porcupine* (49° 117° S.E.) Jim Bakken and Associates, of Salmo, operated a quarry on Porcupine Creek, 7.2 miles by road from the Ymir–Salmo highway. The rock produced is quartzite facing-stone very similar to that being quarried on the Riverside Crown-granted mineral claim on Sheep Creek, near Salmo. About 300 tons of stone was produced, most of which was sold in Alberta through the International Marble & Stone Company Limited.

* P. E. Olson.

The quartzite outcrop at the site of the quarry is more than 100 feet wide and 1,000 feet long. Within the outcrop the stone occurs in readily separated slabs ranging from a fraction of an inch to several inches thick. It comes in a variety of colours, including buff, red, grey, and green—usually in a mottled pattern.

The stone is hauled to the Ymir–Salmo highway, where it is stockpiled and most of it is crated. Three men were employed in 1964.

Continental Marble and Granite Ltd.*—(49° 119° S.E.) Company office, 880 Beach Avenue, Vancouver. This company operates a quarry located in a large granite deposit 9 miles south of Beaverdell, adjacent to the highway. The product is trucked to Beaverdell and then shipped by Canadian Pacific Railway to Vancouver. The stone is then crushed to size and used as facing material in a new building-block process recently developed by the parent company, Continental Bordignon Ltd. Production from the quarry in 1964 was 7,000 tons. A crew of five was employed under the direction of A. Novak.

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 and plant are on the west side of the Trans-Canada Highway about 10 miles west of Hope. The plant consists of a crusher, drier, screens, and bagging machinery. A crew of four men produced several thousand tons of granite products. Production in 1964 is reported to be about 10 per cent below that of 1963. The principal market is for sand-blasting, filler, concrete mix, chicken grit, and stucco dash.

Inland Quarries Ltd.‡—Company office, 5498 Fraser Street, Vancouver 15. W. E. Chandler, president; R. W. Hamilton, quarry superintendent. Two men, employed for a period of eight months at the Sheridon Hill quarry (49° 122° S.W.) 3½ miles northeast of Pitt Meadows, produced 350 tons of granite dimension stone, of which 245 tons was shipped to the Vancouver plant.

Ocean Cement Limited (Gilley Quarry)‡—Pitt River (49° 122° S.W.). Company office, North Foot of Columbia Street, Vancouver 4. N. D. MacRitchie, manager, Aggregates Division; Francis J. MacDonald, quarry superintendent. The quarry is on the west bank of the Pitt River immediately south of its confluence with Munro Creek. During a 2½-month operating period, a crew of 16 men produced 32,500 tons of quartz diorite.

Granite Falls Quarries Ltd.‡—Granite Falls (49° 122° S.W.). Company office, 630 Taylor Street, Vancouver 3. D. Milavsky, manager. During a period of two weeks a crew of three men shipped 1,000 tons of granite riprap.

CEMENT

Ocean Cement Limited (B.C. Cement Division).§—Bamberton (48° 123° N.W.). Head office, North Foot of Columbia Street, Vancouver 4. W. F. Foster, president; B. M. Brabant, executive vice-president; R. E. Haskins, vice-president

* By D. Smith.
† By A. R. C. James.
‡ By J. E. Merrett.
§ By J. W. McCammon.

in charge of production. During 1964 this company operated its cement plant at partial capacity.

Lafarge Cement of North America Ltd.*—Lulu Island (49° 123° S.E.). This company operated its cement plant at partial capacity during 1964.

CLAY AND SHALE

Mountain Minerals Limited.†—Canal Flats (50° 116° S.W.). This company quarried and shipped 1,226 tons of shale during a period of three weeks in April, 1964. There were three men employed.

Clayburn-Harbison Ltd.‡ (49° 122° S.E.) Head office, 1690 West Broadway, Vancouver 9; plants, Kilgard and Abbotsford. R. M. Hungerford, president; G. H. Peterson, general manager; Brian Stephens, mine superintendent. Two plants are operated by this company—one at Kilgard where sewer-pipe and flue-linings are manufactured, and the other at Abbotsford where face and refractory bricks are made. Clay was produced from one underground and two open-pit operations. Eight men employed underground at the Kilgard fireclay mine produced 19,094 tons of clay; three men employed at the Kilgard No. 9 pit, on the mountain above the fireclay portal, produced 23,537 tons of clay; and three men working in the Selby pit, 2½ miles east of Abbotsford, produced 15,280 tons of clay.

Richmix Clays Limited.‡—Kilgard (49° 122° S.E.). Office and plant, 2890 Ken Avenue, Vancouver 12; quarry, Kilgard. G. W. Richmond, manager. The quarry is immediately south of the new fireclay portal of Clayburn-Harbison Ltd. One man quarried and trucked 8,026 tons of fireclay to the Vancouver plant.

Haney Brick and Tile Limited.‡—Haney (49° 122° S.W.). Company office and plant, Haney. E. G. Baynes, president; J. Hadgkiss, managing director. Two men were employed removing clay from a pit and surface scraping area adjacent to the plant, which is on the north bank of the Fraser River at Haney. Twenty-four men were employed in the plant, which produced 9,238 tons of clay products. This included building-brick, agricultural tile, structural tile, and flower pots.

Holdfast Pozzolan Limited.‡ Ganges (48° 123° N.E.). This wholly owned subsidiary of Holdfast Natural Resources Ltd. owns a shale pit and roasting plant at Long Harbour on the northeast coast of Saltspring Island. In 1964 a mining contractor quarried 11,000 tons of shale, most of which was roasted to produce pozzolan clinker. The number of men employed varied according to the work being done, but at one time was 17.

Mainland Clay Products Limited.*—Barnet (49° 122° S.W.). Head office, Angus Drive, Vancouver 14; plant, Barnet. This company, a subsidiary of Pitkethley Brothers Limited, manufactured common and face brick from clay obtained adjacent to the plant and imported from Kilgard.

Fairey & Company Limited.*—Vancouver (49° 123° S.E.). L. T. Fairey, manager. This company produced a variety of fireclay bricks, shapes, and cements from local and imported raw materials.

* By J. W. McCammon.
† By D. R. Morgan.
‡ By J. E. Merrett.

British Columbia Lightweight Aggregates Ltd.*—Saturna Island (48° 123° N.E.). This company operated a shale expanding plant to produce lightweight aggregate at Lyall Harbour on Saturna Island.

DIATOMITE

Fairey & Company Limited.*—Quesnel (53° 122° S.E.). Company office and plant, 661 Taylor Street, Vancouver 3. L. T. Fairey, president. Approximately 1,100 tons of diatomite was quarried from Lot 6182 near Quesnel and shipped to the company processing plant in Vancouver.

DOLOMITE

International Marble & Stone Company Limited*

Crawford Creek (49° 116° N.W.). Head office, 1316 Centre Street North, Calgary, Alta. Late in 1963 this company opened a new quarry on a dolomite exposure 1½ miles northeast of Crawford Bay Post Office. The quarry is beside the road near the centre of the west side of S.L. 40. It is 0.4 mile south of the quarry formerly operated by the same company on the south bank of Crawford Creek.

The rock quarried is medium-grained white dolomite marble of the Lower Cambrian Badshot Formation. In the quarry, visible impurities consist of scattered crystals and small lenses of various metamorphic minerals, chiefly tremolite and diopside. Brown staining is present on the weathered surface and on fracture surfaces. Fractures are numerous and occur in various orientations at 6-inch to 4-foot spacings. In the immediate vicinity of the quarry no rock other than dolomite is visible and bedding is not well displayed. A vague foliation that may represent bedding strikes 10 degrees east of north and dips 26 degrees west. Elsewhere the dip of this same dolomite band is much steeper. At the quarry-site overburden is light. It has been stripped off for 250 feet east from the road. No further outcrops were seen for one-quarter mile to the east, but almost continuous dolomite exposures were found for 400 feet north and 400 feet south of the quarry.

At the end of July the quarry was 42 feet wide, 100 feet long, and had a face 30 feet high.

A sample consisting of chips taken at random from the muck pile in the quarry had the following percentage composition: Insol.=2.14; R_2O_3=0.77; CaO=30.26; MgO=20.17; H_2O (105° C)=0.04; Fe_2O_3=0.92; MnO=0.021; P_2O_5=0.012; Ig. loss=46.37; S=0.01.

The dolomite is hauled by truck to a crushing plant at Sirdar, 40 miles to the south. At the plant it is crushed and sized to make granules and bird grits. In 1964 a crew of four men produced 3,263 tons of dolomite.

GYPSUM

Western Gypsum Products Limited†

Windermere (50° 115° S.W.). Company office, 2650 Lakeshore Highway, Clarkson, Ont.; quarry office, Athalmer. Nigel W. Puttock, president; A. E. Portman, superintendent. This company operates a large gypsum property on the north side of Windermere Creek, 8 miles east of Windermere. The property was formerly owned and operated by the Columbia Gypsum Company but was purchased by the present company in 1957. The claims worked are the Blue Grouse

* By J. W. McCammon.
† By D. R. Morgan.

and Blue Grouse 2. A detailed description of the property has been given in past Annual Reports.

Most of the 1964 production was mined from the No. 2 quarry that was opened in 1958, and the remainder from the No. 3 quarry, which was prepared for production and opened in the fall of 1964. The gypsum is over 100 feet thick. It is mined in 15-foot lifts, using AN/FO explosives, and is trucked 11 miles by private road to a crushing plant adjacent to the Kootenay Central Railway, near Wilmer. The total production in 1964 was 208,626 tons, of which 175,581 tons was crushed, treated, and shipped by rail, and the remainder placed on stockpile near the crushing plant. Most of the work is done by contract, and the rock is hauled in tandem trucks capable of carrying 50 tons. Two-way radios were installed on all the trucks in 1964 to enable the drivers to communicate with each other and a central office at the crushing plant. The area around the plant and 7 miles of the quarry road were asphalted in the spring of 1964 to facilitate the hauling. The average number of employees was 17.

Domtar Construction Materials Limited*

Canal Flats (50° 116° S.W.). Head office, Box 506, Sta. F, Toronto 5, Ont. This company owns a gypsum property near the confluence of Roam Creek and Lussier River, 16 miles southeast of Canal Flats. It can be reached by means of an old logging-road leading from the No. 95 highway, 2 miles north of Skookumchuk. The deposit was drilled in 1962. A minor amount of stripping was done by bulldozer during three weeks in the summer of 1964. There were two men employed, and the work was under the direction of A. C. Ogilvey, geologist, Toronto.

KYANITE

Mike, Mike 1, Mike 2, etc.†

Creston (49° 116° S.W.). In September, 1963, Ralph Maddess and Clair Gallagher, of Creston, located two claims on a showing of kyanite 7 miles northwest of Creston. In January, 1964, Mr. Maddess located seven more claims surrounding the original two claims. The claims are just west of the south end of Leach Lake, adjacent to and north of the Creston–Salmo highway at the Summit Creek bridge.

The kyanite is in a rock series that consists chiefly of micaceous quartzite and mica schist with minor small pods and lenses of pegmatite. This has been mapped as part of the late Precambrian Aldridge Formation. Kyanite occurs as concentrated patches in some of the pegmatite and disseminated in some bands of schist. The pegmatite is in irregular discontinuous masses that range from 1 foot thick by 3 feet long to 5 feet thick by 30 feet long, most being nearer the smaller size. Normally the lenses consist of quartz and muscovite, but some contain scattered patches of kyanite. The kyanite forms large, clean, blue, bladed crystals in clumps as much as 6 or 8 inches in diameter. In the most concentrated area seen, across a distance of 70 feet, there were six lenses of pegmatite with an aggregate width of 12 feet. Three of the lenses contained kyanite. Associated with the pegmatite are a few scattered 6-inch to 2-foot thick zones of mica schist that contain dirty disseminated kyanite crystals ranging in size from minute needles to individuals 2 inches long and one-half inch wide.

No development work had been done on the claims when they were examined, but natural exposures are good over large parts of the ground. The best showing seen where pegmatite and kyanite were most abundant was an area roughly 250

* By D. R. Morgan.
† By J. W. McCammon.

feet wide and 350 feet long in a northeasterly direction, at 2,650 feet elevation immediately northeast of the power-line which services the microwave station on the adjoining mountain. Little pegmatite or kyanite was seen elsewhere.

LIMESTONE

Fraser Valley Lime Supplies*.—Popkum (49° 121° S.W.). Head office, 7583 Edmonds Street, Burnaby 3. W. T. 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. The crushing and screening plant was operated partly with stone from the quarry and partly with stone trucked in from other sources. Production from the quarry is declining due to increasing depth of overburden, and in 1964 was 1,814 tons. A total of 2,876 tons of stone was trucked in, making a total of 4,690 tons put through the plant. The products are sold for agricultural use and as industrial filler. A crew of seven men was employed from January to April; from then to the end of the year only four men were employed.

Beale Quarries Division (Lafarge Cement of North America Ltd.).†—Vananda (49° 124° N.W.). Head office, 1051 Main Street, Vancouver 4; quarry office, Vananda. W. D. Webster, quarry superintendent. Open-pit bench mining methods were used to produce 625,000 tons of limerock, of which 437,000 tons was crushed and 500,500 tons shipped. A crew of 20 men was employed.

Ideal Cement Company Limited†.—Vananda (49° 124° N.W.). British Columbia office, 471, 1155 West Georgia Street, Vancouver 5; quarry office, Vananda. W. S. Beale, manager, Rock Products Division; J. K. Johnson, superintendent. Bench mining methods using vertically drilled holes produced 375,000 tons of limestone at the quarry on Lot 25, 2 miles south of Vananda. The broken rock was trucked to the crushing, screening, and washing plant at Marble Bay, where 350,000 tons of limestone was crushed and shipped. A crew of 21 men was employed.

Imperial Limestone Company Limited†.—Vananda (49° 124° N.W.). Office, 7309½ East Marginal Way, Seattle, Wash. 98108; quarry office, Vananda. James H. Jack, general manager; A. Diewert, quarry superintendent. This company operated a limestone quarry at the summit of a small hill 1 mile west of Spratt Bay on the northeast coast of Texada Island. Two crushing plants were operated—one at the Vananda dock where stucco dash and whiting were produced and the other and larger one at Spratt Bay where whiting and coarse limestone were produced. A crew of 12 men was employed and 58,495 tons of limestone was mined, of which 48,951 tons was crushed and shipped.

Domtar Chemicals Limited (Lime Division)†.—Blubber Bay (49° 124° N.W.). British Columbia office, 1105 West Pender Street, Vancouver 1; quarry office, Blubber Bay. J. M. Greenaway, Blubber Bay plant manager. The quarry is approximately 2 miles south of Blubber Bay at the north end of Texada Island. Two Gardner-Denver air-trac drills drilling vertical holes were used to produce 755,000 tons of limerock. Blasting was done with 70 per cent Dynamex, 40 per cent Forcite, and Ammex II.

* By A. R. C. James.
† By J. E. Merrett.

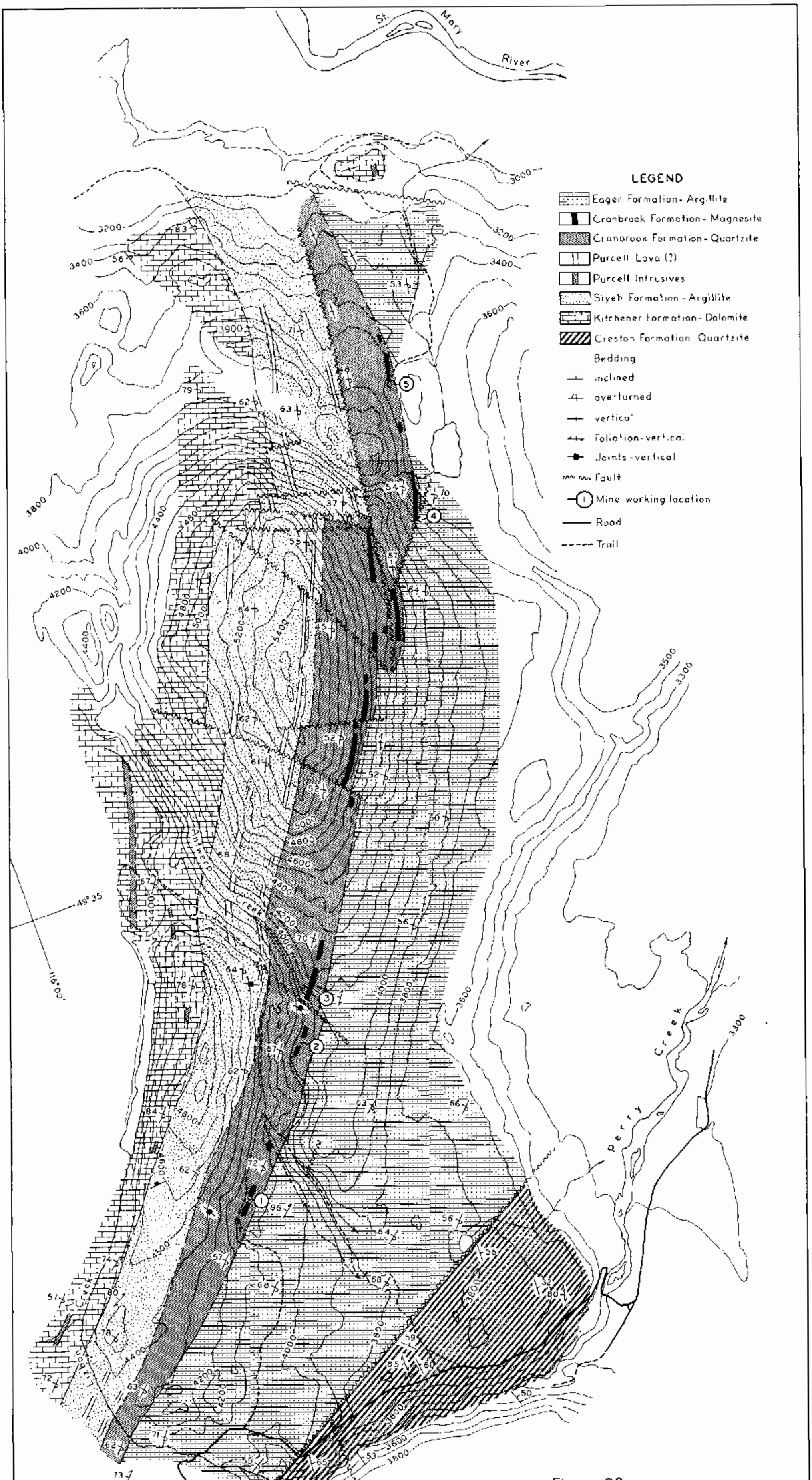


Figure 20
MARYSVILLE MAGNESITE

A 1½-cubic-yard-capacity Dominion K-450 shovel and a 3-cubic-yard-capacity Skooper shovel were used to load the fleet of six trucks. Three of the trucks were of 30-ton capacity and three of 27-ton capacity. Two crushing circuits were in use at the Blubber Bay plant. The primary crusher has a capacity of 300 tons per hour and was used to produce unsized material for cement manufacture. The other crushing circuit of 125-tons-per-hour capacity was used to produce sized limerock. The dock installation provides facilities for the loading of 11,000-ton barges at the rate of 1,000 tons per hour. In 1964, 693,000 tons of limestone was crushed and shipped. A crew of 44 persons was employed.

Koeye River (Koeye Limestone (1962) Ltd.)* Koeye River (51° 127° N.W.). Company office, Bella Bella; quarry office, Koeye River. A. O. Widsten, manager. White limestone is quarried by benching methods from the west pit of two adjacent quarries on the north side of the mouth of Koeye River on Fitz Hugh Sound, 6 miles south of Namu. A crew of four men produced 12,627 tons of limerock, which was shipped to the Crown Zellerbach Canada Limited paper-mill at Ocean Falls.

Ocean Cement Limited (B.C. Cement Division).†—Cobble Hill (48° 123° N.W.). This company quarried the limestone required for its Bamberton cement plant from a quarry at Cobble Hill.

MAGNESITE

The Marysville Magnesite Belt (49° 115° N.W.)†

Introduction

In 1932 C. E. Cairnes, of the Geological Survey of Canada, announced the discovery of a deposit of crystalline magnesite in the area between Perry Creek and St. Mary River due south of Marysville, in southeastern British Columbia. Most of the ground containing the magnesite was acquired by The Consolidated Mining and Smelting Company of Canada, Limited, which has retained ownership to the present. Nominal amounts of trenching and tunnelling have been done and small test shipments of magnesite have been mined, but no commercial production has been attempted at the deposit.

The magnesite is in a band of sedimentary rocks that extends for 5½ miles northeast from Perry Creek across a low hill to St. Mary River. Elevations range from 3,400 feet in Perry Creek, at the south end of the area, to 5,500 feet on the summit of the hill, and 2,900 feet at St. Mary River. The upper and western parts of the hill have been burned over. The remainder of the area has had its better timber removed but is still covered by a moderate growth of fir, larch, and jack pine. Much of the ground is heavily mantled by glacial drift so that large sections lack bedrock outcrops.

A good road extends up Perry Creek from a turn-off on the west side of Highway No. 95 about one-quarter mile south of the St. Mary River bridge. Several logging-roads that branch from this road provide easy access to the southern part of the area. A main branch to the west off the Perry Creek road near its north end follows up the St. Mary River and provides connections with a network of old logging-roads in the northern part of the area. The Canadian Railway line runs parallel to Highway No. 95 through this region and provides several convenient sidings.

* By J. E. Merrett.
† By J. W. McCammon.

The general geology of the area has been described by S. J. Schofield in 1915, H. M. A. Rice in 1937 and 1941, and G. B. Leech in 1957 and 1960. C. E. Cairnes published a description of the magnesite in 1932, and this was reprinted in the report by Rice in 1937. A report on and map of a small section of the magnesite zone was published in the Annual Report of the Minister of Mines for 1959.

The work upon which this report is based was done in two short periods in the 1963 and 1964 field seasons. Geology was plotted on a map-sheet, scaled at 1,000 feet to the inch, specially prepared by the Topographic Division of the Surveys and Mapping Branch of the British Columbia Department of Lands, Forests, and Water Resources. Air photographs taken by the Provincial Government in 1960 were used in conjunction with the map.

[References: Cairnes, C. E. *Geol. Surv., Canada,* Sum. Rept., 1932, Pt. A 11, pp. 101–104; Leech, G. B., *Geol. Surv., Canada,* Map 15-1957, St. Mary Lake, British Columbia, and Map 11-1960, Fernie, West Half, British Columbia; Rice, H. M. A., *Geol. Surv., Canada,* Mem. 207, Cranbrook Map-area, British Columbia, 1937, and Mem. 228, Nelson Map-area, East Half, British Columbia, 1941; Schofield, S. J., *Geol. Surv., Canada,* Mem. 76, Geology of the Cranbrook Map-area, British Columbia, 1915; *Minister of Mines, B.C.,* Ann. Repts., 1937, p. A 25; 1941, p. 78; 1947, p. 219; 1959, pp. 176–178; 1961, p. 150.]

Petrology

Exposed within the area are outcrops of the sedimentary Precambrian Creston, Kitchener, and Siyeh Formations, igneous Purcell flows and sills, and sedimentary Lower Cambrian Cranbrook and Eager Formations.

Creston Formation.—The oldest rocks in the map-area are part of the Creston Formation. They form a small triangular section at the south end of the map-sheet. In the exposures examined the rocks consist of light- to dark-green and grey phyllitic siltstones, siltstones, and sericitic quartzites. The phyllitic siltstones are in ⅛- to ½-inch-thick alternating dark and light beds. The quartzites occur in 4- to 18-inch-thick beds, often interlayered with thin siltstone beds. The mineralogical composition of all thin-sections examined was very similar, the constituents being chiefly irregular-shaped quartz grains and sericite with some chlorite and occasional angular grains of plagioclase. The Creston rocks have a northerly strike and easterly dip. At the west edge of the area the average strike is north 10 degrees east and the dip ranges from 61 to 82 degrees east. On Perry Creek about 1,000 feet below the mouth of Lizbon Creek there is a sudden change of strike to about north 20 degrees west with lower dips. This change is probably due to a fault such as postulated in Figure 20. In all exposures where seen, axial plane cleavage and dragfolds indicate that the beds are right side up and on the east limb of a large anticline. A second well-developed cleavage, especially prominent in the phyllitic siltstones, has an average strike of north 15 degrees east and an average dip of 80 degrees west.

These rocks are in fault contact with the Middle Cambrian Eager argillites to the north. No other contacts are present in the map-area.

Kitchener Formation.—Rocks of the Kitchener Formation, next oldest after the Creston ones, are exposed along the western edge and form a small fault block at the north end of the mapped area. These rocks consist of argillites, calcareous argillites, and argillaceous dolomites. The rocks are dark grey to pale green and buff and weather buff to orange and light grey. The beds are generally thin, ranging from mere films of argillite to 2-inch or more thicknesses of carbonate. A striped appearance is common on many outcrops as a result of the combined effects of alternation of light and dark layers and differential erosion of beds of varying durability. The strike of the bedding swings from north 50 degrees east in the southern part of the area to slightly west of north at the north end. Dips vary a little but are consistently to the northwest and west and average about 67 degrees. Cleavage and dragfolds indicate the beds are overturned and on the steep east limb of an anticline. Nowhere within the mapped area are the Kitchener and Creston beds in contact.

Siyeh Formation.—Above the Kitchener Formation is a conformable sequence of argillaceous rocks that for this report is referred to as the Siyeh Formation, following the usage of Rice in his report on the Cranbrook Map-area. The rocks consist of fine-grained dark- and light-green or buff thin-bedded striped argillites and siltstones composed essentially of angular quartz grains in an abundant argillaceous-sericitic groundmass. The contact between the Siyeh and Kitchener Formations is gradational, and on the map it is drawn as nearly as possible at the top of the stratigraphically highest noticeably calcareous beds. Within the area the thickness of the Siyeh Formation ranges from 1,000 feet at the south to 1,800 feet in the central part.

Cranbrook Formation.—The Cranbrook Formation consists chiefly of quartzites, but near the top includes interlayered carbonate beds wherein the magnesite occurs. The quartzites are medium- to coarse-grained white, pink, pale-green, or brownish rocks. Commonly the beds are thick and bedding is indiscernible, but in other places they are 2 to 4 feet thick, and in yet other places they are 2 to 4 inches thick with thin argillite partings. Cross-bedding is frequently present. For the most part the rocks consist of unclouded, fairly well-rounded quartz grains with variable, though never large, amounts of sericite. The thinner beds contain more impurities, including scattered plagioclase fragments. White quartz veins less than 2 inches wide cut the quartzites in some outcrops.

The lower quartzites grade up into a sequence of thin alternating beds of medium-grained carbonate and quartzite. This is overlain by a thick bed of coarse-grained magnesite which, in turn, is overlain by a second sequence of thin interlayered quartzite and carbonate beds. No completely exposed section across the whole series from pure quartzite through the carbonate zone to the overlying Eager argillites was found, hence accurate measurements of thicknesses are not known. From the measurements that were made it appears that the lower interbedded sequence is between 120 and 150 feet thick, the magnesite band is from 40 to 55 feet thick, and the top interbedded zone is from 75 to 125 feet or more thick.

In the lower interbedded rocks the carbonate seems to be predominantly magnesite. The beds average one-half inch to 2 inches thick but pinch and swell. At first glance they seem to be quite regular and continuous, but on closer examination it is found that any one band of quartz or magnesite does not persist many feet on strike before it is gradually replaced by the other mineral, although farther along on strike the first mineral may reappear. Across strike there are fairly sharp, though gradational, boundaries between magnesite and quartz bands. The quartz bands consist essentially of clear glassy quartz grains averaging slightly less than 1 millimetre in diameter, cemented by serpentine and what is now fine-grained magnesite in irregular masses that mould around and corrode the quartz grains and fill the interstices between them. Scarce calcite grains are also present. They appear to be remnants of grains partly replaced by magnesite. The magnesite bands consist of 1- to 3-millimetre grains of recrystallized magnesite with scattered, corroded remnants of quartz grains enclosed within and between the magnesite crystals. All grains show undulous extinction in thin-sections. Scattered through the thin magnesite bands are dark rectangular, circular, and oval shapes, up to 1 millimetre in maximum diameter, that consist of parallel or radial rows of black dots. These may represent some form of microfossil. None of the shapes were recognized in the quartz bands nor in the massive magnesite or top interlayered bands.

The main magnesite band is composed of recrystallized magnesite in interlocked grains as long as 15 millimetres. Remnants of partially replaced quartz grains occur occasionally within some magnesite crystals. Some serpentine is present in patches and films between magnesite grains. The rock is pale buff to pearl grey or white on fresh surfaces and weathers brownish-buff. Here and there stringers and veinlets of white quartz cut the magnesite. Talc or serpentine are present on minor slip surfaces. The best magnesite is concentrated in one main band which can be traced discontinuously for most of the length of the map-area. In some exposures, one or more similar and parallel bands 2 to 10 feet thick are present.

The interlayered series on top of the main magnesite band consists of beds of quartzite cemented with sericite and calcite alternating with bands of medium-grained, recrystallized, twinned calcite. In one outcrop near the centre of the area a few of the carbonate bands are composed of magnesite. The different bands pinch and swell along strike in the same way as those below the main magnesite band. Upwards in the series the carbonate content decreases rapidly and there is a transition into argillaceous quartzite.

Where it was seen, the contact between the Cranbrook and Siyeh Formations was variable. In Lizbon Creek a tight fracture parallel to the beds separates typical striped Siyeh argillite from a narrow band of interbedded quartzite-argillite beds which grade within a few feet into thick-bedded quartzites. In a road cut on the upper logging-road up Antwerp Creek, argillites of the Siyeh Formation are overlain by a 10-foot-thick bed of grit containing scattered quartz pebbles and abundant magnetite grains. This bed, in turn, is overlain by massive white Cranbrook quartzites. On the hillside east of Antwerp Creek, Siyeh argillites are overlain by Cranbrook quartzites with a few interbeds of quartzite and argillite between them. Near the crest of the hill east of Antwerp Creek, a 3-foot-thick bed of conglomerate containing angular light and dark argillite pebbles in a sandy matrix lies along the contact. In all cases the beds on either side of the contact appear to be parallel or nearly so, thus the contact would seem to be disconformable. At the north end of the area several hundred feet of the lower part of the quartzite is not accounted for. It is thought this has been eliminated by a fault as indicated on the map.

Eager Formation.—The youngest consolidated rocks in the area, those of the Eager formation, are basically argillaceous but do include some thin-bedded, schisty brown quartzites and a few thin beds of dolomite. The argillites are light- to dark-green and black almost slaty rocks that form ¼- to ½-inch-thick beds. A well-developed flow cleavage nearly parallel to the bedding causes outcrops to spall off in thin platy fragments. The flat faces of the fragments typically have a crinkled appearance caused by the intersection of a closely spaced fracture cleavage with the planes of flow cleavage.

No actual contact between the Cranbrook and Eager Formations was observed, although in several places the rocks outcrop within a few feet of each other. In all cases the attitudes on both sides of the contact are the same. Variations in the uppermost beds of the Cranbrook rocks nearest the contact, however, indicate the presence of some type of unconformity and perhaps some faulting. In Lizbon Creek the entire carbonate section of the Cranbrook Formation is missing. This could be due to non-deposition or it might be due to a northeasterly trending fault. Again, at the north end of the area the interbedded zone between the magnesite and Eager argillites is much thinner than elsewhere.

Igneous Rocks.—Four sheets of dark-grey to green igneous rock are exposed in short segments along the magnesite zone. Two of these are near the west limit of the area in the Kitchener rocks. They are composed of coarse-grained granular rock of dioritic composition. Their attitudes are partly conformable with the sediments but are also partly transgressive to them. They are probably best classed as sills.

The other two igneous bodies form thin layers in the Siyeh Formation. The uppermost layer, about 150 feet below the top of the formation, is amygdaloidal in its upper part. Both bodies are conformable with the sedimentary rocks where seen in contact with them and so are most likely flows.

Structure

Except in the fault blocks at the south and north ends, the rocks of the map-area form part of the steep overturned east limb of a north-trending anticline that is overturned to the northeast. The southern fault block is part of the upright east limb of a normal north-trending anticline, probably part of the same fold but from a less disturbed lower level. The beds in the north end fault block are nearly vertical in some outcrops and highly contorted multi-directionally in others. It is not known where they fit into the fold pattern.

The presence of many faults in the area is indicated by stratigraphic relationships. No fault surfaces were seen, however, so direct evidence of relative movements on the faults was not obtained. Fault No. 1 (*see* Fig. 21) is probably a steep north-dipping normal fault of considerable vertical displacement. Faults Nos. 2 and 3 are probably steep southwest-dipping normal faults of relatively small displacement. All of the faults labelled No. 4 appear to represent strike-slip movement in which the north walls have moved east a short distance relative to the south walls. Although not seen, a vertical strike-slip fault on which the west wall moved north relative to the east wall must be located as shown for fault No. 5. This movement must have post-dated that on the No. 4 fault. No. 6 is a strike-slip fault on which the north side moved east relative to the south side. It post-dates fault No. 5. No conclusive evidence was found to indicate what type of movement took place on fault No. 7.

A strong regional cleavage is present in most of the fine-grained rocks in the area. It strikes nearly parallel to the bedding but has a consistent steep dip to the west. In addition to this, an older, axial plane cleavage is prominent in many outcrops.

Jointing is common and is particularly well developed in the Cranbrook quartzites. It is generally nearly vertical and perpendicular to the bedding.

Mine Development

The magnesite has had a small amount of exploration work done on it, and a few hundred tons has been quarried for experimental purposes.

At location No. 1 (Fig. 20) Harbour National Resources did some trenching and drilled a few short diamond-drill holes. This work is described in the Annual Report for 1959, pages 176 to 178. The surface work exposed a band of coarse-grained magnesite between 25 and 40 feet thick for 700 feet along a northeasterly strike. The band dips between 68 and 72 degrees northwest. No magnesite has been quarried from the openings. Three samples taken from the best exposures in the trenches were analysed, and the results are shown in the table that follows as samples 1A, 1B, and 1C.

In 1961 Consolidated Mining and Smelting Company excavated nine trenches at intervals over 1,800 feet along the strike of the rocks at location No. 2. Magnesite

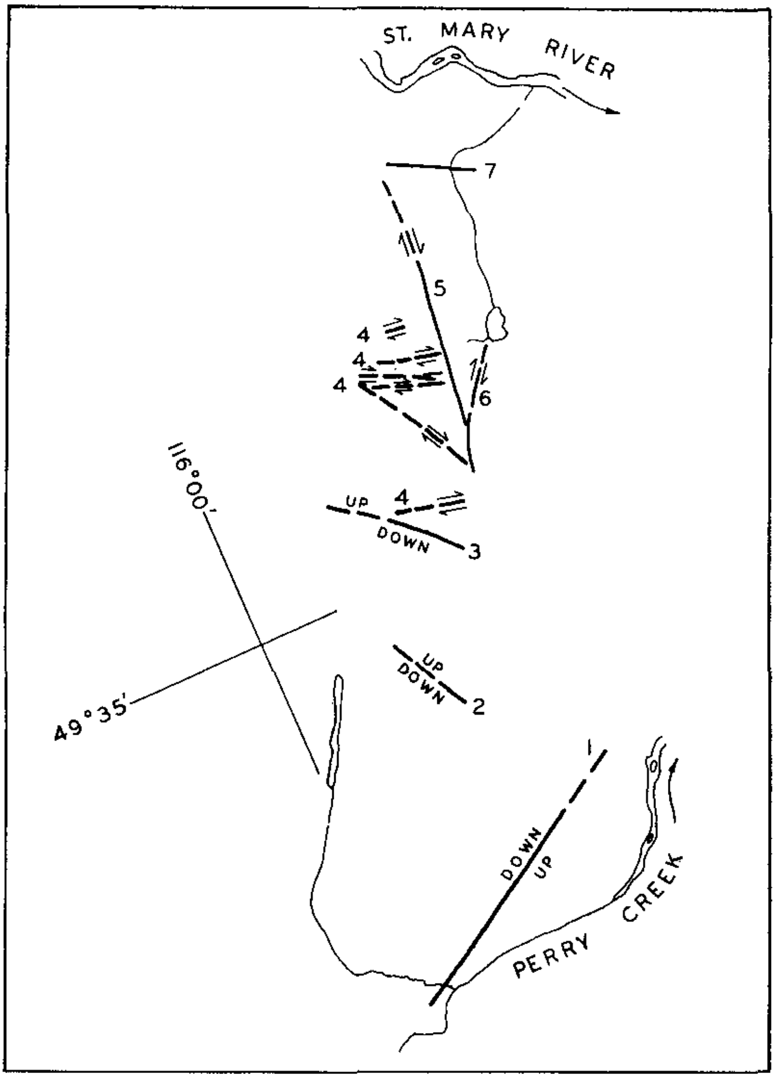


Figure 21. Probable fault movements. Marysville magnesite.

was uncovered in only two of the trenches. In the south trench a magnesite mound 30 feet high, 200 feet long, and 50 feet wide was uncovered. No wallrock is exposed on the west side; interbedded limy quartzites and quartzites lie along the east side. The rocks strike north 30 degrees east, dip 60 degrees northwest, and are overturned. In the second cut, 250 feet northeast of the one just described, a 40-foot width of crystalline magnesite with 130 feet of thin interbeds of quartzite and magnesite on the west is exposed. No east wall is visible. Sample No. 2 in the table consisted of chips gathered at 1-foot intervals along the trench across the 40-foot band of magnesite in the second cut. This area is 10.1 miles by road from Highway No. 95 at the St. Mary River bridge.

At location No. 3 a crosscut adit has been driven 22 feet on a south 65 degrees east bearing into a magnesite bluff. Here the coarse-grained magnesite is 40 feet thick and has interbedded quartzite-carbonate zones on both walls. The rocks strike north 35 degrees east, dip 74 degrees northwest, and are overturned. Continuous natural exposures of the magnesite band extend on strike for 200 feet to the southwest and for 400 feet to the northeast. Sample 3 consisted of chips collected at 1-foot intervals along the wall of the adit.

Another crosscut adit in the magnesite is located at site No. 4. This adit has been driven on a bearing of south 85 degrees west for 70 feet into a low bluff. The magnesite band is about 50 feet thick and has quartzite-carbonate interbeds parallel to it on the west. No east contact is visible. The rocks strike north 25 degrees east, dip 70 degrees northwest, and are overturned. Natural exposures of magnesite extend on strike for 60 feet to the southwest and intermittently for 900 feet to the northeast. Sample 4 consisted of chips collected at 1-foot intervals along the wall of the adit.

Location No. 5 is the site of a small quarry from which the Consolidated Mining and Smelting Company mined 3,000 tons of magnesite for experimental purposes in 1941. The quarry is 33 feet wide across the strike and 125 feet long on the strike of the magnesite band. The magnesite is about 50 feet thick with interbedded quartzite-carbonate on both walls. The rocks strike north 14 degrees east, dip 60 degrees west, and are overturned. Natural exposures continue for 350 feet to the northeast but are cut off by a sharp gully to the southwest. Sample No. 5 consisted of chips taken at 1-foot intervals from across the face of the quarry. The quarry is 7.7 miles by road to Highway No. 95 at the St. Mary River bridge.

Analyses of Samples of Magnesite from the Marysville Magnesite Belt

Sample No.	MgO	CaO	CO_2	SiO_2	Fe (Total)	Al_2O_3
1A	45.13	0.80	45.92	5.42	0.89	......
1B	39.03	9.27	46.92	3.52	0.66	......
1C	45.35	0.70	48.00	4.40	0.67	......
2	39.58	0.48	43.64	7.38	1.20	4.48
3	44.26	0.45	50.36	2.17	0.90	Tr.
4	32.05	1.14	35.56	26.71	1.62	2.00
5	41.90	0.71	42.80	3.98	1.25	2.38
6	43.70	0.79	48.00	4.54	2.40[1]	0.40
7	44.80	0.73	48.30	4.40	1.44[1]	0.66

[1] Fe_2O_3.
Samples 6 and 7 from report by Cairnes (*see* reference).

UPPER PERRY CREEK (49° 116° S.E.)*

A deposit of magnesite in a geological setting similar to that of the Marysville one occurs on the ridge between Hellroaring and Kamma Creek, 2½ miles north 70 degrees west from Richmond Lake, at the head of Perry Creek. This was discovered and owned by The Consolidated Mining and Smelting Company of Canada, Limited, before the magnesite was reported at Marysville. It was mentioned by C. E. Cairnes in 1932 and noted by H. M. A. Rice in 1941.

A good road extends for 23 miles up Perry Creek from Highway No. 95 at the St. Mary River bridge. The magnesite is about 4 miles by trail from and 2,300 feet above the end of the road. The old trail to the property is now largely overgrown and difficult to locate but can be found by climbing northwest up the hillside from the road end for about 600 feet vertically.

Where examined, the magnesite is in the floor and north wall of an irregular cirque. It forms a bed from 10 to 20 feet thick that is underlain by white quartzite and overlain by green thin-bedded siliceous argillite. The rocks are folded into a tight north-trending and north-plunging syncline. The east limb is vertical; the

* By J. W. McCammon.

west limb is steep near the floor of the cirque, but flattens to a 40-degree east dip at the top of the cirque wall. Considerable shearing has taken place nearly parallel to the fold axis. Magnesite is exposed for 430 feet along a north 20 degrees east strike in the centre of the cirque floor and then is missing for 380 feet to the foot of the cirque wall, where it reappears and can be traced up the wall to the ridge-top a distance of about 700 feet horizontally and 400 feet vertically.

A small open cut has been excavated in the east limb of the magnesite at the base of the outcrop in the cirque wall. The west limb of the fold is not exposed here, but it must be very close. The cut is 10 feet wide across the strike of the rocks, 5 feet long, and has a 10-foot high face. The magnesite in the cut is badly sheared and fractured and contains abundant quartz in pods and veinlets. It is very coarse grained, pearly grey to buff in colour, and weathers brown. A sample of chips from across the 10-foot-wide face of the cut had the following percentage composition: $MgO=40.47$; $CaO=0.78$; Fe (total)$=2.07$; $SiO_2=5.97$; $Al_2O_3=3.98$; $CO_2=44.02$. A sample that Cairnes had analysed had the following percentage composition: $MgO=42.09$; $CaO=1.79$; $Fe_2O_3+Al_2O_3=5.11$; $SiO_2=5.92$; Insol.$=2.39$.

[References: Cairnes, C. E., *Geol. Surv., Canada,* Sum. Rept., 1932, Pt. A II, p. 103; Rice, H. M. A., *Geol. Surv., Canada,* Mem. 228, Nelson Map-area, East Half, British Columbia, 1941, pp. 29, 57.]

The Brisco Magnesite Area (50° 116° N.E.)*

Introduction

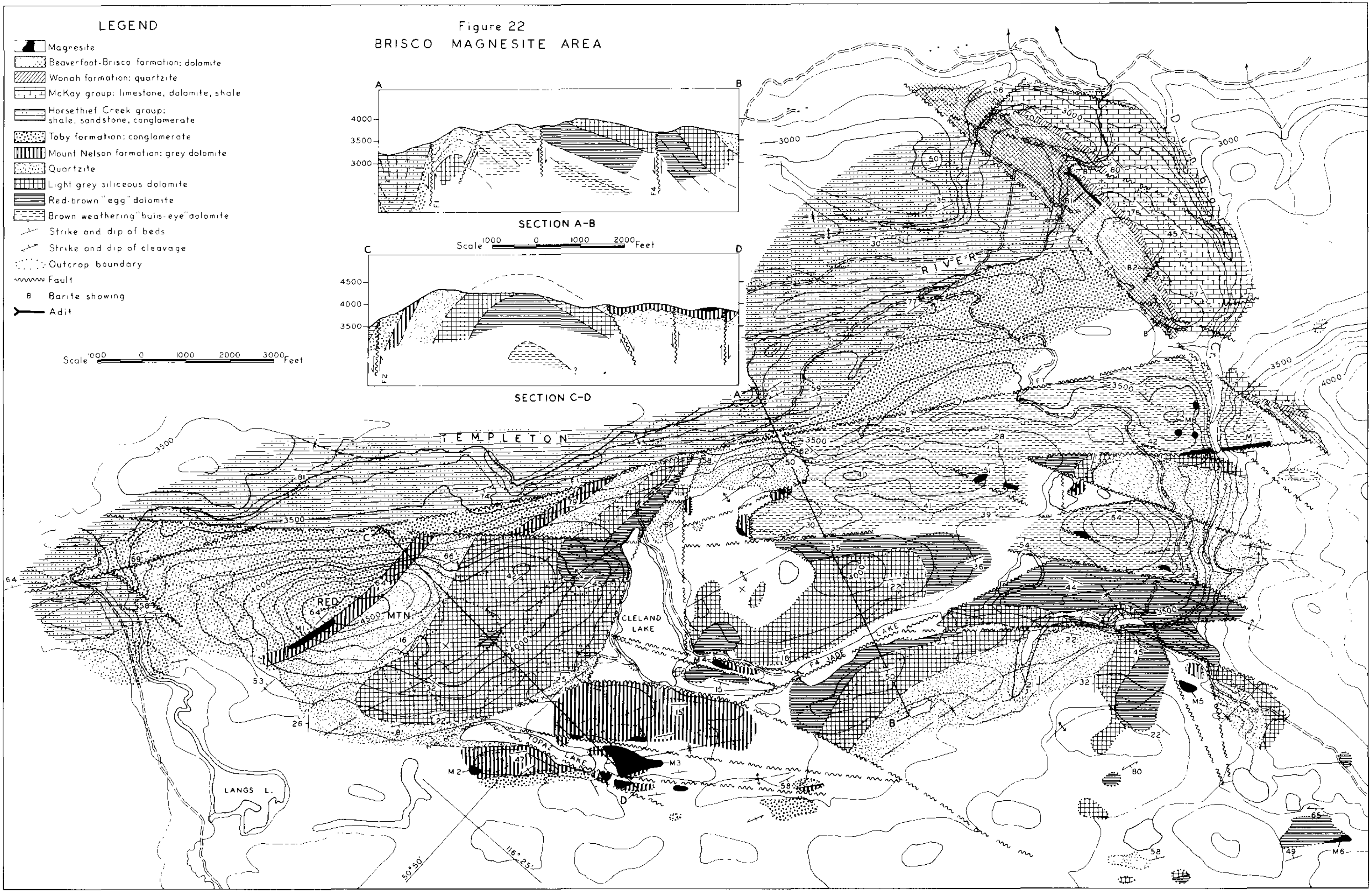
Barite has been produced from the area west of Brisco since 1945. In June, 1959, mining interest in the region increased when J. A. Brown, of Calgary, recorded three claims on a magnesite discovery. In August, 1960, more claims were recorded on magnesite by John and Gordon Hart, of Brisco. Later several additional small deposits of the mineral were found. The A. P. Green Fire Brick Company Limited optioned the two original claim groups and did some diamond drilling and trenching on them in 1961 and 1962. There has been no commercial magnesite production yet.

Brisco is a small community beside the Columbia River in the Rocky Mountain Trench, 48 miles south of Golden. Provincial Highway No. 95 and the Canadian Pacific Railway branch line from Crowsnest Pass to Golden both pass through the village.

Reconnaissance geological reports accompanied by maps that cover this area sketchily were published by J. F. Walker in 1925 and C. S. Evans in 1932. A preliminary geological map by J. E. Reesor in 1957 also included the region. Brief reports on two of the magnesite deposits were published in the Annual Report of the Minister of Mines and Petroleum Resources for 1962. The barite has been mentioned in several Annual Reports since 1945, particularly in 1952 and 1958.

This account is based on work carried out during one-month periods in each of the 1963 and 1964 field seasons. An area 4 miles wide and 6 miles long was mapped geologically. It is bounded along the northeast by the Columbia River, on the north by Bugaboo Creek, and on the south by Dunbar Creek. Geology was plotted on a map-sheet scaled at 1,000 feet to the inch, specially prepared by the Topographic Division of the Surveys and Mapping Branch of the British Columbia Department of Lands, Forests, and Water Resources. Air photographs taken by the Provincial Government in 1960 were used in conjunction with the map.

* By J. W. McCammon.


LEGEND
Magnesite
Beaverfoot-Brisco formation: dolomite
Wonah formation: quartzite
McKay group: limestone, dolomite, shale
Horsethief Creek group: shale, sandstone, conglomerate
Toby formation: conglomerate
Mount Nelson formation: grey dolomite
Quartzite
Light grey siliceous dolomite
Red-brown "egg" dolomite
Brown weathering "bulls-eye" dolomite
Strike and dip of beds
Strike and dip of cleavage
Outcrop boundary
Fault
B Barite showing
Adit
Scale 1000 0 1000 2000 3000 Feet
Figure 22
BRISCO MAGNESITE AREA
SECTION A-B
Scale 1000 0 1000 2000 Feet
SECTION C-D
TEMPLETON
RIVER
RED MTN
CLELAND LAKE
JADE LAKE
TOPAZ LAKE
LANGS L.
DUNBAR CR.
50°50'
116°25'

[References: Evans, C. S., *Geol. Surv., Canada,* Sum. Rept., 1932, Pt. A II, pp. 106–176; Reesor, J. E., *Geol. Surv., Canada,* Map 12-1957, Lardeau, British Columbia, 1957; Walker, J. F., *Geol. Surv., Canada,* Sum. Rept., 1925, Pt. A, pp. 222–229; *Minister of Mines, B.C.,* Ann. Repts., 1945, p. 130; 1952, pp. 246–248; 1958, pp. 84–85; 1962, pp. 156–157.]

General Nature of the Area

The map-area is in the western part of the Rocky Mountain Trench in a hummocky, lake-pocked region between the ends of the intravalley ridges formed by Steamboat and Jubilee Mountains. The lowest part of the Trench at this latitude is 2,600 feet above sea level. It consists of a mile-wide flat through which the Columbia River meanders in several channels. On the west side, from the flat there is an abrupt rise to a hummocky bench with an average elevation of 3,200 feet. A steep northwest-trending fault scarp through the centre of the area separates this bench from a higher one to the southwest. The surface of the second bench is broken up by numerous hills and knolls. Its elevation ranges from 3,600 feet in the lower parts to over 4,500 feet on the peak of Red Mountain. Bedrock outcrops are absent in the bottom of the Trench, scarce on the first bench except in the valleys of Templeton River and Dunbar Creek, and fairly numerous but generally small on the higher parts of the upper bench.

Glaciation has left the area mantled with drift. Crag-and-tail drumlins and striations indicate the last movement of the glaciers was toward the southeast.

Some of the area is semi-open park-like country with well-spaced lodgepole pine or fir trees and little underbrush. Much of it has been burned over, however, and is now covered by a jungle of young pine or a tangle of old windfall.

A good network of gravel roads built and maintained by loggers and fishermen provides easy access to all parts of the map-area.

General Geology

The exposed rocks are all sedimentary. They consist of Proterozoic dolomite, quartzite, conglomerate, and argillite, folded into a large anticline which is thrust up against a syncline of Palæozoic dolomite, quartzite, and limestone. Many minor folds and numerous faults are associated with the major fold. The magnesite occurs in the Proterozoic dolomite. The main barite showings are in Palæozoic dolomite, although small veins of it also are found in Proterozoic rocks.

Proterozoic Rocks

The Proterozoic rocks include the top part of the Upper Purcell Mount Nelson Formation and the Windermere Toby Formation and Horsethief Creek Group.

Rocks thought to belong to the Mount Nelson Formation are shown on the accompanying map divided into five members. The oldest member, No. 1, consists of flesh to light-grey or cream-coloured, very fine-grained dolomite that typically has a sandy medium- to dark-brown weathered surface. The rock is thin bedded and breaks into sharp angled fragments. A distinctive feature of many, but not all, outcrops is the presence of circular " bull's-eyes " up to 10 inches in diameter that consist of concentric layerings 1 to 3 millimetres thick. These may be some form of stromatolite. Scattered quartz grains are present in all beds, and in a few places cherty zones have developed. One layer near the bottom is mainly chert and contains numerous 1- to 3-millimetre oval shapes that closely resemble certain foraminifera. Near faults this member becomes light cream in colour, coarse grained, and frequently altered to magnesite in irregular masses. No lower contact was seen, and all nearby rocks in the direction of the base belong to much younger formations.

Member No. 2 consists of very fine-grained dark reddish-brown argillaceous dolomite that weathers lighter reddish-brown. Normally it contains irregularly scattered ellipsoidal cream-coloured spots that range from one thirty-second of an inch to 2 inches in diameter. The ellipsoids tend to be slightly flattened parallel to the bedding and have their long axes parallel to the strike of the rocks. A strong foliation, probably a regional cleavage, is well developed in most outcrops. This causes the rock to break into thin platy pieces. The foliation is usually nearly parallel to the bedding but may have a different dip. Microscopically the rock is seen to consist of grains of dolomite, quartz, sericite, iron oxide, and unidentified fine-grained material. The only visible difference between the light spots and the dark groundmass is that iron oxide particles are scarce in the former and abundant in the latter. No explanation was found for the formation of these bleached " eggs." At one location in the south central part of the area, magnesite has developed in the rock. No contact between the dolomite and No. 1 member was seen. It is thought the contacts within the area are probably all faulted ones.

Member No. 3 consists of fine-grained, siliceous, pale-grey to buff, or mottled dolomite that weathers to a rough light-grey or buckskin coloured surface. Silica is conspicuous as criss-crossing veinlets and irregular gobs of white quartz. This member appears to lie conformably on top of member No. 2.

Member No. 4 consists of quartzite. Most of the rock is in thick pale-grey to white beds composed of fairly well-rounded clean quartz grains, one-quarter to one-half millimetre in diameter, with a few flakes of sericite cemented with quartz. Near the bottom of the member the beds are a few inches thick and quite brown, while near the top of the member they are argillaceous, thin and platy, and weather reddish. No good contact between members 3 and 4 was seen, but the beds appear to be conformable.

Member No. 5, the top of the Mount Nelson Formation in this area, is a 250-foot-thick band of very fine-grained, siliceous, dark blue-grey dolomite that weathers to a rough light-grey surface. The rock is thin bedded and finely laminated. The laminæ range from hairline to 1 millimetre thick and consist of layers of different shades of colour. Silica is present as lenses and discontinuous thin layers of dark chert parallel to the bedding, as angular quartz grains scattered through the dolomite, and as curved fine-grained chips and segments as large as an inch in diameter. The chips are restricted to a narrow zone at the top of the member. In this zone the laminæ, when present, are contorted and display minor faulting and slump structures. Where continuous laminæ are absent, the rock has the appearance of a breccia that originally had large spaces between fragments and the spaces became filled with concentric layers of dolomite in sheaf-like radial growths. Nothing similar was seen in any of the other dolomites. The bottom part of this dolomite is very similar to the rock of member No. 3, and in isolated outcrops the two cannot be distinguished with assurance. The most numerous and largest deposits of magnesite are in the No. 5 member. The contact between this member and the underlying quartzite is gradational over a few feet, within which are several interbeds of quartzite and dolomite.

Next oldest after the Mount Nelson Formation is the Toby Formation. This consists mainly of conglomerate with a little argillite. The matrix of the conglomerate is dark-grey sandy argillite in which a strong foliation has developed. The pebbles are most commonly quartzite, but a few are dark-grey dolomite and some are chert. They range in diameter from half an inch to 10 inches. Some are well rounded, but others are angular with rounded corners. The pebbles are not abundant, and in some exposures much searching is required to find any of them. The main contact between the Toby and Mount Nelson rocks is in a brushy east-west trending gully 20 feet deep and 50 feet wide across the top of Red Mountain. Mount Nelson dolomite forms the steep south wall of the gully. To the north is a covered zone 10 to 20 feet wide and then an exposure of 20 feet of thin-bedded sandy argillite that grades into typical conglomerate. As near as can be seen, the rocks on both sides of the gully have the same attitude, and neither dragfolding nor brecciation was found, but the gully indicates differential erosion along a weak zone, and it is thought that the contact is probably faulted here.

Overlying the Toby Formation with apparent conformity is the Horsethief Creek Group. Included in the group are quartzites, grits, and conglomerates consisting of closely packed ¼- to ½-inch quartz pebbles, shales, and a few thin limestone beds. These rocks are folded into several small anticlines and synclines nearly parallel to the main fold.

Palæozoic Rocks

At the southeast corner of the map-area, in the lower parts of Templeton River and Dunbar Creek, the eastern half of a syncline composed of Palæozoic rocks is exposed. The older rocks must be thrust up and to the northeast against these rocks along a fault, F3, about as indicated on the map.

The oldest Palæozoic rocks are mapped as part of the Cambrian-Ordovician McKay Group. They consist of 1- to 3-inch-thick beds of flesh to dark-grey limestone separated by films and paper-thin layers of black shale. The uppermost 250 feet of beds are dolomitic and contain thin lenses and occasional thin layers of dark chert. Micro- and macro-fossils are abundant in the limestone beds.

Above the McKay rocks is a 130- to 200-foot-thick bed of white quartzite. It is composed of well-rounded clean quartz grains three- to eight-tenths of a millimetre in diameter cemented by quartz. This corresponds lithologically and stratigraphically with quartzite mapped as Wonah Formation on the east side of the Trench. Although other mappers have stated that no Wonah Formation is found in this area, for the present report the quartzite is considered Wonah Formation.

Overlying the quartzite is light- to dark-grey dolomite that weathers to a light-grey powdery surface. This is considered to be part of the Ordovician-Silurian Beaverfoot-Brisco Formation.

Structure

The Proterozoic rocks have been folded into a large northwest-plunging anticline with its axial plane striking a little north of west and dipping steeply to the southwest. The anticline has been thrust northeastward to override part of its own northeast limb and also the west limb of the adjoining syncline of Palæozoic rocks. Several smaller folds lie southwest of the large fold and parallel to it.

Much faulting accompanied the deformation of the rocks. However, except in the canyons of Templeton River and Dunbar Creek, no fault surfaces are exposed. Where visible, the faults consist of sheared zones several feet wide that do not give much positive indication of the directions of movements. Most of the faults shown on the map and their relative movements are inferred from stratigraphic relationships. At least four of the faults, F1, F2, F3, and F4, must be thrusts and appear to be nearly vertical at the surface. Faults F2 and F3 probably also had right-hand lateral movement. Most of the rest of the faults are best interpreted as normal ones, although some such as F5 also show apparent right-hand lateral movement.

The rocks are badly sheared and disturbed in Dunbar canyon at the point where faults F1 and F3 should intersect. Outcrops are too small and scarce to show clearly what has happened there. It would appear that the Palæozoic block to the northeast has been pushed clockwise around this point, which acted as a hinge. Fault F2 or a similar one probably extends southeastward across the northeast front of Steamboat Mountain.

A regional cleavage that strikes northwest and is vertical or dips steeply to the southwest is well developed in the argillaceous members of the Horsethief Creek Group, in the matrix of the Toby conglomerate, and in parts of the No. 2 and No. 4 members of the Mount Nelson rocks.

Magnesite

Patches of magnesite occur scattered widely throughout the area underlain by Mount Nelson dolomites. The largest and most numerous deposits are at the top of the uppermost or No. 5 member. No good explanation for the origin of these occurrences was found. The magnesite is coarse grained or occasionally porphyritic. It shows definite replacement characteristics, boundaries being quite distinct but gradational over a narrow zone. Most deposits are adjacent to faults, but usually appear to be older than the faults. Probably the magnesite formed early in the tectonic history of the region by the replacement of dolomite as a result of some reaction associated with movement of the Toby conglomerate over the top of the Mount Nelson Formation during folding.

At outcrop M1 magnesite forms a 40- to 90-foot-thick zone 1,200 feet long at the top of the Mount Nelson No. 5 member. At each end magnesite grades on strike into cherty light-grey weathering dolomite. At the contact coarse-grained magnesite appears to replace dolomite. Underlying the magnesite is fine-grained dolomite with irregular ½- to 2-inch-thick layers of dark chert. No rock was seen in contact on top of the magnesite. The next stratigraphically higher outcrops consist of lower thin-bedded argillites of Toby Formation; these are separated from the magnesite by a 10- to 20-foot covered area in the bottom of a narrow ravine. Most of the magnesite is in 1-centimetre-long crystals that are pearl grey when fresh but buff when weathered. In some places, crystals 1 centimetre long are scattered through a groundmass of grains one-half millimetre long and the rock has a marked porphyritic appearance. Considerable silica is present in the form of scattered remnants of partly replaced quartz grains and cherty patches. A sample composed of chips collected at 3-foot intervals across 90 feet of exposed magnesite at the east end of the showing had the chemical composition shown as M1 in the accompanying table.

The magnesite at M2 forms an apparently thin dip-slope surface layer 200 feet long and 200 feet wide across the end of a low hillock. It overlies fine-grained dolomite of the top Mount Nelson member, in which are abundant curved siliceous chips. The magnesite shows features which indicate it has replaced dolomite. A sample consisting of chips collected at random from the surface of the exposure had the composition shown under M2 in the table.

Locality M3 is the site of the Whitehorse 1 to 6 mineral claims on the original magnesite discovery in this part of the area. The deposit consists of a central main mass and six smaller ones, two in a downfaulted block to the northeast, and four in a downfaulted block to the southwest. The main mass is exposed in a right-angled triangular shape 1,400 feet long on the hypotenuse and 600 feet wide at the widest spot. If forms the trough of a syncline that plunges northwestward. Diamond drilling has shown it to be 50 to 100 feet thick, and it is underlain by fine-grained cherty dolomite. The magnesite is light- to pearl-grey rock that weathers to a rough rusty-brown surface. Most is coarse grained with crystals ranging from 2 to 12 millimetres long. The chief visible impurities are quartz, in scattered veinlets and grains, and talc in minute shears. A sample consisting of chips picked up at random from the surface of the main exposure had the composition shown as M3A in the table. A grab sample from the centre outcrop in the gully southwest of the main showing had the analyisis shown as M3B in the table.

At M4 medium- to coarse-grained magensite is exposed as a dip-slope layer 10 to 20 feet thick, 600 feet long, and 100 feet wide on the western side of a low ridge. It overlies fine-grained dolomite typical of the top member of the Mount Nelson Formation. A chip sample cut across a 10-foot stratigraphic thickness of the outcrop had the analysis shown as M4 in the table.

The first recorded magnesite discovery in the area was made on the Jab 1 to 3 claims at site M5. Here the magnesite forms a bare isolated 50-foot-high knoll 400 feet long and 100 to 170 feet wide. Most of the knoll consists of medium- to coarse-grained structureless pale-grey to white rock. However, at the southeast corner thin layers of magnesite separated by slickensided films of talc and serpentine suggest bedding. This layering indicates the outcrop to be on the west limb of a small anticline with its axial plane oriented northwest. Patches of coarse white dolomite, films of talc, discontinuous stringers of quartz and chalcedony, and scattered crystals and small lenses of pyrite make up the megascopically visible impurities. No rock was found in contact with the magnesite. Dolomite outcrops 200 feet to the east and 100 feet to the west. A sample of chips collected at random over the top of the knoll had the composition shown as M5 in the table.

Three other small isolated patches of magnesite believed to be at the top of the No. 5 member are also shown on the accompanying map. All are too small to be of potential economic interest.

At M6 dolomite of the No. 2 member of the Mount Nelson Formation is altered to impure magnesite. This magnesite contains considerable calcite and quartz. It is fine grained and very white. The exposure is 100 feet wide and 400 feet long on strike. In the table, the analysis shown as M6 is for a hand specimen of rock from this showing.

In the bottom member of the Mount Nelson Formation, alteration to magnesite was found in six places, all along or close to known faults. At M7 a near vertical, northwest-striking fault surface forms the cliff face in high dolomite bluffs. For distances of as much as 100 feet northeast of the fault the dolomite has been altered to coarse-grained magnesite. The northeast boundary of the magnesite is very irregular. At M8 the entire hill is at least partially altered, but irregular patches are completely changed to magnesite. Hand specimens from the two localities had the compositions shown in the table as samples M7 and M8. Two small showings of similar alteration are exposed on the west side of the hill three-quarters of a mile west of M7 and two more are on the hillside 1 mile northwest of M7.

A limited amount of exploration work was done on the magnesite deposits at M3 and M5 by the A. P. Green Fire Brick Company Limited in 1961 and 1962. At M3 about 28 diamond-drill holes between 50 and 200 feet long were drilled and several bulk samples were collected for testing. At M5 several holes were diamond drilled, some trenches were dug with a bulldozer, and bulk samples were collected.

Aanalyses of Magnesite Samples from Brisco Area

Sample	MgO	CaO	CO_2	SiO_2	Fe (Total)
M1	39.50	0.76	43.40	14.72	0.88
M2	42.79	1.04	46.72	6.48	0.87
M3A	43.34	0.51	47.60	5.54	1.02
M3B	44.85	0.73	49.20	3.47	0.95
M4	38.20	7.89	47.74	4.51	1.00
M5	44.02	0.47	43.82	8.99	0.99
M6	35.97	8.57	46.02	8.69	0.12
M7	41.41	2.84	47.48	3.97	2.07
M8	42.28	2.67	48.28	3.22	1.03

Barite

Mountain Minerals Limited, of Lethbridge, Alta., has mined barite from a deposit near the mouth of Templeton River since 1945. The deposit is on five Crown-granted mineral claims located by the Hart brothers in 1943 and 1945 and acquired from them by the company in May, 1945.

On the property, barite is found in a north-striking breccia zone in dolomite thought to be part of the Ordovician-Silurian Beaverfoot-Brisco Formation. The deposit is in the east limb of a syncline which is cut by numerous faults of varying magnitude.

The main orebody, shown at B1 on the map, averages 25 feet wide and is 800 feet long. The rock in both walls is brecciated dolomite and the ore itself is brecciated. Much of the barite is white, but the white sections are irregularly shaped and usually edged or cut by zones that have a fine-grained black matrix enclosing angular white barite fragments a fraction of an inch to several inches long. The black coloration is due to finely disseminated carbon. Some pyrite is present and causes yellow and brown staining in parts of the exposure. The barite pinches out to the south and is cut off by a right-hand fault at the north end. A short segment of the offset portion of the ore can be found in Templeton canyon, but it is lost in overburden on the north bank. The deposit has been mined out to the economic limit of surface excavation by a five-bench quarry with a vertical range of 130 feet between the floor of the lowest bench at the north end and the top of the face of the highest bench at the south end. An adit has been driven under the quarry 60 feet below the lowest floor from a portal on the edge of Templeton River. In 1963 barite was mined from stopes between the adit and the quarry floor. There was no production in 1964.

A second quarry at B2 was worked from 1960 to 1962 in a small orebody 1,800 feet south of the main workings. The quarry is about 25 feet deep, nearly 200 feet long, and 100 feet wide at the face. In this deposit the barite is very irregular and badly faulted.

The barite at the other four locations shown on the map in this region is in very small quantities as matrix in dolomite breccia.

A few 1- to 2-inch-thick veins of white barite are exposed in the No. 2 member of the Mount Nelson dolomite in the road cut just south of the V Creek crossing 2 miles southwest of the main quarry. No other barite was noticed in Mount Nelson rocks.

An analysis of a chip sample of barite from the main quarry showed the following precentage composition: $BaO = 63.90$; $SO_3 = 34.35$; $CaO = 0.08$; Fe (total) $= 0.02$; $CO_2 = 0.03$. The specific gravity was 4.389.

Because of the black colour the barite cannot be used where whiteness is required, but it is satisfactory where only weight is important.

First production from the quarry was made in 1945. To the end of 1964 the total reported production was 108,580 tons.

MARL

Cheam Marl Products†

Popkum (49° 121° S.W.). Office, 13 Fletcher Street South, Chilliwack. P. C. Woodward, general manager. This property consists of a lake deposit of marl ranging up to 10 feet thick. The deposit is post-glacial and accumulated on the

* By J. W. McCammon.
† By A. R.C. James.

bed of Cheam Lake, which was drained some years ago. The marl and topsoil are excavated by two small draglines and sold for agricultural purposes. The material is either trucked wet to the consumer or stockpiled on a drainage pad.

Production in 1964 was 25,408 tons of marl. Of this total, 3,650 tons was exported to the United States to customers in Skagit and Whatcom counties. A total of 9,943 cubic yards of topsoil was sold. A crew of three men was employed at the property.

SAND AND GRAVEL

Data on sand and gravel production are presented on the following pages. The abbreviations used in the table for the types of sand and gravel produced are as follows: AA=asphalt aggregate; SA=sized aggregate; WS=washed and sized aggregate; RP=run-of-pit material; AP=asphalt paving mix; RM=ready-mix concrete.

Sand and Gravel Pits

Location	Operator	Equipment and Plant	Men	Products
Fort St. John—				
(1) Boundary Lake	C. B. Harden Cartage Ltd.	Front-end loader and screening plant	....	RP and SA.
(2) North bank of Peace River south of Fort St. John	Norby Bros. Construction Ltd.	Tractor, crushing, and screening	6	SA.
Chetwynd	Frankie's Construction	Loader, crushing, and screening	3	RP and SA.
Prince George—North Nechako Road	Ocean Cement Limited	Scoopmobile, jaw, and roll crusher, screening plant, and ready-mix plant	3	RP, WS, and RM.
Kamloops—				
(1) North Thompson highway	Western Sand & Gravel Ltd.	Loading, crushing, screening, and washing	15	WS.
(2) North Thompson highway	Yellowhead Sand & Gravel	Front-end loader, crushing, screening, and washing	12	RP and WS.
Creston—Goat River	Louis Salvador& Son	Crushing, screening, washing	4	WS and RM.
Wynndel—Duck Creek	Louis Salvador& Son	Loading, screening	2	SA.
Nelson—Anderson Creek	Premier Sand and Gravel Company Limited	Loading, screening, crushing	4	SA and RM.
Trail—Casino Road	McGauley Ready-Mix Concrete Company	Scraping, washing, screening, crushing	3	WS and RM.
Castlegar—Columbia River	McGauley Ready-Mix Concrete Company (Ken Downs, manager	Loading, crushing, screening	4	WS and RM.
Salmo—Erie Creek	Valley Concrete Products Limited	Loading, screening, concrete plant	2	Concrete pipe.
Town of Hope—east of junction of Hope-Princeton and Cariboo Highways	Town of Hope	Front-end loader	....	Sand=7,000 yd.; Columbia Bitulithic Limited, 16,000 tons.
Vancouver—Granville Island	Columbia Bitulithic Limited	Paving plant	....	AP=52,278 tons.
North Vancouver—west end of East Keith Road, east of Seymour Creek	E. R. Taylor Construction Co. Ltd., 2645 Dollarton Highway	Gas shovel, paving plant	3[1]	Sand=3,345 yd.
Coquitlam Municipality—				
(1) West end of Westwood Road	Corporation of the District of Coquitlam	Front-end loader, portable crushing and screening	....	RP and SA.
(2) Pipeline Road, 3½ miles north of Lougheed Highway	Jack Cewe Ltd., 309 Cedar St., New Westminster	Shovel, screening, crushing, paving plant	20	RP and SA=175,000 yd.; AP=148,926 tons.
(3) Pipeline Road, 3 miles north of Lougheed Highway	S & S Sand and Gravel Limited, 1001 Eighth Ave., New Westminster	Front-end loader, crushing, screening and washing	9	WS and RP=182,100 yd.
(4) Pipeline Road, 1½ miles north of Lougheed Highway	Allard Concrete Construction Co., 1930 Pitt River Road, New Westminster	Front-end loader	1	RP=25,000 yd.
(5) Pipeline Road, 1 mile north of Lougheed Highway	Deeks-McBride Ltd., 1051 Main Street, Vancouver	Shovel, 600-tons-per-day washing and screening, ready-mix	5	WS and RM=329,142 yd.
(6) Adjoining Deeks-McBride pit to west Port Coquitlam	Columbia Bitulithic Limited	Paving plant	....	AP=28,600 tons.
(7) Fraser River at Mary Hill, 2 miles south of Port Coquitlam	Ocean Cement Limited, north foot of Columbia St., Vancouver 4	Shovels, etc., 500-tons-per-hour processing plant, barge-loading facilities	46	WS=1,052,700 yd.
Pitt Meadows District Municipality—				
(1) 1 mile northwest of Port Hammond	Haney Brick & Tile Ltd.	Front-end loader	1[1]	Sand=1,777 yd.
(2) Bonson Road (196th St.), 1 mile north of Fraser River	Lasser Trucking Co., Box 38, Pitt Meadows	Front-end loader	1[1]	RP=8,000 yd.

Maple Ridge Municipality—				
(1) Grant Hill, 1 mile east of Albion and also adjoining Kirkpatrick pit	Corporation of the District of Maple Ridge		....	Fill and AP; Columbia Bitulithic Limited, AP=12,000 tons.
(2) Grant Hill, ½ mile north of municipal pit	McIntosh Sand and Gravel, Box 245, Haney	Shovel, crushing, and screening	4[1]	RP and SA=20,000 yd.
(3) Grant Hill, north of McIntosh pit	Henry Van Boeyen, Albion	Shovel	1[1]	RP=685 yd.
(4) Lougheed Highway south of Grant Hill	Valley Ready Mix Co. Ltd., Haney	Shovel, front-end loader, crushing, washing, and screening, ready mix	2	WS and RM=24,000 yd.
(5) East end of No. 27 Road, Alouette River	Kirkpatrick Sand and Gravel Ltd., 22357 McIntosh St., Haney	Shovel, crushing, screening, washing	2	WS and RP=10,640 yd.
(6) Lougheed Highway, 1 mile east of Whonock	Ralph E. George	Front-end loader	1[1]	RP=1,672 yd.
Mission Municipality—				
(1) 1 mile and 3 miles east of Stave Falls power-house, 2 miles east of Ruskin power-house	Corporation of the District of Mission	Screening plants	....	RP and fill.
(2) 1.8 miles south of Steelhead, Dewdney Trunk Road	Department of Highways		....	
(3) 2.3 miles south of Steelhead, Dewdney Trunk Road	Cannon Contracting Ltd., 33323 Broadway, Mission	Front-end loader	1[1]	RP=800 yd.
(4) Dewdney-Lougheed Highway, 2 miles west of Squakum	Department of Highways	Front-end loader	....	RP.
Kent Municipality—				
(1) West end of Cemetery Road, south of Mount Agassiz	Corporation of the District of Kent	Shovel and front-end loader	....	RP.
(2) McCallum Road, 1 mile west of Harrison Hot Springs road	Department of Highways	Front-end loader	....	RP.
(3) McCallum Road, 1½ miles west of Harrison Hot Springs road	Dannielson Contractors Ltd., R.R. 1, McCallum Road, Agassiz	Front-end loader	1[1]	RP=2,973 yd.
Chilliwhack Municipality—				
(1) Arnold Road—from Fraser River bar	P. Heppner & Son, 7113 Sumas Prairie Road	Front-end loader	1[1]	RP=2,328 yd.
(2) Indian Reserve pit, south end of Agassiz-Rosedale bridge	Columbia Bitulithic Limited		....	AP=18,000 tons.
(3) Municipal pits on Fraser River bars	Municipality		....	Sand=66,001 yd.; gravel=101,189 yd.
Sumas Municipality—				
(1) At foot and east of Taggart Peak	Various operators but owned by H. Quadling, Yarrow	Front-end loader	....	Angular fragmental fill, 7,349 yd.
(2) Vye Road, 3 miles south of Abbotsford	Corporation of the District of Matsqui	Shovel	....	RP; Columbia Bitulithic Ltd., AP=11,039 tons.
Matsqui Municipality—				
(1) 1 mile east of Abbotsford	Blackham's Construction Ltd., Abbotsford	Screening and crushing	4	RP and SA=58,707 yd.
(2) Tretheway Road, ¾ mile north of Clearbrook	Department of Highways	Front-end loader	....	
(3) Tretheway Road, ½ mile north of Clearbrook	M.S.A. Paving Co. Ltd., Box 101, Clearbrook	Front-end loader, screening	....	RP and SA.

[1] Part time.

Sand and Gravel Pits—Continued

Location	Operator	Equipment and Plant	Men	Products
Matsqui Municipality—*Continued*				
(4) Clearbrook Road, ½ mile north of border	Abbotsford Gravel Sales Ltd., Abbotsford	Scraper, front-end loader, screening, washing, and ready-mix plant of Totem Trucking Ltd.	3	WS, RP, and RM=34,700 yd.
(5) 12th Ave., ¼ mile west of Clearbrook Road	Valley Rite-Mix Ltd., Box 430, Clearbrook	Front-end loader, screening, washing and crushing, ready-mix plant	13	RP, SA, WS, and RM=28,501 yd.
(6) Corner of King (16th Ave.) and Foy Road (316th St.)	Lepp Trucking, Abbotsford	Front-end loader	1[1]	RP=8,000 yd.
(7) Ross Road, 2¾ miles north of the border	Grant Materials & Equipment Ltd., Box 129, Aldergrove	Front-end loader	....	RP and SA=4,000 yd.
(8) Lefevre Road, ¼ mile north of Eighth Ave.	Corporation of the District of Matsqui	Shovel	....	RP.
(9) Corner of Lefevre Road and Eighth Ave. Caplette pit	E. Bird, Aldergrove	Front-end loader	2[1]	RP=3,981 yd.
Langley Municipality—				
(1) Northwest corner of Jackman Road and Eighth Ave.	Corporation of the Township of Langley	Shovel	....	RP.
(2) ½ mile west of Carvolth Road, north of 24th Ave.	Corporation of the Township of Langley	Shovel	....	RP.
(3) Kinch Road at 36th Ave.	Corporation of the Township of Langley	Shovel	....	RP.
(4) North of the northeast corner of Jackman Road and Eighth Ave.	Aldergrove Cement Tile Product (S. Omelaniec, manager)	Front-end loader	1[1]	RP=950 yd.
(5) ¼ mile north of corner of Jackman Road and Eighth Ave.	J. Craig, Trans-Canada Highway, Langley	Front-end loader	1[1]	RP=1,772 yd.
(6) Dogwood Ave. off Brown Road	Kitsul Bros. Gravel Sales Ltd., 23862 Old Yale Road, R.R. 3, Langley	Front-end loader	2[1]	RP=17,000 yd.
(7) Glen Valley Road at 252nd St.	Fort Langley Aggregates, J. K. McArthur, 11364—95A Ave., North Surrey	Front-end loader, crushing, screening	4[1]	RP and SA=40,000 yd.
(8) 8802 Hudson Bay Road, Fort Langley	H. G. Clark, Box 145, Fort Langley	Front-end loader, screening, washing, and ready mix	1[1]	WS and RM=4,480 yd.
(9) South side of Fort Langley adjoining Clark pit	Dawson Construction Co.	Front-end loader, crushing, screening	8[1]	SA=70,000 yd.
(10) Bradshaw and Berry Roads (Gun Club pit)	B & B Trucking, Cloverdale	Shovel, crushing, screening, asphalt	7	SA, RP, and AP=159,322 yd.
(11) 2962 Lambert Road (Highland pit)	Ocean Cement Limited, north foot of Columbia St., Vancouver	Shovel, crushing, screening, and washing	4	RP and WS=60,000 yd.
(12) 32nd Ave. at Kinch Road	Oscar W. Rees, 3003—208th St., R.R. 2, Langley	Shovel	2[1]	RP=11,674 yd.
(13) 16th Ave. at Surrey boundary	Department of Highways	Shovel	....	Fill.
(14) Boundary Road at Surrey boundary	Border Sand & Gravel Ltd., Boundary Ave., R.R. 2, White Rock	Front-end loader, crushing, screening, and washing	3	RP and WS=16,711 yd.
Surrey Municipality—				
(1) Campbell River Road at Langley boundary	White Rock Sand and Gravel, C. E. Schuler, 2546—176th St., R.R. 2, Cloverdale	Shovel, screen	2[1]	RP and SA=12,455 yd.
(2) Larsen Road (28th Ave.) at 193rd St.	Deeks-McBride Ltd., 1051 Main St., Vancouver	Scraper, front-end loader; crushing, washing, screening, and ready mix	3	WS, RP, and RM=75,140 yd.

(3) East end of Stokes Road (20th Ave.)	Corporation of the District of Surrey	Shovel	....	Fill.
(4) 53rd Ave. at Delta boundary	Corporation of the District of Surrey	Shovel, paving plant	....	Fill and AP.
(5) 15945—112th St., North Surrey	Richmond Sand and Gravel Ltd., c/o McPhail's Cartage Co. Ltd., Westminster Highway, Richmond	Front-end loader, washing, screening	2[1]	RP and WS=10,000 yd.
(6) 112th Ave. east of Pike (160th) St.	United Sand & Gravel Ltd., c/o Steeves and Mann Equipment Ltd.	Shovel, crushing, screening	2	RP and SA=40,909 yd.
Delta Municipality—				
(1) ¼ mile south of west end of 72nd St.	Western Peat Moss Ltd.		1[1]	RP=3,792 yd.
(2) ½ mile west of Scott Road at 68th St.	Western Paving Ltd., 6631—120th St., North Surrey (Lintons Construction Co. Ltd.)	Shovels, crushing, screening, washing, and asphalt paving plant	4	RP and SA=63,425 yd.; AP=46,000 tons.
(3) 10720—84th St., North Surrey	Knight Gravel Ltd.	Front-end loader, crushing, screening	3[1]	RP and SA=16,196 yd.
Howe Sound—				
(1) Furry Creek	Routledge Gravel Ltd.	Front-end loader, crushing, screening, and washing	8	WS, RP, and SA=279,736 yd.
(2) Britannia Beach	Construction Aggregates Ltd.	Scraper, crushing, screening, and washing	31	WS, RP, and SA=899,904 yd.
(3) Mamquam River	PaCo Cement Products Ltd.	Front-end loader	....	RP=11,760 yd.
(4) Port Mellon Road near Langdale	Ed Fiedler, Gibsons	Front-end loader	....	RP=1,794 yd.
(5) Veterans Road, Gibsons (Pacific pit)	Gibsons Building Supply, Gibsons	Front-end loader	1	RP=1,500 yd.
(6) Cemetery Road, Gibsons	P & W Development Co. Ltd., Gibsons	Front-end loader, crushing, screening, ready mix	1	SA and RM=8,000 yd.
Powell River				
(1) Haslam Lake Road, 3 miles northeast of Westview	G & H Sand and Gravel Co. Ltd.	Shovel, screening, washing and ready mix	2	
(2) Off Allen Road, 3 miles northeast of Westview	P. Nassichuk	Screening	1	Sand=6,290 yd.
(3) Yukon Ave. at Cassiar St.	Parsons Tractor Services Ltd.	Shovel, crushing, screening	4	RP and SA=79,263 yd.
Vancouver Island—				
(1) Campbell River, Elk Falls Lookout Road	Island Ready-Mix Ltd.	Front-end loader, crushing, washing, screening	1	WS, RP, and SA=12,952 yd.
(2) Campbell River, south of Buttle Lake road at Elk Falls road	G & A Trucking Ltd.	Front-end loader	....	RP.
(3) 2½ miles from Courtenay	Island Ready-Mix Ltd.	Mobile loader, rotary screening	2	SA and RM=11,028 yd.
(4) Wilkinson Road near Comox	Central Gravel Supplies Ltd.	Front-end loader, washing, and screening	12	SA=120,000 yd.
(5) Near Comox airfield	S. H. Marriott Sand & Gravel	Front-end loader, crushing, and screening	....	SA and AP=29,300 yd; Columbia Bitulithic Limited AP=21,000 tons.
(6) Cassidy No. 4 pit, Island Highway at Cassidy	Ocean Cement Limited	Front-end loader, washing, crushing, screening	4	WS, RP, and SA=32,650 yd.
(7) Duncan, Cowichan Lake Road	Butler Bros. (Duncan) Ltd., Duncan	Front-end loader, washing, crushing, screening	14	WS, RP, and RM=30,000 yd.
(8) Duncan, Koksilah	Armour & Saunders Ltd., Duncan	Front-end loader, crushing, washing, screening, asphalt paving	5	WS, SA, and AP=25,000 yd.
(9) Sooke, Sooke Road east of Milnes Landing	Wickheim Sand and Gravel	Front-end loader	1[1]	RP=18,000 yd.
(10) Royal Bay	Evans, Coleman & Evans Limited		13	WS=310,150 yd.

[1] Part time.

SILICA

Crystal Group* Grohman Creek (49° 117° N.E.). In 1963 H. E. Stevenson and J. O. Grady, of Nelson, located 14 claims on a quartz deposit on the northwest slope of Mount Nelson. In February, 1964, they located two more adjoining claims. The 16 claims were combined into the Crystal group in August, 1964, and turned over to Monzoon Industries Ltd.

The quartz is at 5,500 feet elevation on the Grohman Creek side of Mount Nelson, 3 miles northwest of Nelson City. Access is by boat to the mouth of Grohman Creek, then by jeep for 5 miles up the old Grohman Creek logging-road to the forks at Baldface Creek, and thence by 2½ miles of rough tractor-road to the property.

The showings are on the flat burned-over shoulder of the mountain. Although overburden probably averages not more than a foot or two deep, clean exposures of bedrock are small and discontinuous. Bare quartz patches a few feet in diameter occur scattered at 5- to 20-foot intervals over an area 300 to 400 feet long by 100 to 150 feet wide, the length oriented a little north of west. The highest exposure is approximately 65 feet above the lowest. At the northwest limit the quartz appears to lens out into coarse-grained perthite. Similar feldspar is uncovered in a gully just off the southeast end of the showing. On the edge of another gully along the southwest side the quartz is iron stained and shattered, indicating that it probably is limited in that direction by a fault trending north 70 degrees west down the gully. About 400 feet northeast of the main showing more quartz occurs in intermittent patches scattered over an area 250 feet long and 90 feet wide. A sharp gully trending north 20 degrees west, probably the site of a fault, separates the two quartz bodies, so it is possible they are offset segments of one original mass. The surrounding country rock is light-grey to white granite. The quartz is apparently the core, surrounded by feldspar, of a pegmatite lens in the granite. Two samples consisting of chips collected at random over the surfaces of the two quartz bodies were analysed. No. 1 was from the main showing and No. 2 was from the other. They had the following percentage compositions:—

	SiO_2	Al_2O_3	Fe (Total)	CaO
No. 1	98.64	0.89	0.02	Tr.
No. 2	98.84	0.42	0.04	0.06

No development work had been done on the ground when it was examined. Later in the season the tractor-road was completed to the outcrop site, and about 2,000 feet of stripping is reported to have been done with a bulldozer. The stripping revealed the quartz outcrops to be discontinuous and the possible tonnage of silica available too small for commercial mining.

Winlaw (Ren Silica Limited)† (49° 117° N.E.) Ren Silica Limited is a private company headed by Garnet Norris, of Winlaw. The company owns a crushing and screening plant at Winlaw and operates a silica quarry on the east side of the north fork of Winlaw (Cedar) Creek, 2¼ miles upstream from the forks. The road from the quarry to Winlaw was improved to permit heavy-duty trucks to haul quarried silica from the pit to the crusher, a distance of 5½ miles.

* By J. W. McCammon and P. E. Olson.
† By P. E. Olson.

The silica was found to be stained by greenish vegetable matter, and thus considerable hand sorting was required.

About 400 tons of stucco chips was produced and sold during 1964.

Oliver Silica Quarry*

(49° 119° S.W.) Pacific Silica Limited. Registered office, 717 West Pender Street, Vancouver 1; quarry office, Box 39, Oliver. I. A. Hunter, manager. The Oliver silica quarry is is on the Gypo mineral claim, owned by The Consolidated Mining and Smelting Company of Canada, Limited, and operated under lease by Pacific Silica Limited. The claim is less than one-quarter of a mile west of Highway No. 97, 1 mile north of Oliver. Estimated production for 1964 was 49,315 tons, and shipments made were 9,315 tons sacked and 40,000 tons in bulk. Thirty-one persons were employed.

Alba Sands Ltd.†

Valemount (52° 119° N.E.). Company office, 736 Granville Street, Vancouver 2. D. S. Bigelow, president. This company holds a lease on a deposit of silica sand about 1 mile west of Valemount. During 1964 a spur rail line was constructed from Valemount and additional equipment was installed in the washing plant. The material produced was sold mainly for sand-blasting. Three men were employed under the supervision of George Rhodes.

Mountain Minerals Limited‡

Brisco (50° 116° N.E.). Company office, P.O. Box 700, 529 Sixth Street South, Lethbridge, Alta.; quarry office, Brisco. R. A. Thrall, managing director; William McPherson, superintendent. In 1964 this company opened up a new silica quarry 100 feet east of Highway No. 95 at a point 1.5 miles north of Brisco Post Office. The rock quarried is a hard medium- to fine-grained white quartzite mapped as part of the Ordovician Wonah Formation. The quartzite forms a bed 200 to 300 feet thick that strikes northwest and dips steeply northeast. It is overlain by dolomite. No underlying rock is exposed near the quarry. Good exposures of the quartzite extend for 1,500 feet along strike parallel to the highway. To the north the rock plunges under overburden, and 200 to 300 feet south of the quarry it ends in a steep bluff with no further outcrops visible for a considerable distance on strike. Joints of irregular spacing and various orientations are numerous, and some faults about parallel to the bedding are indicated. Staining along fractures gives the quarry face a rusty coloration, but analyses are reported to show an iron content of only 0.7 to 0.8 per cent. One sample consisting of pieces picked at random from the muck pile in the quarry had the following percentage composition: $SiO_2 = 98.66$; $Al_2O_3 = 0.47$; $Fe_2O_3 = 0.06$; $CaO = 0.08$.

At the end of July the quarry had a diameter of approximately 50 feet and a face 30 to 40 feet high. During 1964 about 2,700 tons of silica was quarried and truck-hauled 2½ miles to a loading-ramp at Brisco. The work was done under contract by three men.

TALC

View 1, 2, 3§

Placer Creek (49° 116° S.W.). In May, 1964, R. Emel and R. Maddess, of Creston, located three claims on a talc deposit one-quarter mile north of the Creston–Salmo high-

* By D. Smith.
† By W. C. Robinson.
‡ By J. W. McCammon and D. R. Morgan.
§ By J. W. McCammon.

way on the west side of Placer Creek, 20 miles west of Creston. The main talc showing is near the top of a cleared area where stripping had uncovered bedrock during the operation of a large gravel pit used when the highway was built. Talc is also exposed in the bed of Placer Creek some 200 yards northeast of the gravel pit. No development work had been done on the talc when it was examined.

The rocks on the claims consist of an interbedded series of late Precambrian schists, sandy limestones, dolomites, quartzites, argillites, and amphibolites. They strike northeast and dip steeply northwest. The main talc seam appears to have formed along a shear zone by the partial alteration of a 20-foot-thick dolomite bed. Along the footwall is a 1-foot-thick zone of brown earthy material which lies upon a band of hard amphibolite. On the hangingwall is another zone of loose brown material apparently derived from the disintegration of an overlying band of thin-banded siliceous dolomite. The talc is poorly exposed along strike for 75 feet, with a further isolated patch 10 feet in diameter about 150 feet to the southwest. The rock in the zone consists of white talc enclosing numerous variably sized remnant lenses of white and grey fine-grained dolomite. A thin-section showed talc to be replacing dolomite. Toward the edges of the zone the talc is buff coloured.

In Placer Creek a 10-foot-thick zone of buff to yellow talc is exposed. This is approximately on strike from the talc in the gravel pit.

Petroleum and Natural Gas

CONTENTS

GENERAL ADMINISTRATION

Administration of the *Petroleum and Natural Gas Act* in the Department is divided between a General Administrative Section and the Petroleum and Natural Gas Branch. The former, under the direction of the Chief Commissioner, is responsible for the administration of the *Petroleum and Natural Gas Act,* which includes all matters related to and affecting title to Crown petroleum and natural-gas rights. The regulations governing geophysical operations are also administered by the Chief Commissioner.

The Petroleum and Natural Gas Branch, under the direction of the Chief of the Branch, is responsible for administration of the " Regulations Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas," made pursuant to the *Petroleum and Natural Gas Act.* The regulations specify the conditions which must be employed for efficiency and safe practice in the drilling, completion, and abandonment of wells; for well spacing; prevention of waste; conservation; and all related matters.

As at December 31, 1964, 34,727,862 acres, or approximately 54,262 square miles, of Crown petroleum and natural-gas rights, issued under the *Petroleum and Natural Gas Act,* were held in good standing by operators ranging in stature from small independent companies to major international ones. The form of title held, total number issued, and acreage in each case were as follows:—

Form of Title	Number	Acreage
Permits	302	22,417,836
Natural-gas licences	1	9,669
Drilling reservations	19	451,998
Leases (all types)	3,716	11,848,359
Total		34,727,862

Details of land disposition for the years 1947 to 1960, inclusive, may be found on page A 61 of the 1960 Annual Report. Figures for 1961, 1962, and 1963 will be found in the Annual Reports for those years.

The northeastern corner of the Province continued to be the area of major interest in the acquisition of title to petroleum and natural gas as well as the development and production of those substances. Interest in the Groundhog Basin and Flathead River areas lagged during 1964, but exploration permits covering offshore petroleum and natural-gas rights referred to in the Annual Report for 1963 were maintained and explored by seismic work during the workable season of 1964.

The question of jurisdiction of offshore mineral rights—that is, whether the Provincial or the Federal Government rightfully had jurisdiction in law—was not resolved as had been anticipated, and it is not now known when the problem will be adjudicated. The companies which were interested in oil and gas production possibilities in subsea lands continued to maintain title obtained from both agencies over such lands.

During 1964, land disposition was changed by the following transactions:—

Form of Title	Issued	Terminated	Decrease (—) or Increase (+)
	No.	No.	No.
Permits	27	74	—47
Natural-gas licences	....	2	—2
Drilling reservations	9	19	—10
Leases—			
Petroleum and natural gas	462	146	+316
Natural gas	8		+8
Petroleum			

Petroleum and natural-gas revenue for the year 1964 was as follows:—

Rentals and fees—		
Permits	$1,302,305	
Drilling reservations	64,800	
Natural-gas licences		
Petroleum, natural-gas, and petroleum and natural-gas leases	7,077,488	
Total rentals and fees		$8,444,593
Sale of Crown reserves—		
Permits	$721,193	
Drilling reservations	1,541,685	
Leases	10,830,994	
Total Crown reserve sales		13,093,872
Royalties—		
Gas	$1,583,292	
Oil	3,502,222	
Processed products	104,990	
Total royalties		5,190,504
Miscellaneous fees		26,851
Total petroleum and natural-gas revenues		$26,755,820

Details of yearly revenue, 1947 to 1962, inclusive, are tabled on page 168 of the Annual Report for 1962. For 1963 figures *see* the Annual Report for that year.

Cumulative totals, April 1, 1947, to December 31, 1964, are as follows:—

Rentals and fees—		
Permits	$37,186,076	
Drilling reservations	590,777	
Natural-gas licences	63,788	
Petroleum, natural-gas, and petroleum and natural-gas leases	28,225,210	
Total rentals and fees		$66,065,851
Sales of Crown reserves—		
Permits	$16,346,744	
Drilling reservations	12,491,302	
Leases	35,605,257	
Total Crown reserve sales		64,443,303
Royalties—		
Gas	$7,379,248	
Oil	10,566,265	
Processed products	656,336	
Total royalties		18,601,849
Miscellaneous fees		191,257
Total petroleum and natural-gas revenues		$149,302,260

GENERAL REVIEW

During 1964 there was a significant decrease in exploration for petroleum and natural gas in British Columbia compared with 1963. Drilling activity also decreased as the footage drilled was 25 per cent less. Oil production was reduced by 8 per cent, mainly due to the introduction of more pressure-maintenance schemes, and gas production increased by 10 per cent.

The decline in exploration of over 60 per cent included a 56-per-cent decrease in geophysical operations, a 58-per-cent decrease in geological operations, and an 86-per-cent decrease in structure test-hole drilling. During 1964, 188 geophysical crew weeks, 82 geological party weeks, and 5 test-holes were completed, compared to 431 crew weeks, 194 party weeks, and 36 test-holes completed in 1963. The significant decrease in this initial phase of the petroleum industry was also reflected in other activities. Footage drilled at development wells remained at about the same level, being 385,676 feet, compared with 376,298 feet drilled in 1963, but the footage drilled at exploratory wells was down 30 per cent at outpost locations and 53 per cent at wildcat locations. The lack of exploratory work is further indicated by a 47-per-cent decrease in the number of completed gas wells and a 27-per-cent decrease in the number of abandonments.

Over 50 per cent of the wells completed for oil production during 1964 were located in the Nancy area, where a concentrated development was made of a newly discovered oil pool. This activity resulted in a 45-per-cent increase in the number of oil wells completed compared with 1963.

Production statistics for 1964 indicate a continued increase in the gas production and a slight reduction in the oil production. Gas liquids and sulphur production, which are directly related to the processing of gas, showed proportionate increases.

With the installation of a gas-conservation plant in the Boundary Lake area, greater efficiency was attained in the disposition of produced gas. Gas produced in association with the oil production was previously flared in this area, but now it is gathered and delivered to the main pipe-line system.

Three pressure-maintenance schemes were effected in 1964. While the immediate effect of these schemes is to reduce oil production, the end result is for greater recovery of the petroleum resource. Because of the introduction of these new schemes, the reserves of crude oil recorded at the end of 1964 showed an increase of over 65 per cent above those at the end of 1963. The reserves of gas were reduced by 7 per cent in the same period due to the increased production and the lack of exploratory drilling. Reserves of the various by-products of natural gas were changed by a complete review of the submitted gas analyses. The reserves of natural-gas liquids increased 10 per cent, while the reserves of sulphur decreased 6 per cent.

The near completion of the extension of the gas pipe-line system to Fort Nelson is expected to increase drilling activity in that area and eventually the gas production.

FIELD OFFICE

Field Work

The field administration of the " Regulations Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas " and the compilation of field data necessary for engineering and geological studies is accomplished by a permanent field office at Charlie Lake and a temporary office at Fort Nelson. A trailer office is used in various fields and areas in the Province during extended surveys or field work.

The oil- and gas-producing areas were extended during 1964, and this resulted in an increase in the number and types of field engineering studies. In order that more complete studies were possible, an electronic sonic well recorder was purchased to determine fluid levels in producing wells. Fluid levels were determined in 20 wells. The sonic recorder was received November 3, 1964, at the field office.

Bottom hole pressure surveys were made in 118 wells, using a specially equipped truck and pressure bombs provided by the Department of Mines and Petroleum Resources. Results of the pressure surveys are used by Departmental personnel in engineering studies and as a check on pressure data submitted to the Department by companies. The Department has four bombs used to determine pressure and two bombs used to determine temperature for Departmental surveys.

A 10,000-pounds-per-square-inch Coleman tester and a Coleman temperature bath serve as standards for bottom hole pressure and temperature bombs in use in the Province. Services are provided free of charge for owners of bombs at Charlie Lake laboratory for routine and special pressure calibrations, routine and special temperature calibrations, and for combination temperature-pressure calibrations.

A total of 132 bombs was calibrated during 1964.

Inspections of 544 lease and abandonment locations were made during 1964. There were 190 " fast check " and 227 " complete check " inspections made of meters which measure the gas production. During 1964, 100 battery inspections were completed and 150 drilling rigs were inspected in the field office area. Fifty-four absolute open-flow tests were witnessed on potential and producing gas wells by Branch personnel. To complete these inspections, a total distance of 98,451 miles was driven by the field office staff.

GEOLOGICAL SECTION

Staff geologists directed their studies to the oil- and gas-producing strata of northeastern British Columbia, where drilling provided much new data. The main source of information for the subsurface studies was geophysical well logs, drilled rock cuttings, and core.

The majority of these studies were completed in Victoria. However, during the summer of 1964 staff geologists examined core and samples at the Branch geological laboratory at Charlie Lake and two staff geologists studied outcrops of Middle Devonian strata in the Redfern Lake area of northeastern British Columbia and on the shore of Great Slave Lake from Pine Point to Moraine Point.

Geological Laboratories

Core and Well Samples

All cores from British Columbia wells must be preserved in labelled boxes having an inside length not greater than 30 inches and must be delivered to the geological laboratory for permanent storage. During 1964, 1,340 boxes of core from 104 wells were received at the laboratory. At the end of 1964, 20,759 boxes from 1,048 wells were stored.

Unless otherwise directed, any operator who drills a well for petroleum or natural gas is required to take a sample of drilled rock (bit cuttings) at least every 10 feet of depth. Each sample, consisting of several ounces of rock fragments, is placed in a small bag at the well, labelled, and submitted to the geological laboratory, where it is washed and bottled.

Each 10-foot sample is divided, resulting in three complete sets of samples for each well. One set is retained at the laboratory library, one is sent to headquarters at Victoria, and the other to the Geological Survey of Canada in Calgary. The remainder of the 10-foot sample from the original sample-bag is retained at the laboratory for a period not exceeding one year, should further samples be required. The main sample-examination facilities are at Charlie Lake, with limited facilities available at Victoria.

The Charlie Lake sample library and the Geological Survey of Canada sample library in Calgary each has a set of samples from wells drilled in British Columbia since 1948; the Victoria sample library has samples from wells drilled since September, 1957. At the end of 1964 the Charlie Lake sample library contained 413,553 samples and the Victoria library contained 406,406 samples.

During 1964 samples were received at the laboratory from 146 wells. This represented over 600,000 feet of drilling, mainly in northeastern British Columbia. A total of 238,270 10-foot samples was washed and bottled in 1964.

Core and Sample Examination

A nominal fee is charged for the use of the core- and sample-examination facilities provided by the Department.

In 1964, 6,787 boxes of core from 322 wells were studied by oil company personnel and other interested individuals. Approximately 1,050 boxes of core from significant wells were examined by Department geologists. Cores from 31 wells were temporarily removed from the laboratory by the operators for reanalyses or other studies. Samples from 39 wells were studied, using the laboratory facilities at Charlie Lake.

Since the core- and sample-examination laboratory at Charlie Lake was made available to the public in February, 1961, 31,742 boxes of core from 1,602 wells have been removed from the racks for examination.

Exploration

Twenty-five oil and gas companies did seismic work in northeastern British Columbia in 1964. Two of these companies also had crews in the Fernie area; one of them operated a marine seismic survey from April 10th to September 24th off the west coast of Vancouver Island in Queen Charlotte Sound and in Hecate Strait, on the continental shelf and slope. This offshore geophysics featured a conventional marine seismic crew with a shore-based survey system to locate the reflection and refraction marine seismic lines. Sea-floor samples were collected by this company in the areas of offshore study. In northeastern British Columbia 300 seismic crew weeks were completed (Table 1). Aeromagnetic work was done by one company in northeastern British Columbia (Table 1).

At least six companies had surface geological parties in the field in northeastern British Columbia (Table 2). One of these companies also did surface geology in the Fernie area. Two companies drilled nine test-holes in northeastern British Columbia in 1964 (Table 3).

Twenty-six exploratory wildcat wells were drilled in 1964; in addition, two were suspended and three were still drilling at the year's end. All but one well was drilled in northeastern British Columbia; this well, located in the Fraser Valley near Chilliwack, was suspended in October. Exploratory drilling was concentrated in the developing areas of Devonian gas accumulations in the general Fort Nelson area and the oil-bearing sandstones near the depositional edge of the Triassic Halfway Formation. Twenty-five per cent of the exploratory wildcat wells were successful in finding new hydrocarbon accumulations.

Twenty-eight wells, classified as exploratory outpost, were drilled adjacent to known oil and gas accumulations during 1964; 75 per cent of these wells were successfully completed.

There was a decrease in the number of new discoveries made during 1964 as compared with 1963. Eleven new discoveries were made, including four oil and seven gas accumulations. Five of these discoveries were made in relatively untested areas by exploratory wildcat wells, and the remainder were located close to known trends by exploratory outpost drilling.

A significant oil discovery in the Triassic Halfway Formation just west of the Peejay field was made by Pacific SR CanDel Nancy d-85-H/94-A-15. Triassic Halfway oil was also found immediately west of the Wildmint field in the well Pacific SR CanDel Ptarmigan d-90-I/94-A-15. Union HB BA Ladyfern d-48-H/94-H-1 discovered oil in the Lower Cretaceous Bluesky Formation 20 miles east of the Milligan Creek field, adjacent to the Alberta boundary. A development well, Uno Tex et al Stoddart 10-31-85-19, drilled at the south end of the Stoddart field discovered oil in the hitherto only gas-bearing Permian Belloy Formation.

The developing trend of Middle Devonian Slave Point gas accumulations north of Fort Nelson was augmented by a discovery 30 miles northeast of the Kotcho Lake field in West Nat Cabin a-19-G/94-P-5. Exploratory outpost drilling increased the size of known accumulations at Yoyo, 6 miles southeast of the Kotcho Lake field, and at Tsea, 40 miles northwest of the Kotcho Lake field.

Gas was discovered in the Permian Belloy Formation in IOE Pac Parkland 10-26-81-16, 2 miles west of the Parkland Devonian field.

Triassic Halfway gas was found 3 miles west of the Laprise West gas field in Texaco Tepee d-99-G/94-G-8. Texaco NFA Redeye d-69-I/94-H-6 discovered gas in a Charlie Lake reservoir 22 miles northwest of the Beatton River oil field, which is approximately 85 miles north of Fort St. John.

Gas was discovered in the Lower Cretaceous Dunlevy Formation in IOE Fina N Rigel d-57-I/94-A-10, 4 miles north of Rigel field production. Lower Cretaceous gas was also found in the well Gray Oil PRP NW Grizzly c-25-A/93-I-15, approximately 100 miles south of Fort St. John in the Rocky Mountain foothills.

RESERVOIR SECTION

Maximum Permissible Rates

In 1964 the Reservoir Section established 43 maximum permissible rates for oil wells, of which 37 were initial rates, 2 were revisions of existing rates, and 4 were interim approvals granted pending further evaluation of reservoir data. One M.P.R. was cancelled. The maximum permissible rates at December 31, 1964, are shown in Table 7.

Four applications for pool M.P.R.'s were received. Three were new applications, and one was an application for revision of an existing pool M.P.R. All were approved. A previous application approved in 1963 for a portion of the area applied for was extended to the full area, and to the full volume upon conclusion of a unit agreement.

Dome Petroleum Limited applied for a project M.P.R. of 2,225 barrels per day for its Boundary Lake Project No. 1,* and for a project M.P.R. of 733 barrels per day for its Boundary Lake Project No. 2. Approval was granted on July 22nd. The approval of Project No. 1 was later amended to 2,343 barrels per day. Imperial Oil Limited applied for a unit M.P.R. of 18,488 barrels per day for Boundary Lake Unit No. 1. The unit M.P.R. was approved on June 2, 1964.

Texaco Exploration Company applied for a unit M.P.R. of 9,754 barrels per day for Boundary Lake Unit No. 2. The application was approved on August 24th to be effective upon the first of the month following commencement of the water-injection scheme. The unit M.P.R. had not become effective at the end of 1964.

Triad Oil Company applied to have the pool M.P.R. of the Halfway pool of the Beatton River field increased to 1,960 barrels per day from 1,940 barrels per day, and to have the well Triad et al Beatton d-41-K deleted from the pool M.P.R. The application was approved on September 1st.

The pool M.P.R. of 2,018 barrels per day for the south portion of the Peejay field was increased on April 14th to 4,430 barrels per day upon inclusion of all producing wells in the field in a unit operation.

Absolute Open-flow Potential Tests and Production Rate Limits

The results of 256 absolute open-flow potential tests of gas wells were processed and the corresponding production rate limits established in 1964.

The absolute open-flow potentials and the production rate limits for all gas wells at December 31, 1964, except those still held confidential are shown in Table 8.

* Dome Petroleum's operation in the Boundary Lake field is called a "project" rather than a "unit" because Dome is sole owner.

Pressure Maintenance

The supplementing of the natural driving energy of oil pools by pressure maintenance was continued during 1964. Six applications were received and approved.

Dome Petroleum Limited applied for approval to inject water into three wells in Dome Boundary Project No. 1 and into one well in Dome Boundary Project No. 2. Water for injection was obtained from the Gething Formation of the well Dome Boundary 6-11-86-14, and from a well drilled to obtain water from the Cadomin at the location 2-35-85-14W6.

The application was approved on May 7th.

Texaco Exploration Company applied on behalf of the working-interest owners in Boundary Lake Unit No. 2 for approval of a scheme of pressure maintenance by water injection on a nine-spot pattern into the Boundary Lake zone in the unit. The application was approved on July 22nd to become effective upon conclusion of the unit agreement.

Triad Oil Co. Ltd. applied for approval of a pilot water-injection scheme for the Bluesky-Gething pool of the Beatton River West field. The application was approved on November 3rd.

Union Oil Company of Canada Limited applied on behalf of itself and Hudson's Bay Oil and Gas Company Limited for approval of a scheme to return a portion of the gas produced from the Upper Halfway sand reservoir of the Wildmint field to the same reservoir for the purposes of conserving gas and reducing the produced gas-oil ratio to a net gas-oil ratio. The application was approved on April 30th. Union Oil Company of Canada Limited applied on behalf of itself, Hudson's Bay Oil and Gas Company Limited, and Richfield Oil Corporation for approval of a scheme of gas conservation by the return of approximately 5,000,000 cubic feet per day of gas produced from the Halfway sand of the Milligan Creek field to the same reservoir. The scheme was also approved on April 30th.

Union Oil Company of Canada Limited applied for approval of a scheme to cycle gas-cap gas and high-pressure separator gas produced from the Gething (Aitken conglomerate) reservoir of the Aitken Creek field at a rate of approximately 10,000,000 cubic feet per day. The scheme was approved on August 24th.

Gas-Oil Ratio Adjustment Factors

The control over the gas-oil ratio of oil wells was continued during 1964, and B.C. Regulation 147/64 was established on July 28, 1964. This regulation replaces B.C. Regulation 122/63, and makes provision for more flexible control of gas-oil ratios by allowing for a reasonable degree of overproduction on a month-to-month basis to meet operating exigencies. It provides also for an adjustment of overproduction on an annual basis during the period of low summer demand.

Reserves

Proved recoverable reserves of oil increased during 1964, as a result of new discoveries and because of the increased potential for recovery of existing reserves brought about by the establishment of pressure-maintenance schemes.

Established reserves of gas at the end of 1964 were down slightly compared with 1963, partly as a result of production but mainly as a result of reappraisal of existing reserves. Discovery trends indicate that a rapid recovery will be made from the downward revision.

A summary of the reserves of oil, gas, natural-gas liquids, and sulphur at the end of 1964, with explanatory notes, is given in Table 6.

Oil and gas reservoir data as compiled at the end of 1964 is given in Tables 4 and 5.

DEVELOPMENT SECTION

Drilling

British Columbia's drilling activity was down 25 per cent in 1964, totalling 674,842 feet, compared with 898,720 feet drilled in 1963. Footage made at development locations was up slightly at 385,676 feet compared with 376,298 feet, but exploratory drilling was down by 233,256 feet or nearly 45 per cent to a total of 289,166 feet.

Fewer drilling rigs worked in the Province than in 1963, but the number of different drilling contractors and operating oil companies remained virtually the same. Forty-three drilling rigs owned by 18 different contractors and employed by 43 oil companies were active during 1964. This compares with 55 drilling rigs, 18 drilling contractors, and 43 operating companies in 1963.

The only drilling activity outside the northeastern corner of the Province was near Chilliwack, where 3,717 feet was drilled at an exploratory location. At the close of 1964 this well was suspended at 8,317 feet pending further drilling.

Well completions decreased by 21 per cent compared with 1963. Oil-well completions increased by 45 per cent over 1963, but gas-well completions and abandonments were down by 47 and 27 per cent respectively. These statistics reflect the concentrated effort to drill out a newly discovered pool in the Nancy area. Twenty-three of the 45 oil wells completed during the year were in the Nancy area and six others were nearby, along the Triassic oil trend. Only 37 gas wells were completed during 1964, compared with 70 in 1963. Most of these wells were additions to known gas pools, as very few new gas pools were discovered. Probably the most significant gas discovery of 1964 was in the Monkman Pass area, some 70 miles south of the nearest completed gas well. Sixty locations resulted in abandonments, compared with 82 in 1963. The success ratio for wells in British Columbia remained very high at nearly 60 per cent. Four other wells were specifically drilled for use as service wells.

The method of counting each zone of a multiple completion as a completed well was continued in 1964. There were 145 wells actually completed in 1964, of which one was a multiple gas well. At the end of 1964, 11 wells were actively drilling and 2 were suspended pending further drilling to their objective depth.

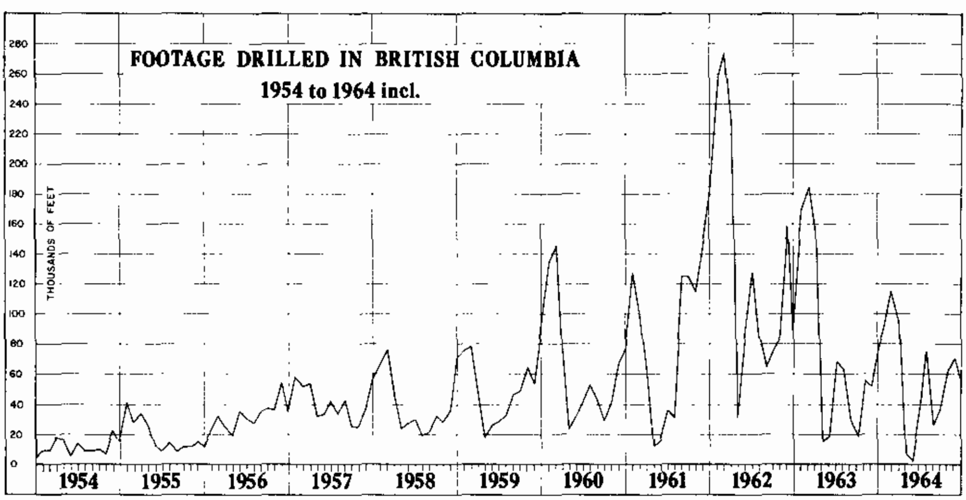


Figure 23. Footage drilled in British Columbia wells, 1954–64.

Wells drilled and drilling in 1964 are listed in Table 9. Monthly footages drilled since 1954 are given graphically in Figure 23, which shows the seasonal fluctuations throughout each year.

Work-overs for the purposes of repair, abandonment, or increase of productivity were reported at 68 completed wells during 1964. Any operation which is performed on a well subsequent to rig release and which changes the producing interval or alters, or intends to alter, the producing characteristics of the well is considered a work-over. The producing interval of a well may be changed by perforating, cementing perforations, or by running casing or plugs. The producing characteristics of a well may be changed by any operation performed to increase the production of oil or gas. These operations include perforating, acidizing, fracturing, installing a pump, or changing a choke, but do not include the replacement of equipment.

Designated fields were reviewed quarterly, and during 1964 three new fields were established and nine field boundaries were amended. The new fields were Bulrush, Jedney West, and Stoddart West. At the end of 1964 there were 45 designated fields, which are listed in Table 10, and their locations are shown in Figure 24. New fields are designated when one or more wells are on continuous production or three or more completed wells are located in contiguous spacing areas, provided that one year has elapsed since the rig release date of the discovery well for the field. The area taken into a newly designated field is based upon geological interpretation and generally consists of only full spacing areas.

It is the primary responsibility of the Development Section to study for approval all submissions made relative to the drilling operations. Such approvals must be obtained prior to the commencement of drilling of a new well, changing a well name, abandoning a location, or any alteration proposed to change the physical characteristics of the well.

In 1964, 146 drilling authorities were issued. This represents a decrease of 17 per cent as 175 were issued in 1963. Upon receipt of any application requiring approval by the Development Section, the proposed drilling programme, the title under which the petroleum and natural-gas rights are held, and the various geological requirements are reviewed. The survey of the well location, which is required with each application for a drilling authority, is computed to verify the stated position. Depending upon whether the objective of the well is oil or natural gas, a spacing area is assigned to each well. When participants share a spacing area, letters of agreement to drill a well must be submitted. When all these requirements are met, permission is granted to commence drilling and a drilling authority number is issued.

Each well is classified according to its location relative to the completed wells. The classifications assigned are development, exploratory outpost, and exploratory wildcat. A development well may be defined as being in a location that is within a spacing area which is contiguous to a completed well. When a location is greater than 4½ miles from a completed well, it is called an exploratory wildcat location. Locations between wildcat and development wells are called exploratory outpost locations. For classification purposes a well is considered completed if it is either physically able to produce or is a potential producer still requiring completion work. Development wells may be further classified as deep-pool or shallow-pool tests, when undeveloped pools below or above the known pool are being explored. These classifications are used as the basis for the requirements of various reports submitted to the Branch. Any application that is received to alter the equipment in a well or the proposed programme for a well is handled in a similar manner. Details of the

DISCOVERY WELLS - 1964

A	UNION HB BA LADYFERN d 48 H/94 H 1	OIL
B	WEST NAT CABIN a 19 G/94 P 5	GAS
C	TEXACO NFA REDEYE d 69 I/94 H 6	GAS
D	IOE FINA N RIGEL d 57 I/94 A 10	GAS
E	GRAY OIL PRP NW GRIZZLY c 25 H/93 I 15	GAS
F	PACIFIC SR CANDEL PTARMIGAN d 90 I/94 A 15	OIL
G	PACIFIC SR CANDEL NANCY d 85 H/94 A 15	OIL
H	TEXACO TEEPEE d 99 G/94 G 8	GAS
I	IOE PAC PARKLAND 10 26 81 16	GAS
J	BA HB W POCKETKNIFE d 33 I/94 G 6	GAS
K	TEXACO NFA E OSBORN 6 33 88 14	GAS
L	UNO-TEX et al STODDART 10 31 85 19	OIL

FIELDS & POOLS - DEC. 31, 1964

NO	FIELD	PRODUCING HORIZON	
		OIL	GAS
1	AITKEN CR.	Gething	
2	BEATTON R.	Halfway	
3	BEATTON R W	Bluesky-Gething	
4	BEG		Baldonnel Halfway
5	BEG WEST		Baldonnel
6	BERNADET		Bluesky-Gething
7	BLUEBERRY	Mississippian	Dunlevy Baldonnel Charlie Lake
8	BLUEBERRY EAST		Baldonnel Halfway Mississippian
9	BLUEBERRY WEST		Dunlevy Baldonnel
10	BOUNDARY LAKE	Boundary Lake Halfway	Bluesky-Gething Gething Dunlevy Baldonnel
11	BUBBLES		Baldonnel
12	BUICK CREEK		Dunlevy Charlie Lake
13	BUICK CREEK E		Bluesky-Gething Dunlevy
14	BUICK CREEK W	Dunlevy	Baldonnel Halfway
15	BULRUSH	Halfway	
16	CHARLIE LAKE	Gething	
17	CLARKE LAKE		Slave Point
18	DAWSON CREEK		Cadotte
19	FORT ST. JOHN	Charlie Lake	Cadomin Baldonnel Halfway Belloy
20	F S J AIRPORT		Cadomin Baldonnel Halfway
21	FORT ST JOHN S E		Cadomin Baldonnel Halfway Belloy
22	GUNDY CREEK		Baldonnel Charlie Lake
23	HALFWAY		Baldonnel Halfway
24	HIGHWAY		Dunlevy Baldonnel Mississippian
25	JEDNEY		Gething Baldonnel Halfway
26	JEDNEY WEST		Baldonnel Halfway
27	KOBES-TOWNSEND		Dunlevy Charlie Lake Halfway Mississippian
28	KOTCHO LAKE		Slave Point
29	LAPRISE CREEK		Baldonnel
30	LAPRISE CREEK W.		Baldonnel
31	MILLIGAN CREEK	Halfway	
32	MONTNEY		Bluesky-Gething Charlie Lake Halfway
33	NIG CREEK		Baldonnel
34	PARKLAND		Wabamun
35	PEEJAY	Halfway	
36	PEEJAY WEST	Halfway	
37	PETITOT RIVER		Slave Point
38	RED CREEK		Charlie Lake Halfway
39	RIGEL		Dunlevy
40	SNYDER CREEK		Dunlevy
41	STODDART		Belloy
42	STODDART WEST		Belloy
43	SUNRISE		Cadotte
44	WILDMINT	Halfway	
45	WILLOW	Bluesky-Gething	Halfway

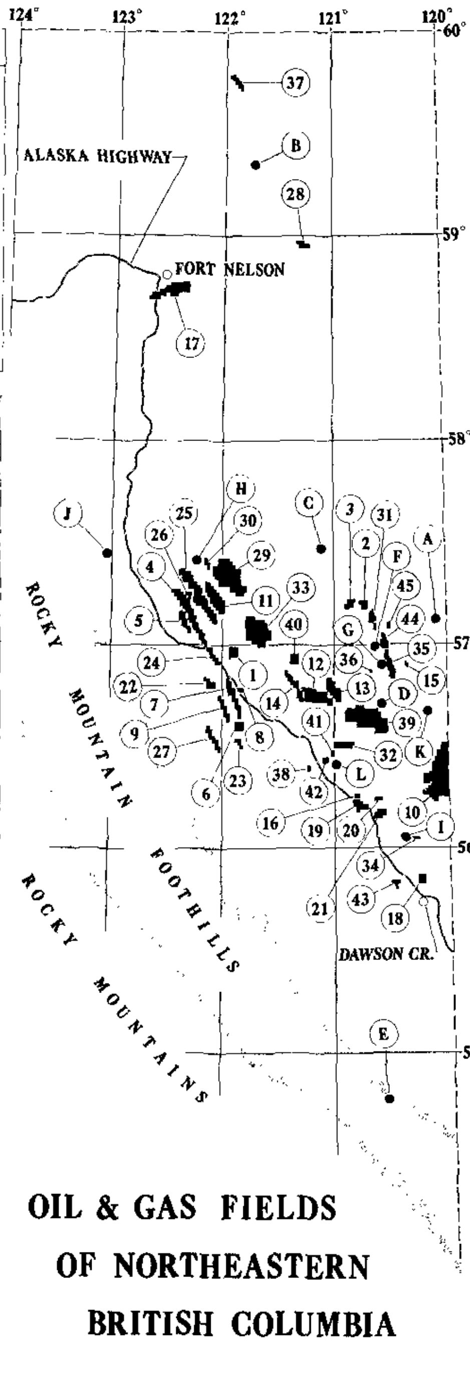


Figure 24. Petroleum and natural-gas fields, 1964.

alteration are examined and given approval by the various sections of the Branch. Prior to the abandonment of wells, the operators must submit an abandonment programme to the field engineer for his approval, but all other alterations are studied by the staff at Victoria, where the official records are filed.

The Development Section is also responsible for the issuance of rig licences. In 1964, 5 new rig licences were issued and 52 were renewed.

At the time of approval of a drilling authority, the Development Section must examine the well name submitted. Instructions have been issued by the Branch for the naming of wells in British Columbia, and operators must conform to this system. Each well name is divided into three basic parts:—

(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 the geographic area, a topographic feature, or to an established survey position such as a triangulation station. When a definite reference is not possible, some other basis is used to select an area name.

(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 divided into townships, the quarter unit, unit, and block as described in the publication entitled "Permit and Lease Grid System." The National Topographic System map numbers given in this publication are not included in the official well name but are recorded by the Branch for reference purposes.

Several maps are prepared by the Development Section for distribution to the industry and other interested persons. Maps are maintained to indicate the designated fields and well locations as well as the various major plant and pipe-line installations. These maps are mailed to regular subscribers or they may be obtained by writing to the Branch in Victoria.

During 1964 there were two fires of a minor nature involving gas-well completion equipment.

The salt-water disposal well located in the Fort St. John area at Pacific Ft St John 3-30-83-18(6) received 46,377 barrels during 1964. The salt water is produced at nearby gas wells, transported to the disposal well, and returned to the Belloy Formation in this well. Salt water obtained at other producing wells in the Province amounted to 235,415 barrels. This water was contained in pits near the producing wells for disposal by evaporation.

Drilling and geophysical operations are a significant factor in the opening of new lands for settlers. Many areas that were previously isolated now have year-round access to the populated centres.

Production

The volume of natural gas produced in 1964, 146,899,255 M s.c.f., was 10 per cent higher than the production for 1963. This total is comprised of the well-head production of wet and dry gas plus the associated gas produced in conjunction with the production of oil. Six fields which produced in excess of 10 billion cubic feet during 1964 were Jedney, 21,530,222 M s.c.f.; Laprise Creek, 14,835,933 M s.c.f.; Nig Creek, 12,114,908 M s.c.f.; Beg, 11,390,482 M s.c.f.; Buick Creek, 11,234,488 M s.c.f.; and Rigel, 10,535,612 M s.c.f. Other fields that produced in excess of 5 billion cubic feet were Bubbles, 6,944,465 M s.c.f.; Kobes-Townsend, 6,469,544 M s.c.f.; Fort St. John Southeast, 6,393,190 M s.c.f.; and Fort St. John, 6,305,383 M s.c.f.

Oil produced during 1964 was 11,551,843 barrels, a decline of almost 8 per cent compared with 1963. The Boundary Lake field produced just over half of the Provincial total at 5,911,797 barrels. The next three largest oil-producing fields were Milligan Creek, 1,637,993 barrels; Peejay, 1,365,329 barrels; and Blueberry, 1,155,639 barrels.

Monthly crude-oil and natural-gas production by fields and pools for 1964 are given in Tables 12 and 13.

Graphs of the monthly production from 1954 to 1964 are shown in Figures 25 and 26.

Sales of natural gas showed significant increases. The 1964 sales, which includes Alberta gas imported through the Westcoast transmission system, increased 7½ per cent to 147,520,318 M s.c.f. There was 103,610,556 M s.c.f. of gas exported to the United States and 42,801,649 M s.c.f. used in British Columbia during 1964.

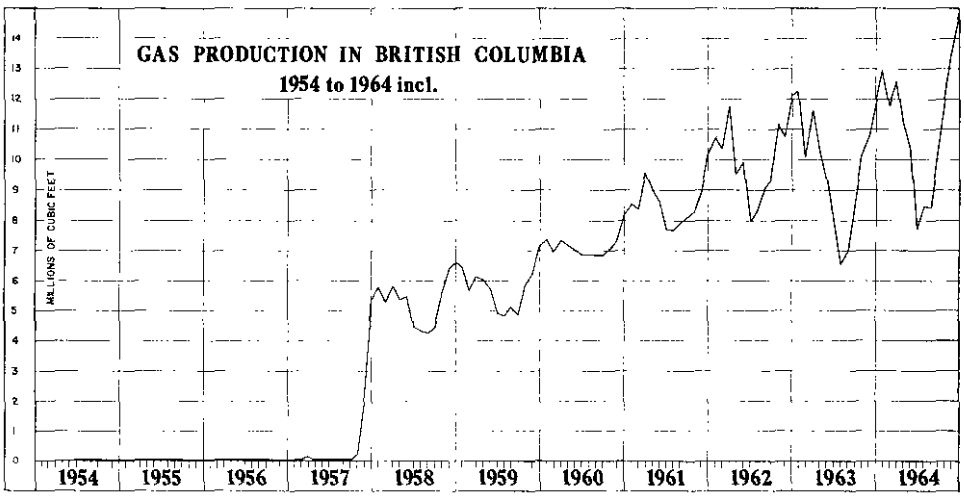


Figure 25. Natural-gas production, 1954–64.

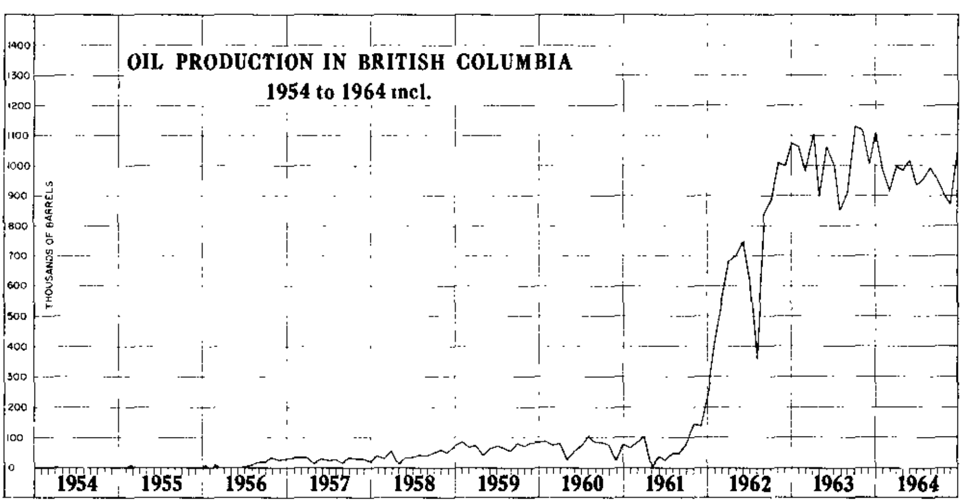


Figure 26. Oil production, 1954–64.

Condensate/pentanes plus production for 1964 was 948,578 barrels, of which 26,367 barrels was produced in the field and 922,211 barrels at the gas plants. Total sales of condensate/pentanes plus was 991,342 barrels, of which 643,361 barrels was exported.

Butane production for 1964 consisted of 461,759 barrels of gas-plant production and 160,633 of oil-refinery production. Of the total 270,915 barrels sold as butane, 70 per cent or 190,985 barrels was marketed in the Province.

The 1964 propane production was 542,702 barrels, of which 244,804 barrels was produced at the gas plants and 297,898 barrels at the oil refineries. About 87 per cent of the 468,962 barrels of propane sold was distributed in British Columbia.

The production of sulphur for 1964 increased by 9 per cent over 1963 to 65,836 short tons. Total sales for 1964 were 69,188 short tons, of which over 81 per cent was exported.

General statistics showing well operation and production data are given in Table 14. The monthly dispositions of the various petroleum products are shown in Tables 15, 16, and 17. The monthly values to the producers are given in Table 18.

PIPE-LINES

Gas-gathering System

Extensions to the gas-gathering systems in the Beg and Rigel fields were completed during 1964. The most significant change was made in the Clarke Lake field, where 8 miles of pipe-line was laid in preparation for connection to the main transmission-line.

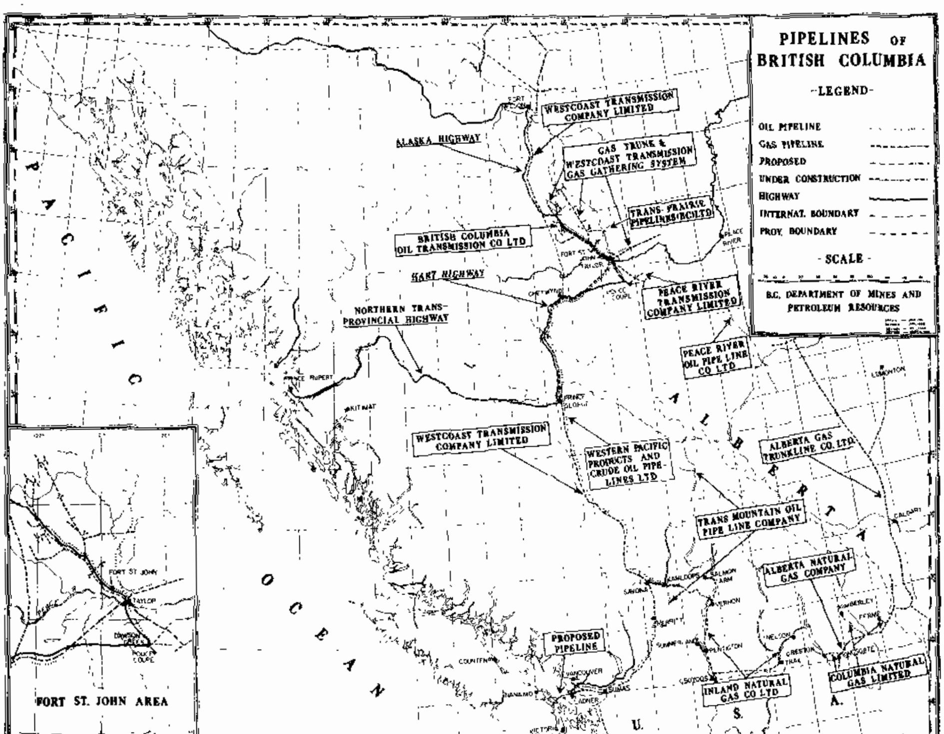


Figure 27. Petroleum and natural-gas pipe-lines.

Gas-transmission System

Additional mileages of 127.2 and 6.8 respectively were completed in 1964 to the transmission systems operated by British Columbia Hydro and Power Authority and Inland Natural Gas. The principal pipe-line construction in British Columbia during 1964 was the 220-mile 30-inch transmission-line from Chetwynd to the Fort Nelson area. Most of the work was completed in 1964, and throughput was expected to start in early 1965. This line was designed with an initial capacity of 200 million cubic feet per day.

Gas-distribution System

Increased distribution facilities totalling 40.9 miles were completed in 1964. The Columbia Natural Gas, Inland Natural Gas, Northland Utilities, and Plains Western systems added 10, 25.1, 5.1, and 0.7 miles respectively.

Oil-gathering System

British Columbia Oil Transmission and Trans Prairie Pipelines increased their oil-gathering systems in northeastern British Columbia by 10.8 and 0.2 miles respectively. The average throughput of these pipe-lines during 1964 was decreased by 1,967 barrels per day from that of 1963, a result of the drop in annual oil production.

Oil-transmission System

Western Pacific Products and Crude Oil Pipeline, which carries petroleum and liquid products from Taylor to Kamloops, increased its storage facilities by 63 per cent, although the average throughput for 1964 decreased by 14 per cent.

Gas-processing Plants

No alterations were reported during 1964 at the two principal gas-processing plants at Taylor and Boundary Lake. A field conservation plant in the Boundary Lake area was put into operation in 1964. This plant receives the associated gas from producing oil wells and extracts gas liquids prior to delivery to the gas-transmission system. The plant has an output capacity of 15,000,000 cubic feet per day.

The Fort Nelson Gas Treating Plant, located 15 miles south of Fort Nelson, was constructed in 1964 and will be put on stream in conjunction with the Westcoast gas-transmission line. It has a capacity of 200 million cubic feet per day and was designed to treat high-pressure gas containing carbon dioxide, nitrogen, and hydrogen sulphide to meet the required pipe-line standards.

Oil Refineries

During 1964 the six British Columbia oil refineries increased their combined crude-oil capacity to 101,404 barrels per day and their cracking capacity to 38,480 barrels per day.

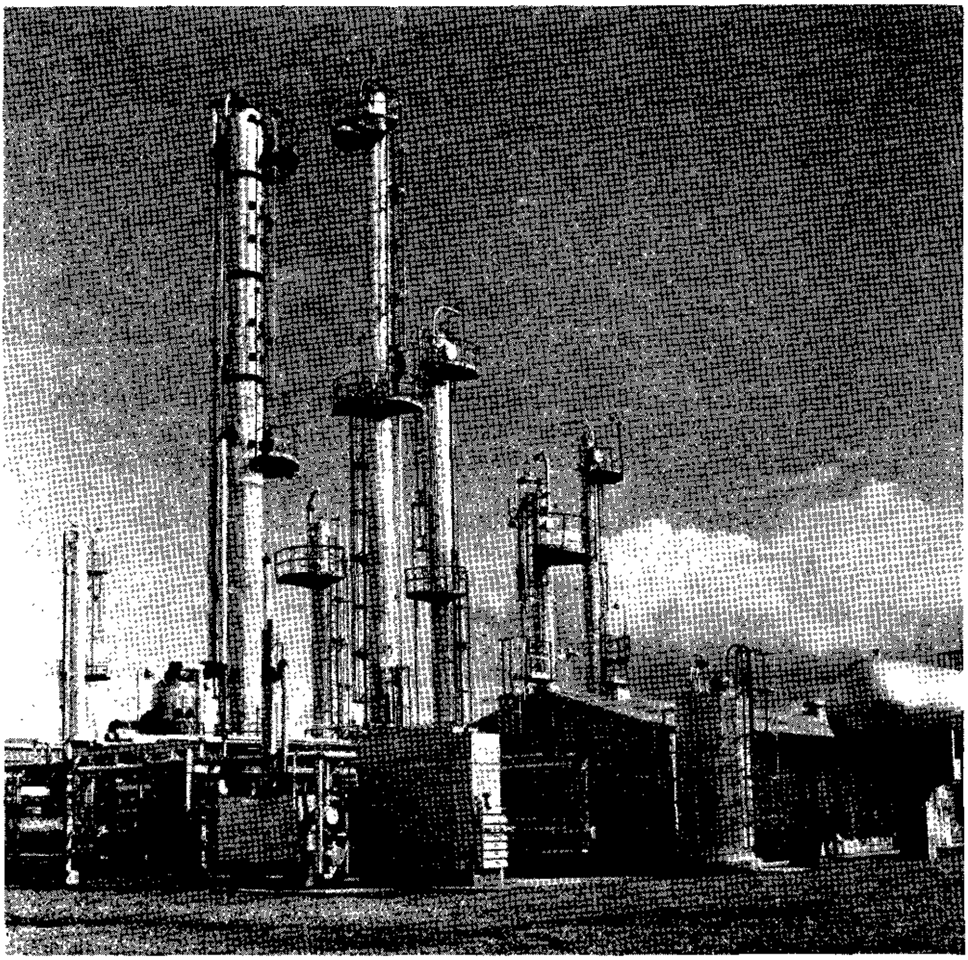
Sulphur Plant

No change was made in 1964 to the sulphur plant located adjacent to the gas-processing plant at Taylor.

Tables 19, 20, 21, 22, and 23 provide data on the pipe-lines, gas-processing plants, oil refineries, and sulphur plant at the end of 1964.

Well Records

Information concerning the petroleum and natural-gas industry in British Columbia is collected and compiled by the Petroleum and Natural Gas Branch.



Boundary Lake gas-conservation plant. (Imperial Oil photo.)

The data are made available to interested persons, in strict accordance with section 51 of the regulations. Location, elevation, current depth, casing, status, and monthly production of individual wells are released upon request. Other information is held confidential, depending upon the relationship of the well location to the designated fields.

Data obtained from wells located within a field are available 30 days after the release of the drilling rig, provided that one year has expired since the rig release date of the discovery well for the field. When a well location is not within a designated field, all data are confidential for one year after the release of the drilling rig. In the case of deep-pool and shallow-pool tests, the data from the exploratory portions of the wells are held confidential for the one-year period. Confidential well information may be released to an interested person, if a letter is received by the Branch from the operator of the well authorizing its release.

Information is released by publication, examination of Branch records, or reproduction of data. Cost-defraying charges are made by the Branch for these services.

The records maintained by the Branch are in constant use by the Reservoir, Development, and Geological Sections. Therefore, they must be kept up to date and in a manner suitable for many purposes. As the published reports are expanded to meet the requirements of the industry and of other government bodies, the systems of keeping records must be altered.

The Branch has representation on the Statistical Sub-committee which was established at the request of the Mines Ministers' Conference in 1955. This committee is composed of representatives from each Province actively engaged in the petroleum industry and personnel employed by oil companies. The objectives of the group are as follows:—

(1) Standardization of forms designed for the same purpose but which are required individually by both the Provincial and Federal Governments under different formats.

(2) Standardization of forms to accommodate machine accounting procedures for reporting production statistics to the Provincial Governments.

(3) Amendment of existing model report forms to conform with present requirements.

(4) Investigation of ways and means to obtain the co-operation of both Provincial and Federal Government agencies and provide earlier availability of information on all phases of the oil and gas industry.

One meeting of the Statistical Sub-committee was held in 1964, when revisions in the model forms were approved and discussions were held concerning the procedures and reports employed by the Provincial authorities. The Petroleum and Natural Gas Branch has adopted many features of these model forms and uses the following applications and reports:—

Form No. Form Name

*1. Well-names Register.
2. Application for a Drilling Authority.
3. Application to Amend a Drilling Authority.
4. Application to Change a Well Name.
5. Application to Abandon a Well.
6. Application to Alter a Well.
7. New Oil Well Report.
8. New Gas Well Report.
9. Application for M.P.R.—Oil.
10. Application to Commingle Production before Measurement.
BC S1. Monthly Production Report.
BC S2. Monthly Disposition and Crown Royalty Statement.
15. Monthly Gas-gathering Operations Report.
16. Monthly Natural Gas Plant Statement.
17. Monthly Natural Gas Processing Statement.
18. Monthly Sulphur Plant Operations Report.
19. Monthly Refinery Operations Report.
20. Monthly Crude Oil and Condensate/Pentanes Plus Purchaser's Statement.
21. Monthly Liquefied Petroleum Gas Purchaser's Statement.
22. Well Completion Report.
23. Supplement to Well Completion Report.
24. Work-over Report No. .
*25. Work-over Card.
*26. Monthly Operations Report.

* For Department use only.

Form No.	Form Name
27.	Application for a Rig Licence.
28.	Monthly Water Flood Operations Report.
29.	Monthly Water Receipts and Disposal Report.
30.	Statement of Nomination and Estimated Requirements for British Columbia Crude Oil, Condensate/Pentanes Plus.
31.	New Service Well Report.
32.	Well Allowable Report.
*33.	Drilling Report.
*7C.	Meter Inspection Report.
*7D.	Battery Inspection Report.
	†Monthly Natural Gas Distributor's Statement.
	†Monthly Report on Oil Pipeline Gathering Operations.

* For Department use only.
† Used in conjunction with the Dominion Bureau of Statistics.

The Branch has representation on the Provincial-Federal Committee on Oil and Gas Statistics, which held one meeting during 1964. The purpose of this committee is to establish and revise, as required, statistical forms on the production, transportation, and distribution of oil and gas and to foster the joint collection of these statistics, eliminating as much duplication by the Provincial and Federal agencies as possible.

Reports

Schedule of Wells

An annual volume is compiled and published giving all well information released during the year. It covers the period from 8 a.m. January 1st to 8 a.m. January 1st of the succeeding year.

The data are arranged by geographical areas and provide the following information when applicable: Well name, classification, drilling authority number, operator, title and title number, location, co-ordinates, spud date, rig release date, ground elevation, Kelly bushing elevation, total depth, status, interval open to production, casing details, logs, core intervals, sample intervals, drill-stem tests, wire-line tests, and geological markers as determined by the operator and the Branch.

This information is condensed from reports submitted to the Branch by the various operators.

Weekly Report

A weekly report is published for Departmental use from data collected by the field office staff at Charlie Lake. The week reported is from 8 a.m. Friday to 8 a.m. of the succeeding Friday. The following information is included:—

(1) Well locations approved.
(2) Well locations pending approval.
(3) Well locations cancelled.
(4) Changes of well names.
(5) Changes of well classification.
(6) Changes of well status.
(7) Wells spudded.
(8) Rigs operating.
(9) Suspended wells.
(10) Abandoned wells.

(11) Completed wells.
  (*a*) Oil wells.
  (*b*) Gas wells.
(12) Water-injection wells.
(13) Gas-injection wells.
(14) Disposal wells.
(15) Water-source wells.
(16) Observation wells.
(17) Work-overs.
(18) Summary of well count giving the following totals:—
  (*a*) Oil wells.
  (*b*) Gas wells.
  (*c*) Abandoned wells.
  (*d*) Injection wells.
  (*e*) Disposal wells.
  (*f*) Completed wells.
  (*g*) Locations drilled.
  (*h*) Multiple wells.
  (*i*) Drilling wells.
  (*j*) Suspended wells.
  (*k*) Approved but not spudded wells.
  (*l*) Locations in good standing.
  (*m*) Locations approved.
  (*n*) Locations cancelled.

The number of completed wells is calculated by two methods to provide verification. The number of wells of different status, counting each zone of a multiple completion as a well, is compared to the number of locations drilled less the multiple completions.

The number of locations in good standing is calculated also by two methods. The total number of locations drilled, drilling, suspended, and approved but not spudded is compared to the total number of locations approved less the number of locations cancelled.

Oil and Gas Production Report

The Oil and Gas Production Report is prepared monthly from returns made by the operators of the producing wells, pipe-lines, gas plants, refineries, and distribution facilities. The contents of the report are as follows:—

(1) Graphical presentations of the daily average oil production, the daily average residual and dry gas production, and the monthly footage drilled with comparative graphs of the totals for the preceding year.
(2) Monthly summary of the drilling and completion activity with cumulatives for the year and comparative figures for the same month of the preceding year.
(3) New oil- and gas-well reports received.
(4) The number of producing and producible oil and gas wells by field and pool and comparative figures for the same month of the preceding year.
(5) Production of crude oil, natural gas, condensate, and water by field and pool with comparative volumes produced in the same month of the preceding year. These quantities are given for the current month, the current year, and the all-time cumulative.
(6) Estimated oil production for the succeeding month.
(7) Crude oil and equivalent disposition.

(8) Value of crude-oil sales to British Columbia producers.
(9) Disposition of produced water.
(10) Tabulation of nominations and estimated requirements for British Columbia crude oil and condensate/pentanes plus.
(11) Approved maximum permissible rates.
(12) Withdrawn maximum permissible rates.
(13) Natural-gas disposition.
(14) Value of natural gas to British Columbia producers and distributors.
(15) Production and disposition of condensate/pentanes plus, butane, propane, and sulphur.
(16) Value of sales of natural-gas liquids and sulphur to British Columbia producers.
(17) Water flood operations showing the number of injection wells and the current monthly, current yearly, and all-time cumulative figures for each formation in each pool and field.

This report is compiled and mailed to subscribers approximately two weeks after receipt of the returns from the operators.

In 1964 all production statistics were changed to a machine accounting system. The information is taken from the original documents, punched onto I.B.M. cards, and then calculated and printed mechanically.

Drilling and Land Report

The Drilling and Land Report is published and distributed monthly concurrently with the Oil and Gas Production Report.

The Drilling Section is compiled from information forwarded by the Branch field office and contains the following:—

(1) Monthly summary of drilling and completion activity with cumulatives for the year, and comparative figures for the same month of the preceding year.
(2) Summary of the well count giving the following totals:—
  (*a*) Locations drilled.
  (*b*) Oil wells.
  (*c*) Gas wells.
  (*d*) Abandoned wells.
  (*e*) Injection wells.
  (*f*) Disposal wells.
  (*g*) Wells completed.
(3) Drilling authorities approved.
(4) Locations cancelled.
(5) Locations outstanding.
(6) Changes of well status.
(7) Changes of well classification.
(8) Changes of well names.
(9) Suspended wells.
(10) Drilling and completed wells.
(11) Rig licences issued.
(12) Rig licences renewed.
(13) Rig licences cancelled.
(14) Well data released from confidential status.
(15) Descriptions of designated fields.

The Land Section is prepared by the Petroleum and Natural Gas Titles Section and contains the following:—

(1) Acreage synopses.
(2) Summary of changes in acreage held under the following titles:—
  (*a*) Permits.
  (*b*) Leases.
  (*c*) Natural-gas licences.
  (*d*) Drilling reservations.
(3) Operator's licences issued and renewed.
(4) Notices regarding sales of Crown petroleum and natural-gas rights.
(5) Summary of disposition of permits, leases, natural-gas licences, and drilling reservations.

PUBLICATIONS

The following publications are available from the General Administrative Section:—

Petroleum and Natural Gas Act, consolidated to January 8, 1964	$0.35
Underground Storage Act, 1964	.25
Geophysical Regulations	.25
Permit and Lease Grid System	1.00
List of Leases in the Peace River District, showing lease number, lessee, acreage, issue date, term, and ex-permit number	2.50
Oil and Gas Production Report (monthly)	$6.00 per calendar year or 75¢ per copy
Drilling and Land Report (monthly)	$6.00 per calendar year or 75¢ per copy
Crown Reserve Sale Notices and Results—a mailing list is maintained for the benefit of interested persons	Free
Synopsis of the Laws Relating to the Mineral Industry of British Columbia	Free
List of Publications, Department of Mines and Petroleum Resources	Free

The following publications are available from the Petroleum and Natural Gas Branch:—

Regulations Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas	$0.50
Regulations Establishing Gas-Oil Ratio Adjustment Factors, Oil Production Allowables, Overproduction and Underproduction	.25
Oil and Gas Field Descriptions (quarterly)	.50
Daily List of Drilling Authorities Issued	$12.00 per year
Petroleum and Natural Gas Report, reprinted from the Annual Report of the Minister	.25
Petroleum and Natural Gas Resources, reprinted from the Transactions of the 15th B.C. Natural Resources Conference, February, 1964	1.00
Stratigraphic Correlation Chart, Northeastern British Columbia and adjacent areas—	
Size 19" x 29"	.75
Size 9" x 14"	.25
Representative Well Logs, Northeastern British Columbia (1960) (this is included in Volume I, Schedule of Wells)	.50
List of Permit Geological Reports Released to November, 1960	.50

Redfern Lake Area, Preliminary Geological Report (mimeographed) $0.45
Schedule of Wells Drilled for Oil and Natural Gas in British Columbia—
- Volume I, 1906 to 1959 .... 7.50
- Volume II, 1960 .... 5.00
- Volume III, 1961 .... 5.00
- Volume IV, 1962 .... 5.00
- Volume V, 1963 .... 5.00

Reservoir Performance Charts, Oil and Gas Fields 5.00
Monthly Crude Oil and Natural Gas Production Summaries—
- 1954 .... .50
- 1955 .... .75
- 1956 .... 1.00
- 1957 .... 2.00
- 1958 .... 3.00
- 1959 to 1960 .... $5.00 each

(Since 1961 the summary has been included in the December issue of the Oil and Gas Production Report.)
Memoranda to Operators, complete set to end of 1964 .... Free

TABLES

TABLE 1.—GEOPHYSICAL EXPLORATION, 1964

Seismic Surveys

NOTE.—Unless otherwise shown, the exploration method used is the reflection seismic survey. For indicating location, the National Topographic map numbering system is used, except in the Peace River Block, where the township system is used.

Company	Location of Exploration	Number of Seismic Crews	Number of Crew-weeks
January			
Altair Oil & Gas Co.	94-J-13, 14	1	1
Atlantic Refining	94-I-6, 7, 10, 11	1	4.5
	94-P-1	1	1
British American	94-P-13	1	4
Calgary & Edmonton	94-H-3; 94-J-14, 15; 94-P-4, 13; 94-N-12	2	12.9
California Standard	94-P-7, 11	1	4
Canada Southern	94-P-5, 6	1	4
French Petroleum	94-O-4; Tp. 79, 80, R. 22–26, W. of 6th M.	1	6
Hudson's Bay	94-H-15	1[1]	3
	94-B-15	1	2
Imperial Oil Enterprises	94-O-3	1	1
	94-O-4	1	3
	94-H-10	1	0.5
	94-H-11		2
	94-H-14		1
	94-H-15		0.5
Pacific Petroleums	Tp. 85, 86, R. 24, 25, W. of 6th M.	1	3
	94-J-3, 6, 12	1	3
	94-J-7, 8, 10	1	2
	94-P-1, 8, 9	1	4
	94-P 4, 5, 12	1	4
	94-J-9	1	2
Pan American	93-I-8	1	2
Richfield	94-A-11	1	0.5
Shell Oil	94-B-6, 11	1	4
Sinclair Canada	94-I-15, 16	1	2
	94-I-16; 94-P-1	1	2
	Tp. 84, R. 20, 21, W. of 6th M.	1	1
	Tp. 80, 81, R. 14, 15, W. of 6th M.	1	1.5

[1] Seismic " Vibroseis " technique.

TABLE 1.—GEOPHYSICAL EXPLORATION, 1964—*Continued*

Seismic Surveys—Continued

Company	Location of Exploration	Number of Seismic Crews	Number of Crew-weeks
Socony Mobil	94-P-13, 14, 15	1	4
Sohio Petroleum	94-J-7, 8, 9; 94-I-10, 12, 14	1	4
Texaco Oil & Minerals	94-H-4	1	4
Triad Oil	94-H-5	1	1.5
	94-I-12	1	0.5
February			
Atlantic Refining	94-I-10, 11, 12, 13, 14	1	4
British American	94-J-8		3
	94-J-7	1	0.5
	94-J-1		0.5
Calgary & Edmonton	94-O-2, 3, 16; 94-P-4, 7	2	13.1
California Standard	94-P-7, 8, 10	1	4
	94-N-15	1	2
Canadian Fina	Tp. 78, R. 21, W. of 6th M.	1	1
French Petroleum	94-N-1	1	6
Hudson's Bay	94-H-15; 94-J-14	1[1]	4
Imperial Oil Enterprises	94-H-6		0.5
	94-H-11	1	0.5
	94-H-12		0.5
	94-N-10	1	3
	94-O-3	1	1
Pacific Petroleums	94-J-9	1	4
	94-J-7	1	1
	94-G-9	1	1
	94-B-7, 8	1	2
	94-P-13	1	1
	94-O-16	1	2
	94-I-11, 12	1	1
	94-P-10, 11	1	3
	94-I-1, 8	1	1
Pan American	93-I-8	1	2
Richfield	94-A-11, 14	1	2
	94-I-3, 6	1	2
Shell Oil	94-N-1, 2, 7, 8; 94-K-15	1	4
Sinclair Canada	94-G-11	1	2
	94-G-2	1	1
Socony Mobil	94-P-7, 8, 9, 10, 11	1	4
Tenneco	94-H-4	1	2
Triad Oil	94-H-4	1	0.3
Union Oil	94-P-2	1	4.3
March			
Amerada Petroleum	94-G-1	1	2
Atlantic Refining	94 I-2, 6, 7, 9, 10, 11, 12, 13, 14	1	4.5
Calgary & Edmonton	94-I-14; 94-P-3, 7	1	8
California Standard	94-P-10	1	1
	94-N-15	1	1
	94-H-7	1	1
Canadian Kewanee	94-J-10	1	2
French Petroleum	Tp. 80, R. 22, 23, W. of 6th M.	1	2
Hudson's Bay	94-J-14	1[1]	4
Imperial Oil Enterprises	94-H-5	1	1
	94-O-3	1	3
	Tp. 82, R. 17, W. of 6th M.		0.5
Monsanto Oils	94-A-13; 94-H-4	1	2
Pacific Petroleums	94-G-7, 8	1	2
	94-I-11, 12	1	2
	94-O-2	1	2
	94-I-1, 8	1	2
	Tp. 86, 87, R. 15, W. of 6th M.	1	2
	Tp. 86, R. 19, W. of 6th M.	1	1
Richfield	94-A-11	1	1
	94-I-3, 6	1	0.5
	94-J-14, 15; 94-O-2	1	2
Sinclair Canada	94-B-9	1	1
	94-G-2, 3	1	1
Socony Mobil	94-P-7; 94-I-10, 14, 15	1	4
Tenneco	94-I-13	1	1.5

[1] Seismic " Vibroseis " technique.

TABLE 1.—GEOPHYSICAL EXPLORATION, 1964—*Continued*

Seismic Surveys—Continued

Company	Location of Exploration	Number of Seismic Crews	Number of Crew-weeks
April			
Atlantic Refining	94-I-9, 10, 11	1	1
British American	93-P-15, 16	1	3.5
Calgary & Edmonton	94-J-16	1	1.8
Pan American	94-G-10	1	1
Shell Oil	92-D, E	2	6[2]
May			
British American	93-P-15	1	1.5
	93-P-16		2
	94-A-3		0.5
Pan American	94-G-10, 15	1	4
Shell Oil	92-D, E	2	8[2]
June			
British American	94-A-3	1	4
Canadian Kewanee	94-A-12, 13; 94-B-16	1	1
Pan American	94-G-15	1	2
	94-J-4	1	2
Shell Oil	92-D, E	2	7[2]
	103-G	1	1[2]
July			
British American	82 G	1[3]	2
Canadian Kewanee	94-J-10	1	2
Pan American	94-J-5, 12	1	2.5
Shell Oil	103-A, B, G	2	4[4]
August			
British American	82-G	1[3]	4
Canadian Kewanee	94-J-10	1	2
Imperial Oil	82 G-1, 2	1	4
Pan American	94-J-5, 12	1	3
Shell Oil	92-E; 102-I, O, P; 103-A	2	4[4]
September			
British American	82-G	1[3]	2
Imperial Oil Enterprises	94-A	1	2[4]
Pacific Petroleums	94-B-16	1	0.5
	94-J-10	1	1
Pan American	94-J-5, 12	1	3
Shell Oil	92-C, D	1	3[4]
October			
Pacific Petroleums	94-J-10	1	2
Pan American	94 G-7, 8, 9, 10	1	2.5
November			
Pan American	94-G-7, 8, 9, 10	1	3
December			
Canadian Kewanee	94-A-12	1	1
	94-B-16	1	1.5
	94-A-5, 12	1	1
Monsanto Oils	Tp. 88, R. 19, W. of 6th M.	1	2
Placid Oil	94-I-12, 13; 94-J-9, 16	1	4
Triad Oil	94-H-5	1	1

[1] Seismic " Vibroseis " technique.
[2] Marine seismic.
[3] Refraction.
[4] River seismic (Peace and Pine Rivers).

Aeromagnetic Surveys

Company	Location	Time
Calgary & Edmonton	93-O-8, 9, 15, 16; 94-B-1, 2, 7, 8, 9, 10	Sept. 2–22, incl.

TABLE 2.—SURFACE GEOLOGICAL EXPLORATION, 1964

Company	Location	Number of Geologists	Two-man Party-weeks
June			
California Standard	94-G	1	0.5
	94-J	1	0.5
Hudson's Bay	93-I-8	5	9
Imperial Oil Enterprises	95-J, O, N; 96-C	6	12
Sohio Petroleum	93-P-9	2	1
	93-P, O	1	1
July			
British American	82-G	4	4
	83-L; 93-I	4	8
California Standard	94-J; 94-G	1	1
Hudson's Bay	93-I	5	8
Imperial Oil Enterprises[1]	94-A	6	6
Pan American	93-I		
August			
British American	82-G	4	4
	94-B	4	8
Hudson's Bay	93-O	2	3
Imperial Oil Enterprises[1]	94 A	6	12
Pan American	93-I		
September			
Imperial Oil Enterprises[1]	94-A	6	3
Pan American	93-I		
Sohio	93-O,P	2	1
October			
Imperial Oil Enterprises[1]	94-A	----	...

[1] Photogeologic mapping by contract.

TABLE 3.—EXPLORATORY TEST-HOLES DRILLED, 1964

Company	No.		Ground Elevation
Altair Oil & Gas	1	N. 2,593.9', E. 1,399.7', Sec. 14, Tp. 85, R. 21, W. of 6th M.	2,348.7'
	2	N. 2,323.9', W. 2,659.5', Sec. 4, Tp. 86, R. 21, W. of 6th M.	2,194.1'
	3	S. 1,063.8', E. 2,663.8', Sec. 15, Tp. 85, R. 21, W. of 6th M.	2,180.1'
	4	S. 166.7', E. 1,461.7', Sec. 12, Tp. 88, R. 25, W. of 6th M.	2,671.8'
	5	b-21-E/94-G-15	----------
	6	c-39-F/94-G-15	----------
	7	Centre of Sec. 15, Tp. 85, R. 21, W. of 6th M.	2,213.1'
Sohio Petroleum	1	N. 1,679', E. 1,995', b-79-D/94-A-14	2,580.1'
	2	N. 2,084', E. 1,417', b-52-A/94-A-13	2,744.0'

TABLE 4.—OIL-FIELD RESERVOIR DATA AT DECEMBER 31, 1964

Field	Pool	Rock Type	Age	Trap	Drive Mechanism	Average Porosity (per Cent)	Average Reservoir Thickness (Net Ft.)	Average Permeability (Md.)	Average Water Saturation (per Cent)	Shrinkage Factor (Stock Tank Barrel per Reservoir Barrel)	Gravity Degrees (A.P.I.)	Original Pressure (Psig.)	Average M.P.R. (Bbl./Day)
Aitken Creek	Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	Depletion with gas cap	12.0	17.0	1,993	18.0	0.77	39.2	1,534	116[1]
Beatton River	Halfway	Sandstone	Triassic	Structural-stratigraphic	Depletion	20.0	9.6	288	24.0	0.86	40.4	1,158	245[1] 49[2]
Beatton River West	Bluesky-Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	Depletion and gas cap	14.0	8.0	65	31.0	0.80	42.1	1,017	72
Blueberry	Mississippian	Carbonate	Mississippian	Structural-stratigraphic	Gas cap and partial water	10.5	27.9	31[3]	16.6	0.75	42.4	2,701	256[1]
Boundary Lake	Boundary Lake	Carbonate	Triassic	Structural-stratigraphic	Depletion	18.3	11.9	45	10.9	0.80	33.7	1,800	130[1] 196[2]
Boundary Lake	Halfway	Sandstone	Triassic	Structural	Water with partial gas cap	13.2	10.7	14	26.0	0.82	42.6	1,685	74
Bulrush	Halfway	Sandstone	Triassic	Stratigraphic	Depletion and gas cap	16.5	5.5	302	15.0	0.83	40.4	1,336	25
Charlie Lake	Gething	Sandstone	Lower Cretaceous	Stratigraphic	Depletion	19.0	13.0	(4)	25.0	0.83	34.4	1,097	36
Fort St. John	Charlie Lake	Sandstone	Triassic	Stratigraphic	Gas cap	13.8	3.3	570	25.0	0.77	39.6	1,939	37
Fort St. John	Belloy	Carbonate	Permian	Structural-stratigraphic	Depletion	10.0	21.0	23	25.0	0.75	43.0	2,770	85
Milligan Creek	Halfway	Sandstone	Triassic	Structural-stratigraphic	Depletion	24.7	16.5	23	13.9	0.88	40.4	1,170	476[1] 157[2]
Peejay	Halfway	Sandstone	Triassic	Stratigraphic	Depletion	15.0	9.4	81	18.0	0.83	39.0	1,368	233[1] 5[2]
Peejay West	Halfway	Sandstone	Triassic	Stratigraphic	Depletion	22.0	20.0	82	31.0	0.83	39.0	1,426	170
Wildmint	Halfway	Sandstone	Triassic	Structural-stratigraphic	Depletion	18.0	13.0	380	21.0	0.87	40.0	1,212	149[1] 104[2]
Willow	Bluesky-Gething	Sandstone	Lower Cretaceous	Stratigraphic	Depletion	29.0	9.0	150	13.0	0.89	44.2	973	122

[1] Daily average M.P.R. obtained by dividing unit M.P.R. by the number of producible wells in the unit.
[2] Daily average M.P.R. of wells not included in a unit M.P.R.
[3] Plus fractures.
[4] Not available.

TABLE 5.—GAS-FIELD RESERVOIR DATA AT DECEMBER 31, 1964

Field	Pool	Rock Type	Age	Trap	Av. Porosity (per Cent)	Av. Reservoir Thickness (Net Ft.)	Av. Permeability (Md.)	Av. Water Saturation (per Cent)	Compressibility Factor	Specific Gravity (Air=1.0)	Original Pressure (Psig.)	Av. A.O.F.P. (M S.C.F./Day)
Beg	Baldonnel	Carbonate	Triassic	Structural	8.0	32.0	64.7[1]	21.0	0.840	0.652	1,630	4,660
Beg	Halfway	Sandstone	Triassic	Structural	10.0	36.0	10.0	35.0	0.839	0.673	1,820	7,430
Beg West	Baldonnel	Carbonate	Triassic	Structural	8.0	86.0	22.9	23.0	0.848	0.653	1,674	1,430
Bernadet	Bluesky-Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	8.0	13.0	(2)	15.0	0.838	0.644	1,193	3,840
Blueberry	Dunlevy	Sandstone	Lower Cretaceous	Structural	11.0	32.7	10.3	33.0	0.840	0.659	1,363	3,050
Blueberry	Baldonnel	Carbonate	Triassic	Structural	10.0	17.0	38.3	37.0	0.837	0.673	1,611	1,380
Blueberry	Charlie Lake	Sandstone	Triassic	Structural-stratigraphic	9.3	26.0	(2)	27.5	0.706	0.939	2,073	......
Blueberry East	Baldonnel	Carbonate	Triassic	Structural	10.0	30.0	47.7	25.0	0.832	0.675	1,715	2,500
Blueberry East	Mississippian	Carbonate	Mississippian	Structural	12.3	17.0	32.5	30.5	0.871	0.615	2,680	3,260
Blueberry West	Dunlevy	Sandstone	Lower Cretaceous	Structural	10.0	9.0	61.8	25.0	0.850	0.658	1,410	1,930
Blueberry West	Baldonnel	Carbonate	Triassic	Structural	9.3	16.0	83.7	22.8	0.824	0.648	1,715	1,450
Boundary Lake	Bluesky-Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	17.7	9.0	(2)	28.0	0.858	0.634	1,276	830
Boundary Lake	Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	17.0	57.0	(2)	16.0	0.843	0.648	1,371	13,000
Boundary Lake	Dunlevy	Sandstone	Lower Cretaceous	Structural	24.1	46.0	(2)	38.0	0.845	0.629	1,453	......
Boundary Lake	Baldonnel	Carbonate	Triassic	Structural	14.0	19.6	(2)	34.0	0.799	0.677	1,447	4,610
Boundary Lake	Halfway	Sandstone	Triassic	Structural	10.0	25.0	(2)	11.0	0.841	0.632	1,556	360
Bubbles	Baldonnel	Carbonate	Triassic	Structural	10.0	52.0	33.3	17.0	0.843	0.663	1,596	10,800
Buick Creek	Dunlevy	Sandstone	Lower Cretaceous	Structural-stratigraphic	13.3	25.0	139.8	28.0	0.836	0.659	1,293	8,720
Buick Creek	Charlie Lake	Sandstone	Triassic	Structural-stratigraphic	13.0	6.0	(2)	33.0	0.859	0.613	1,554	2,300
Buick Creek East	Bluesky-Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	10.0	10.0	(2)	47.0	0.865	0.639	1,096	1,000
Buick Creek East	Dunlevy	Sandstone	Lower Cretaceous	Structural-stratigraphic	11.0	20.3	125.0	29.0	0.853	0.648	1,289	6,250
Buick Creek West	Dunlevy	Sandstone	Lower Cretaceous	Structural-stratigraphic	11.0	28.0	165.0	32.0	0.850	0.657	1,305	7,380
Buick Creek West	Baldonnel	Carbonate	Triassic	Structural-stratigraphic	11.4	18.0	44.9	27.0	0.817	0.698	1,467	2,160
Buick Creek West	Halfway	Sandstone	Triassic	Structural	11.0	39.0	20.8	31.0	0.782	0.748	1,721	......
Clarke Lake	Slave Point	Carbonate	Devonian	Stratigraphic	9.0	157.0	247.8	14.0	0.935	0.670	2,875	56,260
Dawson Creek	Cadotte	Sandstone	Lower Cretaceous	Structural-stratigraphic	16.5	48.6	33.2	25.0	0.921	0.580	686	1,440
Fort St. John	Cadomin	Sandstone	Lower Cretaceous	Structural	12.4	8.0	421.0	40.0	0.869	0.581	1,324	......
Fort St. John	Baldonnel A	Carbonate	Triassic	Structural	15.9	18.9	120.4	25.0	0.822	0.661	1,604	4,260
Fort St. John	Baldonnel A/B	Carbonate	Triassic	Structural	12.0	44.1	101.6	25.0	0.822	0.661	1,604	4,950
Fort St. John	Charlie Lake	Sandstone	Triassic	Stratigraphic	15.0	6.0	(2)	10.0	0.825	0.648	1,906	......
Fort St. John	Halfway	Sandstone	Triassic	Structural	11.1	28.2	22.6	25.0	0.799	0.679	2,006	4,430
Fort St. John	Belloy	Carbonate	Permian	Structural-stratigraphic	12.0	11.0	59.3	25.0	0.828	0.655	2,756	780
Fort St. John Airport	*Cadomin*	*Sandstone*	*Lower Cretaceous*	*Structural*	17.5	23.0	(2)	40.0	0.870	0.581	1,432	......
Fort St. John Airport	Baldonnel A	Carbonate	Triassic	Structural	10.0	10.0	(2)	38.0	0.825	0.661	1,614	......
Fort St. John Airport	Halfway	Sandstone	Triassic	Structural	10.0	13.0	(2)	25.0	0.825	0.693	2,039	......
Fort St. John Southeast	Cadomin	Sandstone	Lower Cretaceous	Structural	15.8	32.0	64.2	40.0	0.876	0.581	1,389	2,950
Fort St. John Southeast	Baldonnel A	Carbonate	Triassic	Structural	18.0	12.0	30.0	28.0	0.778	0.702	1,634	4,110
Fort St. John Southeast	Halfway	Sandstone	Triassic	Structural	9.8	16.0	14.5	25.0	0.821	0.693	2,072	4,550

Fort St. John Southeast	Belloy	Carbonate	Permian	Structural-stratigraphic	9.2	16.0	62.2	25.0	0.842	0.640	2,814	10,400
Gundy Creek	Baldonnel	Carbonate	Triassic	Structural	8.9	9.0	69.3	20.0	0.850	0.636	1,731	3,630
Gundy Creek	Charlie Lake	Sandstone	Triassic	Structural-stratigraphic	7.0	10.0	([2])	25.0	0.810	0.653	2,339	......
Halfway	Baldonnel	Carbonate	Triassic	Structural	7.9	31.0	5.9[1]	35.0	0.818	0.639	1,642	2,720
Halfway	Halfway	Sandstone	Triassic	Structural	16.0	7.0	49.1	25.0	0.800	0.650	2,212	720
Highway	Dunlevy	Sandstone	Lower Cretaceous	Structural	8.7	14.0	84.9	25.0	0.857	0.669	1,346	920
Highway	Baldonnel	Carbonate	Triassic	Structural	10.0	5.0	124.0	25.0	0.805	0.675	1,666	920
Highway	Mississippian	Carbonate	Mississippian	Structural	10.0	13.0	104.7	25.0	0.903	0.609	3,122	2,820
Jedney	Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	10.6	10.0	([2])	24.0	0.870	0.663	1,126	13,600
Jedney	Baldonnel	Carbonate	Triassic	Structural	10.4	57.0	33.7	13.0	0.852	0.693	1,602	7,300
Jedney	Halfway	Sandstone	Triassic	Structural	9.8	51.0	16.4	22.0	0.842	0.673	1,688	7,550
Jedney West	Baldonnel	Carbonate	Triassic	Structural	9.0	11.0	([2])	64.0	0.850	0.693	1,622	750
Jedney West	Halfway	Sandstone	Triassic	Structural	8.0	32.0	([2])	45.0	0.839	0.673	1,768	1,900
Kobes-Townsend	Dunlevy	Sandstone	Lower Cretaceous	Structural	12.5	26.0	17.9	19.8	0.782	0.651	1,486	1,790
Kobes-Townsend	Charlie Lake	Sandstone	Triassic	Structural-stratigraphic	11.0	12.0	([2])	29.0	0.820	0.629	2,470	1,810
Kobes-Townsend	Halfway	Sandstone	Triassic	Structural-stratigraphic	7.6	24.0	5.1	28.0	0.823	0.638	2,636	14,500
Kobes-Townsend	Mississippian	Carbonate	Mississippian	Structural-stratigraphic	4.9	21.0	10.4	16.2	0.841	0.647	3,025	6,210
Kotcho Lake	Slave Point	Carbonate	Devonian	Stratigraphic	10.0	19.0	45.7	8.0	0.920	0.670	2,550	......
Laprise Creek	Baldonnel	Carbonate	Triassic	Structural-stratigraphic	10.0	60.5	130.0	19.0	0.843	0.679	1,528	8,750
Laprise Creek West	Baldonnel	Carbonate	Triassic	Structural-stratigraphic	10.3	43.8	47.7	23.0	0.845	0.694	1,326	2,300
Montney	Bluesky-Gething	Sandstone	Lower Cretaceous	Structural-stratigraphic	17.0	6.0	([2])	45.0	0.843	0.670	1,250	810
Montney	Charlie Lake	Sandstone	Triassic	Structural-stratigraphic	20.0	5.0	([2])	30.0	0.830	0.664	1,746	2,200
Montney	Halfway	Sandstone	Triassic	Structural	14.6	15.0	67.1	33.0	0.805	0.702	1,846	3,550
Nig Creek	Baldonnel	Carbonate	Triassic	Structural-stratigraphic	10.0	51.0	61.3	21.0	0.849	0.678	1,642	12,520
Parkland	Wabamun	Carbonate	Devonian	Structural-stratigraphic	13.0	53.0	......	16.0	1.022	0.623	4,900	21,000
Petitot River	Slave Point	Carbonate	Devonian	Structural-stratigraphic	7.2	79.9	([2])	18.0	0.936	0.674	2,775	185,000
Red Creek	Charlie Lake	Sandstone	Triassic	Structural-stratigraphic	18.0	6.0	([2])	32.0	0.838	0.614	1,866	2,200
Red Creek	Halfway	Sandstone	Triassic	Structural	11.0	19.0	18.1	20.0	0.719	0.779	2,021	1,770
Rigel	Dunlevy	Sandstone	Lower Cretaceous	Structural-stratigraphic	14.0	18.7	25.1[1]	25.0	0.848	0.654	1,274	14,270
Snyder Creek	Dunlevy	Sandstone	Lower Cretaceous	Structural-stratigraphic	12.0	10.5	([2])	30.0	0.858	0.664	1,275	2,300
Stoddart	Belloy	Carbonate	Permian	Stratigraphic	15.0	17.0	105.9[1]	10.0	0.805	0.695	2,411	17,500
Stoddart West	Belloy	Carbonate	Permian	Stratigraphic	14.0	15.0	23.8	14.0	0.805	0.695	2,411	9,300
Sunrise	Cadotte	Sandstone	Lower Cretaceous	Structural-stratigraphic	20.6	32.0	36.2	55.0	0.924	0.590	696	......
Willow	Halfway	Sandstone	Triassic	Stratigraphic	23.0	11.0	169.0	18.0	0.854	0.635	1,227	......

[1] Plus fractures.
[2] Not available.

Table 6.—Proved Reserves of Crude Oil and Established Reserves of Natural Gas and Natural-gas Products, December 31, 1964

	Crude Oil[1] (Barrels of 34.97 Imperial Gallons at 60° F.)	Disposable Gas[2] (Billion S.C.F. at 14.65 Psia. and 60° F.)	Gas Liquids (Barrels of 34.97 Imperial Gallons at 60° F.)	Sulphur (Short Tons)
Reserves remaining at December 31, 1963	153,583,411	7,060.4	138,148,800	3,637,428
Revisions and extensions[3]	+111,958,833	−336.8	+15,567,300	−151,828
Production, 1964	11,525,476	125.5	1,388,053	67,615
Reserves remaining at December 31, 1964	254,016,768	6,598.1	152,328,047	3,417,985

[1] Includes only proved drilled reserves. There are an additional 13,285,600 barrels of probable reserves which are in effect proved undrilled reserves.

[2] Associated gas is included only for pools in which gas-conservation schemes are in operation.

[3] Includes discovery from new drilling and revisions arising from new information.

The production of residual gas, gas liquids, and sulphur are the quantities calculated from gas analyses to have been produced with the raw gas, sweet and sour, and are not the quantities actually extracted. The quantity of gas delivered to the transmission-line and distributed in 1964 was 118,959,880 M s.c.f., and the amounts of natural-gas liquids and sulphur actually extracted were 1,655,141 barrels and 65,836 short tons respectively. The actual production of raw gas, including conserved associated gas from Blueberry and Boundary Lake fields, was 142,386,488 M s.c.f.

TABLE 7.—AUTHORIZED MAXIMUM PERMISSIBLE RATES TO DECEMBER 31, 1964

Field	Drilling Authority No.	Well Name	Location	Pool	Maximum Permissible Rate (Bbl./Day)
Aitken Creek	1160	Union Aitken d-33-L	d-33-L/94-A-13	Gething	
	1205	Union Aitken d-34-L	d-34-L/94-A-13	Gething	
	485	Union Aitken Creek b-42-L	b-42-L/94-A-13	Gething	582[1]
	1173	Union Aitken d-43-L	d-43-L/94-A-13	Gething	
	1186	Union Aitken d-44-L	d-44-L/94-A-13	Gething	
Beatton River	1224	Triad Beaton b-28-J	b-28-J/94-H-2	Halfway	
	396	Triad Beatton River d-28-J	d-28-J/94-H-2	Halfway	
	395	Triad Beatton River d-29-J	d-29-J/94-H-2	Halfway	
	309	Triad Beatton River b-38-J	b-38-J/94-H-2	Halfway	
	393	Triad Beatton River d-39-J	d-39-J/94-H-2	Halfway	1,960[1]
	1419	Triad Beatton b-49-J	b-49-J/94-H-2	Halfway	
	896	Triad Beatton d-49-J	d-49-J/94-H-2	Halfway	
	816	Triad Beatton d-50-J	d-50-J/94-H-2	Halfway	
	1038	Triad Beatton b-59-J	b-59-J/94-H-2	Halfway	
	869	Triad et al Beatton d-41-K	d-41-K/94-H-2	Halfway	49
Beatton River West	408	Triad West Beatton River d-39-K	d-39-K/94-H-2	Bluesky-Gething	47
	441	Triad West Beatton River d-48-K	d-48-K/94-H-2	Bluesky-Gething	94
	515	Triad West Beatton River d-57-K	d-57-K/94-H-2	Bluesky-Gething	78
	1398	Triad West Beatton River d-58-K	d-58-K/94-H-2	Bluesky-Gething	30
	512	Triad West Beatton River d-59-K	d-59-K/94-H-2	Bluesky-Gething	78
	1408	Whitehall et al W Beatton d-21-L	d-21-L/94-H-2	Bluesky-Gething	105
Blueberry	1333	Decalta Blueberry d-57-D	d-57-D/94-A-13	Mississippian	97
	785	West Nat et al Blueberry d-19-K	d-19-K/94-A-12	Mississippian	
	549	West Nat et al Blueberry c-A29-K	c-29-K/94-A-12	Mississippian	
	746	West Nat et al Blueberry d-30-K	d-30-K/94-A-12	Mississippian	
	783	West Nat et al Blueberry d-40-K	d-40-K/94-A-12	Mississippian	
	242	West Nat et al Blueberry d-50-K (13)	d-50-K/94-A-12	Mississippian	
	851	West Nat et al Blueberry b-60-K	b-60-K/94-A-12	Mississippian	
	1317	West Nat et al Blueberry d-41-L	d-41-L/94-A-12	Mississippian	
	948	West Nat et al Blueberry c-71-L	c-71-L/94-A-12	Mississippian	
	205	West Nat et al Blueberry d-82-L (11)	d-82-L/94-A-12	Mississippian	4,600[1]
	1072	West Nat et al Blueberry b-92-L	b-92-L/94-A-12	Mississippian	
	1242	West Nat et al Blueberry d-93-L	d-93-L/94-A-12	Mississippian	
	1258	West Nat et al Blueberry b-24-D	b-24-D/94-A-13	Mississippian	
	1169	West Nat et al Blueberry d-25-D	d-25-D/94-A-13	Mississippian	
	1146	West Nat et al Blueberry b-35-D	b-35-D/94-A-13	Mississippian	
	960	West Nat et al Blueberry d-36-D	d-36-D/94-A-13	Mississippian	
	745	West Nat et al Blueberry 6-25-88-25	6-25-88-25 W6M	Mississippian	
	850	West Nat et al Blueberry 14-25-88-25	14-25-88-25 W6M	Mississippian	

[1] Pool.

TABLE 7.—AUTHORIZED MAXIMUM PERMISSIBLE RATES TO DECEMBER 31, 1964—*Continued*

Field	Drilling Authority No.	Well Name	Location	Pool	Maximum Permissible Rate (Bbl./Day)
	272	West Nat et al Blueberry d-46-D (16)	d-46-D/94-A-13	Mississippian	78[2]
Boundary Lake	1033	Dome Boundary 6-22-85-14	6-22-85-14 W6M	Boundary Lake	2,343[1]
	768	Dome Boundary 8-22-85-14	8-22-85-14 W6M	Boundary Lake	
	575	Dome Boundary Lake 6-26-85-14	6-26-85-14 W6M	Boundary Lake	
	550	Dome Boundary Lake 8-26-85-14	8-26-85-14 W6M	Boundary Lake	
	573	Dome Boundary Lake 14-26-85-14	14-26-85-14 W6M	Boundary Lake	
	1470	Dome Boundary 14-34-85-14	14-34-85-14 W6M	Boundary Lake	
	1022	Dome Boundary 16-34-85-14	16-34-85-14 W6M	Boundary Lake	
	574	Dome Boundary Lake 6-35-85-14	6-35-85-14 W6M	Boundary Lake	
	488	Dome Boundary Lake 8-35-85-14	8-35-85-14 W6M	Boundary Lake	
	528	Dome Boundary Lake 14-35-85-14	14-35-85-14 W6M	Boundary Lake	
	606	Dome Boundary Lake 16-35-85-14	16-35-85-14 W6M	Boundary Lake	
	1440	Dome Boundary 6-2-86-14	6-2-86-14 W6M	Boundary Lake	
	642	Dome Boundary Lake 8-2-86-14	8-2-86-14 W6M	Boundary Lake	
	1064	Dome Boundary 14-2-86-14	14-2-86-14 W6M	Boundary Lake	
	1156	Dome Boundary 8-3-86-14	8-3-86-14 W6M	Boundary Lake	
	764	Dome Boundary 8-11-86-14	8-11-86-14 W6M	Boundary Lake	
	765	Dome Boundary 16-11-86-14	16-11-86-14 W6M	Boundary Lake	
	808	Dome Boundary 8-14-86-14	8-14-86-14 W6M	Boundary Lake	
	1070	Dome Boundary 16-14-86-14	16-14-86-14 W6M	Boundary Lake	
	1041	Homestead et al Boundary 6-18-84-13	6-18-84-13 W6M	Boundary Lake	
	1108	Homestead et al Boundary 8-18-84-13	8-18-84-13 W6M	Boundary Lake	
	1104	Imp Pac Boundary 14-18-84-13	14-18-84-13 W6M	Boundary Lake	
	1098	Imp Pac Boundary 6-19-84-13	6-19-84-13 W6M	Boundary Lake	
	1078	Imp Pac Boundary 8-19-84-13	8-19-84-13 W6M	Boundary Lake	
	998	Imp Pac Boundary 14-19-84-13	14-19-84-13 W6M	Boundary Lake	
	1117	Imp Pac Boundary 6-20-84-13	6-20-84-13 W6M	Boundary Lake	
	296	Imp Pac Boundary 14-20-84-13	14-20-84-13 W6M	Boundary Lake	
	1091	Imp Pac Boundary 6-29-84-13	6-29-84-13 W6M	Boundary Lake	
	1060	Imp Pac Boundary 14-29-84-13	14-29-84-13 W6M	Boundary Lake	
	1061	Imp Pac Boundary 8-30-84-13	8-30-84-13 W6M	Boundary Lake	
	975	Imp et al Boundary 14-30-84-13	14-30-84-13 W6M	Boundary Lake	
	931	Imp et al Boundary 6-31-84-13	6-31-84-13 W6M	Boundary Lake	
	930	Imp et al Boundary 8-31-84-13	8-31-84-13 W6M	Boundary Lake	
	888	Imp Pac Boundary 14-31-84-13	14-31-84-13 W6M	Boundary Lake	
	965	Imp Pac Boundary 6-32-84-13	6-32-84-13 W6M	Boundary Lake	
	935	Imp Pac Boundary 14-32-84-13	14-32-84-13 W6M	Boundary Lake	
	939	Imp Pac Boundary 16-32-84-13	16-32-84-13 W6M	Boundary Lake	
	813	Imp Pac Boundary 6-5-85-13	6-5-85-13 W6M	Boundary Lake	
	878	Imp Pac Boundary 8-5-85-13	8-5-85-13 W6M	Boundary Lake	

832	Imp Pac Boundary 14-5-85-13	14-5-85-13 W6M	Boundary Lake
789	Imp Pac Boundary 6-6-85-13	6-6-85-13 W6M	Boundary Lake
795	Imp Pac Boundary 8-6-85-13	8-6-85-13 W6M	Boundary Lake
792	Imp Pac Boundary 14-6-85-13	14-6-85-13 W6M	Boundary Lake
796	Imp Pac Boundary 16-6-85-13	16-6-85-13 W6M	Boundary Lake
763	Imp Pac Boundary 6-7-85-13	6-7-85-13 W6M	Boundary Lake
807	Imp Pac Boundary 8-7-85-13	8-7-85-13 W6M	Boundary Lake
368	Imp Pac Boundary 14-7-85-13	14-7-85-13 W6M	Boundary Lake
847	Imp Pac Boundary 6-8-85-13	6-8-85-13 W6M	Boundary Lake
906	Imp Pac Boundary 8-8-85-13	8-8-85-13 W6M	Boundary Lake
767	Imp Pac Boundary 14-8-85-13	14-8-85-13 W6M	Boundary Lake
889	Imp Pac Boundary 16-8-85-13	16-8-85-13 W6M	Boundary Lake
760	Imp Pac Boundary 6-17-85-13	6-17-85-13 W6M	Boundary Lake
738	Imp Pac Boundary 14-17-85-13	14-17-85-13 W6M	Boundary Lake
734	Imp Pac Boundary 6-18-85-13	6-18-85-13 W6M	Boundary Lake
523	Imp Pac Boundary 8-18-85-13	8-18-85-13 W6M	Boundary Lake
524	Imp Pac Boundary 6-20-85-13	6-20-85-13 W6M	Boundary Lake
774	Imp Pac Boundary 8-20-85-13	8-20-85-13 W6M	Boundary Lake
1166	Imp Pac Boundary 14-2-84-14	14-2-84-14 W6M	Boundary Lake
1369	Imp Pac Boundary 14-4-84-14	14-4-84-14 W6M	Boundary Lake
1358	Imp Pac Boundary 16-4-84-14	16-4-84-14 W6M	Boundary Lake
1357	Imp Pac Boundary 16-7-84-14	16-7-84-14 W6M	Boundary Lake
1164	Imp Pac Boundary 14-8-84-14	14-8-84-14 W6M	Boundary Lake
1367	Imp Pac Boundary 8-9-84-14	8-9-84-14 W6M	Boundary Lake
1133	Imp et al Boundary 16-9-84-14	16-9-84-14 W6M	Boundary Lake
843	Imp Pac Boundary 14-10-84-14	14-10-84-14 W6M	Boundary Lake
1079	Imp Pac Boundary 16-10-84-14	16-10-84-14 W6M	Boundary Lake
1127	Imp Pac Boundary 6-11-84-14	6-11-84-14 W6M	Boundary Lake
1136	Imp Pac Boundary 8-11-84-14	8-11-84-14 W6M	Boundary Lake
1080	Imp Pac Boundary 14-13-84-14	14-13-84-14 W6M	Boundary Lake
1085	Imp Pac Boundary 16-13-84-14	16-13-84-14 W6M	Boundary Lake
1059	Imp Pac Boundary 14-14-84-14	14-14-84-14 W6M	Boundary Lake
1175	Imp Pac Boundary 16-14-84-14	16-14-84-14 W6M	Boundary Lake
1084	Imp Pac Boundary 6-15-84-14	6-15-84-14 W6M	Boundary Lake
1076	Imp Pac Boundary 8-15-84-14	8-15-84-14 W6M	Boundary Lake
1035	Imp et al Boundary 6-16-84-14	6-16-84-14 W6M	Boundary Lake
1128	Imp et al Boundary 8-16-84-14	8-16-84-14 W6M	Boundary Lake
1143	Imp Pac Boundary 14-16-84-14	14-16-84-14 W6M	Boundary Lake
1102	Imp Pac Boundary 6-17-84-14	6-17-84-14 W6M	Boundary Lake
1151	Imp Pac Boundary 8-17-84-14	8-17-84-14 W6M	Boundary Lake
1220	Imp Pac Boundary 14-17-84-14	14-17-84-14 W6M	Boundary Lake
1158	Imp Pac Boundary 16-17-84-14	16-17-84-14 W6M	Boundary Lake
1273	Imp Pac Boundary 8-18-84-14	8-18-84-14 W6M	Boundary Lake
1343	Imp Pac Boundary 16-18-84-14	16-18-84-14 W6M	Boundary Lake
1189	Imp Pac Boundary 8-20-84-14	8-20-84-14 W6M	Boundary Lake

[2] Included in pool M.P.R. but not to exceed individual M.P.R.

TABLE 7.—AUTHORIZED MAXIMUM PERMISSIBLE RATES TO DECEMBER 31, 1964—*Continued*

Field	Drilling Authority No.	Well Name	Location	Pool	Maximum Permissible Rate (Bbl./Day)
Boundary Lake	1338	Imp Pac Boundary 16-20-84-14	16-20-84-14 W6M	Boundary Lake	18,488[1]
	1157	Imp Pac Boundary 6-21-84-14	6-21-84-14 W6M	Boundary Lake	
	1120	Imp Pac Boundary 8-21-84-14	8-21-84-14 W6M	Boundary Lake	
	1172	Imp Pac Boundary 14-21-84-14	14-21-84-14 W6M	Boundary Lake	
	1122	Imp Pac Boundary 16-21-84-14	16-21-84-14 W6M	Boundary Lake	
	250	Imp Pac Boundary 1-23-84-14	1-23-84-14 W6M	Boundary Lake	
	1017	Imp Pac Boundary 6-23-84-14	6-23-84-14 W6M	Boundary Lake	
	929	Imp Pac Boundary 14-23-84-14	14-23-84-14 W6M	Boundary Lake	
	997	Imp Pac Boundary 16-23-84-14	16-23-84-14 W6M	Boundary Lake	
	1036	Imp Pac Boundary 6-24-84-14	6-24-84-14 W6M	Boundary Lake	
	978	Imp Pac Boundary 8-24-84-14	8-24-84-14 W6M	Boundary Lake	
	1010	Imp Pac Boundary 14-24-84-14	14-24-84-14 W6M	Boundary Lake	
	979	Imp Pac Boundary 6-25-84-14	6-25-84-14 W6M	Boundary Lake	
	928	Imp Pac Boundary 8-25-84-14	8-25-84-14 W6M	Boundary Lake	
	1077	Imp et al Boundary 14-25-84-14	14-25-84-14 W6M	Boundary Lake	
	927	Imp Pac Boundary 6-26-84-14	6-26-84-14 W6M	Boundary Lake	
	966	Imp Pac Boundary 8-26-84-14	8-26-84-14 W6M	Boundary Lake	
	1111	Imp et al Boundary 14-26-84-14	14-26-84-14 W6M	Boundary Lake	
	1019	Imp Pac Boundary 6-30-84-14	6-30-84-14 W6M	Boundary Lake	
	861	Imp Pac Boundary 8-34-84-14	8-34-84-14 W6M	Boundary Lake	
	883	Imp Pac Boundary 14-34-84-14	14-34-84-14 W6M	Boundary Lake	
	833	Imp Pac Boundary 6-35-84-14	6-35-84-14 W6M	Boundary Lake	
	815	Imp Pac Boundary 8-35-84-14	8-35-84-14 W6M	Boundary Lake	
	805	Imp Pac Boundary 14-35-84-14	14-35-84-14 W6M	Boundary Lake	
	804	Imp et al Boundary 6-36-84-14	6-36-84-14 W6M	Boundary Lake	
	814	Imp et al Boundary 8-36-84-14	8-36-84-14 W6M	Boundary Lake	
	793	Imp et al Boundary 14-36-84-14	14-36-84-14 W6M	Boundary Lake	
	761	Imp et al Boundary 6-1-85-14	6-1-85-14 W6M	Boundary Lake	
	770	Imp et al Boundary 8-1-85-14	8-1-85-14 W6M	Boundary Lake	
	521	Imp et al Boundary 14-1-85-14	14-1-85-14 W6M	Boundary Lake	
	501	Imp et al Boundary 6-2-85-14	6-2-85-14 W6M	Boundary Lake	
	788	Imp Pac Boundary 8-2-85-14	8-2-85-14 W6M	Boundary Lake	
	493	Imp Pac Boundary 14-2-85-14	14-2-85-14 W6M	Boundary Lake	
	362	Imperial Pacific Boundary 6-3-85-14	6-3-85-14 W6M	Boundary Lake	
	379	Imperial Pacific Boundary 8-3-85-14	8-3-85-14 W6M	Boundary Lake	
	363	Imperial Pacific Boundary 14-3-85-14	14-3-85-14 W6M	Boundary Lake	
	267	Imperial Pacific Boundary 16-4-85-14	16-4-85-14 W6M	Boundary Lake	
	360	Imperial Pacific Boundary 8-10-85-14	8-10-85-14 W6M	Boundary Lake	
	282	Imperial Pacific Boundary 6-11-85-14	6-11-85-14 W6M	Boundary Lake	
	769	Imp Pac Boundary 8-11-85-14	8-11-85-14 W6M	Boundary Lake	
	821	Imp Pac Boundary 14-11-85-14	14-11-85-14 W6M	Boundary Lake	

759	Imp Pac Boundary 14-12-85-14	14-12-85-14 W6M	Boundary Lake	
758	Imp Pac Boundary 6-13-85-14	6-13-85-14 W6M	Boundary Lake	
1124	Imp Pac Boundary 6-14-85-14	6-14-85-14 W6M	Boundary Lake	
848	Imp Pac Boundary 8-14-85-14	8-14-85-14 W6M	Boundary Lake	
1037	Marathon Boundary 14-12-84-14	14-12-84-14 W6M	Boundary Lake	
989	Marathon Boundary 6-13-84-14	6-13-84-14 W6M	Boundary Lake	
1068	Marathon Boundary 8-13-84-14	8-13-84-14 W6M	Boundary Lake	
1024	Mobil Boundary 6-10-84-14	6-10-84-14 W6M	Boundary Lake	
1023	Mobil Boundary 8-10-84-14	8-10-84-14 W6M	Boundary Lake	
895	Pacific Boundary 16-14-85-14	16-14-85-14 W6M	Boundary Lake	
961	Pacific Boundary 16-15-85-14	16-15-85-14 W6M	Boundary Lake	
982	Sinclair et al Boundary 6-3-84-14	6-3-84-14 W6M	Boundary Lake	
941	Sinclair Boundary 8-3-84-14	8-3-84-14 W6M	Boundary Lake	
969	Sinclair et al Boundary 14-3-84-14	14-3-84-14 W6M	Boundary Lake	
942	Sinclair Boundary 16-3-84-14	16-3-84-14 W6M	Boundary Lake	
841	Sinclair Boundary 14-11-84-14	14-11-84-14 W6M	Boundary Lake	
865	Sinclair Boundary 16-11-84-14	16-11-84-14 W6M	Boundary Lake	
803	Sinclair Boundary 6-14-84-14	6-14-84-14 W6M	Boundary Lake	
866	Sinclair Boundary 8-14-84-14	8-14-84-14 W6M	Boundary Lake	
755	Sinclair Boundary 14-15-84-14	14-15-84-14 W6M	Boundary Lake	
780	Sinclair Boundary 6-22-84-14	6-22-84-14 W6M	Boundary Lake	
742	Sinclair Boundary 8-22-84-14	8-22-84-14 W6M	Boundary Lake	
794	Sinclair Boundary 14-22-84-14	14-22-84-14 W6M	Boundary Lake	
802	Sinclair Boundary 6-27-84-14	6-27-84-14 W6M	Boundary Lake	
743	Sinclair Boundary 8-27-84-14	8-27-84-14 W6M	Boundary Lake	
853	Sinclair Boundary 14-27-84-14	14-27-84-14 W6M	Boundary Lake	
590	Amerada Cr BC-B Boundary 14-18-85-13	14-18-85-13 W6M	Boundary Lake	151
628	Amerada Boundary Lake 16-18-85-13	16-18-85-13 W6M	Boundary Lake	181
563	Amerada Cr BC-C Boundary 14-20-85-13	14-20-85-13 W6M	Boundary Lake	164
591	Amerada Cr BC-C Boundary 6-29-85-13	6-29-85-13 W6M	Boundary Lake	125
771	Amerada Boundary 14-29-85-13	14-29-85-13 W6M	Boundary Lake	146
629	Amerada Boundary Lake 14-13-85-14	14-13-85-14 W6M	Boundary Lake	125
580	Amerada Cr BC-B Boundary 16-13-85-14	16-13-85-14 W6M	Boundary Lake	137
639	Amerada Boundary Lake 6-24-85-14	6-24-85-14 W6M	Boundary Lake	105
1454	Amerada Boundary A6-24-85-14	6-24-85-14 W6M	Halfway	99
608	Amerada Cr BC-D Boundary 8-24-85-14	8-24-85-14 W6M	Boundary Lake	131
736	Amerada Boundary 16-24-85-14	16-24-85-14 W6M	Boundary Lake	186
736	Amerada Boundary 16-24-85-14	16-24-85-14 W6M	Halfway	96
918	Basin Boundary 6-17-86-13	6-17-86-13 W6M	Boundary Lake	73
962	Basin Boundary 14-17-86-13	14-17-86-13 W6M	Boundary Lake	74
624	Dome Boundary Lake 6-12-85-14	6-12-85-14 W6M	Boundary Lake	187
625	Dome Boundary Lake 8-12-85-14	8-12-85-14 W6M	Boundary Lake	194
602	Dome Boundary Lake 16-12-85-14	16-12-85-14 W6M	Boundary Lake	171
603	Dome Boundary Lake 8-13-85-14	8-13-85-14 W6M	Boundary Lake	181
1386	Imp Pac Boundary 16-20-84-13	16-20-84-13 W6M	Boundary Lake	120

[1] Pool.

TABLE 7.—AUTHORIZED MAXIMUM PERMISSIBLE RATES TO DECEMBER 31, 1964—*Continued*

Field	Drilling Authority No.	Well Name	Location	Pool	Maximum Permissible Rate (Bbl./Day)
Boundary Lake	1400	Imp Pac Boundary 8-29-84-13	8-29-84-13 W6M	Boundary Lake	98
	1425	Imp Pac Boundary 16-29-84-13	16-29-84-13 W6M	Boundary Lake	112
	1450	Imp Pac Boundary 14-7-84-14	14-7-84-14 W6M	Boundary Lake	61
	1513	Imp Pac Boundary 16-9-85-14	16-9-85-14 W6M	Boundary Lake	87
	1495	Imp Pac Boundary 9-10-85-14	9-10-85-14 W6M	Boundary Lake	69
	1368	Imp Pac Boundary 6-15-85-14	6-15-85-14 W6M	Boundary Lake	134
	618	Marathon Boundary 6-19-85-13	6-19-85-13 W6M	Boundary Lake	147
	632	Marathon Boundary 8-19-85-13	8-19-85-13 W6M	Boundary Lake	117
	635	Marathon Boundary 14-19-85-13	14-19-85-13 W6M	Boundary Lake	131
	636	Marathon Boundary 16-19-85-13	16-19-85-13 W6M	Boundary Lake	32
	898	Marathon Boundary 14-5-86-13	14-5-86-13 W6M	Boundary Lake	68
	949	Marathon Boundary 6-8-86-13	6-8-86-13 W6M	Boundary Lake	98
	604	Marathon Boundary 14-8-86-13	14-8-86-13 W6M	Boundary Lake	70
	667	Pacific Boundary Lake 11-14-85-14	11-14-85-14 W6M	Halfway	8
	895	Pacific Boundary 16-14-85-14	16-14-85-14 W6M	Halfway	102
	646	Sun Boundary Lake 6-23-85-14	6-23-85-14 W6M	Boundary Lake	181
	646	Sun Boundary Lake 6-23-85-14	6-23-85-14 W6M	Halfway	83
	643	Sun Boundary Lake 14-23-85-14	14-23-85-14 W6M	Boundary Lake	172
	719	Sun Boundary 16-23-85-14	16-23-85-14 W6M	Boundary Lake	219
	1137	Texaco NFA Boundary 6-30-85-13	6-30-85-13 W6M	Boundary Lake	166
	1097	Texaco NFA Boundary 8-30-85-13	8-30-85-13 W6M	Boundary Lake	139
	1097	Texaco NFA Boundary 8-30-85-13	8-30-85-13 W6M	Halfway	56
	1171	Texaco NFA Boundary 14-30-85-13	14-30-85-13 W6M	Boundary Lake	163
	1481	Texaco NFA Boundary 16-30-85-13	16-30-85-13 W6M	Boundary Lake	153
	183	Texaco NFA Boundary L 6-31-85-13	6-31-85-13 W6M	Boundary Lake	107
	1150	Texaco NFA Boundary 8-31-85-13	8-31-85-13 W6M	Boundary Lake	131
	167	Texaco NFA Boundary L 14-31-85-13	14-31-85-13 W6M	Boundary Lake	100
	218	Texaco NFA Boundary L 16-31-85-13	16-31-85-13 W6M	Boundary Lake	136
	101	Texaco NFA Boundary L 6-6-86-13 (1)	6-6-86-13 W6M	Boundary Lake	114
	972	Texaco NFA Boundary 8-6-86-13	8-6-86-13 W6M	Boundary Lake	92
	152	Texaco NFA Boundary L 14-6-86-13	14-6-86-13 W6M	Boundary Lake	87
	1009	Texaco NFA Boundary 16-6-86-13	16-6-86-13 W6M	Boundary Lake	156
	862	Texaco NFA Boundary 6-7-86-13	6-7-86-13 W6M	Boundary Lake	92
	953	Texaco NFA Boundary 8-7-86-13	8-7-86-13 W6M	Boundary Lake	99
	1100	Texaco NFA Boundary 14-7-86-13	14-7-86-13 W6M	Boundary Lake	130
	844	Texaco NFA Boundary 16-7-86-13	16-7-86-13 W6M	Boundary Lake	193
	811	Texaco NFA Boundary 6-18-86-13	6-18-86-13 W6M	Boundary Lake	200
	995	Texaco NFA Boundary 8-18-86-13	8-18-86-13 W6M	Boundary Lake	147
	1116	Texaco NFA Boundary 14-18-86-13	14-18-86-13 W6M	Boundary Lake	181

	1066	Texaco NFA Boundary 16-18-86-13	16-18-86-13 W6M	Boundary Lake	68
	1074	Texaco NFA Boundary 6-19-86-13	6-19-86-13 W6M	Boundary Lake	126
	1049	Texaco NFA Boundary 8-19-86-13	8-19-86-13 W6M	Boundary Lake	120
	1123	Texaco NFA Boundary 14-19-86-13	14-19-86-13 W6M	Boundary Lake	69
	901	Texaco NFA Boundary 16-19-86-13	16-19-86-13 W6M	Boundary Lake	127
	1050	Texaco NFA Boundary 6-30-86-13	6-30-86-13 W6M	Boundary Lake	85
	1167	Texaco NFA Boundary 8-30-86-13	8-30-86-13 W6M	Boundary Lake	201
	1482	Texaco NFA Boundary 16-30-86-13	16-30-86-13 W6M	Boundary Lake	20
	823	Texaco NFA Boundary 16-22-85-14	16-22-85-14 W6M	Boundary Lake	137
	1539	Texaco NFA Boundary 8-25-85-14	8-25-85-14 W6M	Boundary Lake	180
	656	Texaco NFA Boundary Lake 14-25-85-14	14-25-85-14 W6M	Boundary Lake	78
	1144	Texaco NFA Boundary 16-25-85-14	16-25-85-14 W6M	Boundary Lake	131
	1144	Texaco NFA Boundary 16-25-85-14	16-25-85-14 W6M	Halfway	22
	924	Texaco NFA Boundary 6-27-85-14	6-27-85-14 W6M	Boundary Lake	119
	845	Texaco NFA Boundary 8-27-86-14	8-27-85-14 W6M	Boundary Lake	157
	971	Texaco NFA Boundary 14-27-85-14	14-27-85-14 W6M	Boundary Lake	158
	812	Texaco NFA Boundary 16-27-85-14	16-27-85-14 W6M	Boundary Lake	152
	857	Texaco NFA Boundary 8-34-85-14	8-34-85-14 W6M	Boundary Lake	209
	662	Texaco NFA Boundary Lake 6-36-85-14	6-36-85-14 W6M	Boundary Lake	30
	1058	Texaco NFA Boundary 8-36-85-14	8-36-85-14 W6M	Boundary Lake	70
	657	Texaco NFA Boundary Lake 14-36-85-14	14-36-85-14 W6M	Boundary Lake	156
	206	Texaco NFA Boundary L 16-36-85-14	16-36-85-14 W6M	Boundary Lake	127
	663	Texaco NFA Boundary Lake 6-1-86-14	6-1-86-14 W6M	Boundary Lake	112
	1083	Texaco NFA Boundary 8-1-86-14	8-1-86-14 W6M	Boundary Lake	196
	664	Texaco NFA Boundary Lake 14-1-86-14	14-1-86-14 W6M	Boundary Lake	110
	860	Texaco NFA Boundary 16-1-86-14	16-1-86-14 W6M	Boundary Lake	112
	829	Texaco NFA Boundary 6-12-86-14	6-12-86-14 W6M	Boundary Lake	96
	1096	Texaco NFA Boundary 8-12-86-14	8-12-86-14 W6M	Boundary Lake	109
	900	Texaco NFA Boundary 14-12-86-14	14-12-86-14 W6M	Boundary Lake	117
	593	Texaco NFA Boundary L 16-12-86-14	16-12-86-14 W6M	Boundary Lake	155
	880	Texaco NFA Boundary 6-13-86-14	6-13-86-14 W6M	Boundary Lake	115
	1101	Texaco NFA Boundary 8-13-86-14	8-13-86-14 W6M	Boundary Lake	84
	952	Texaco NFA Boundary 14-13-86-14	14-13-86-14 W6M	Boundary Lake	46
	858	Texaco NFA Boundary 16-13-86-14	16-13-86-14 W6M	Boundary Lake	89
	885	Texaco NFA Boundary 6-24-86-14	6-24-86-14 W6M	Boundary Lake	91
	1086	Texaco NFA Boundary 8-24-86-14	8-24-86-14 W6M	Boundary Lake	93
	633	Texaco NFA Boundary Lake 14-24-86-14	14-24-86-14 W6M	Boundary Lake	107
	1029	Texaco NFA Boundary 16-24-86-14	16-24-86-14 W6M	Boundary Lake	74
Bulrush	1267	Union HB Sinclair Bulrush d-78-F	d-78-F/94-A-16	Halfway	23
	1394	Union HB Sinc Pac Bulrush d-89-F	d-89-F/94-A-16	Halfway	26
Charlie Lake	269	Imp Pac Charlie 13-5-84-18	13-5-84-18 W6M	Gething	36
Fort St. John	34	Pacific Ft St John 3-14-83-18 (9)	3-14-83-18 W6M	Charlie Lake	46
	214	Pacific Ft St John 10-14-83-18 (76)	10-14-83-18 W6M	Charlie Lake	14
	171	Imp Pac Ft St John 9-19-83-18 (45)	9-19-83-18 W6M	Belloy	85
	225	Pacific Ft St John 1-23-83-18 (81)	1-23-83-18 W6M	Charlie Lake	23
	216	Pacific Ft St John 9-23-83-18 (78)	9-23-83-18 W6M	Charlie Lake	65

[1] Pool.

TABLE 7.—AUTHORIZED MAXIMUM PERMISSIBLE RATES TO DECEMBER 31, 1964—*Continued*

Field	Drilling Authority No.	Well Name	Location	Pool	Maximum Permissible Rate (Bbl./Day)
Milligan Creek	973	Union HB Milligan b-42-G	b-42-G/94-H-2	Halfway	
	409	Union HB Milligan Creek d-42-G	d-42-G/94-H-2	Halfway	
	435	Union HB Milligan Creek d-43 G	d-32-G/94-H-2	Halfway	
	909	Union HB Milligan b-52-G	b-52-G/94-H-2	Halfway	
	401	Union HB Milligan Creek d-52-G	d-52-G/94-H-2	Halfway	
	899	Union HB Milligan b-53-G	b-53-G/94-H-2	Halfway	
	398	Union HB Milligan Creek d-53-G	d-53-G/94-H-2	Halfway	
	402	Union HB Milligan Creek d-54-G	d-54-G/94-H-2	Halfway	
	826	Union HB Milligan b-62-G	b-62-G/94-H-2	Halfway	
	1001	Union HB Milligan d-62-G	d-62-G/94-H-2	Halfway	
	440	Union HB Milligan Creek d-63-G	d-63-G/94-H-2	Halfway	10,000[1]
	341	Union HB Milligan Creek d-64-G	d-64-G/94-H-2	Halfway	
	1182	Union HB Milligan c-72-G	c-72-G/94-H-2	Halfway	
	911	Union HB Milligan b-73-G	b-73-G/94-H-2	Halfway	
	248	Union HB Milligan Creek d-73-G	d-73-G/94-H-2	Halfway	
	436	Union HB Milligan Creek d-74-G	d-74-G/94-H-2	Halfway	
	1011	Union HB Milligan b-82-G	b-82-G/94-H-2	Halfway	
	875	Union HB Milligan b-83-G	b-83-G/94-H-2	Halfway	
	1014	Union HB Milligan d-84-G	d-84-G/94-H-2	Halfway	
	985	Union HB Milligan b-93-G	b-93-G/94-H-2	Halfway	
	1170	Union HB Milligan d-94-G	d-94-G/94-H-2	Halfway	
	1493	Union HB Milligan b-65-G	b-65-G/94-H-2	Halfway	157
Peejay	1025	Medallion Ashland Peejay d-61-H	d-61-H/94-A-15	Halfway	
	990	Pacific SR CanDel Peejay d-81-H	d-81-H/94-A-15	Halfway	
	981	Medallion AORCO Blair Peejay d-60-E	d-60-E/94-A-16	Halfway	
	1026	Medallion Ashland Peejay d-68-E	d-68-E/94-A-16	Halfway	
	902	Medallion Ashland Peejay d-69-E	d-69-E/94-A-16	Halfway	
	903	Medallion Ashland Peejay d-70-E	d-70-E/94-A-16	Halfway	
	1329	Pacific SR CanDel Peejay d-79-E	d-79-E/94-A-16	Halfway	
	569	Pacific SR West Cdn Peejay d-80-E	d-80-E/94-A-16	Halfway	
	954	Pacific SR West Cdn Peejay d-90-E	d-90-E/94-A-16	Halfway	
	612	Sinclair et al Peejay d-18-E	d-18-E/94-A-16	Halfway	4,430[1]
	589	Sinclair et al Peejay d-28-E	d-28-E/94-A-16	Halfway	
	543	Sinclair et al Peejay d-29-E	d-29-E/94-A-16	Halfway	
	578	Sinclair et al Peejay d-38-E	d-38-E/94-A-16	Halfway	
	418	Sinclair Pac Peejay d-39-E (B8-3)	b-39-E/94-A-16	Halfway	
	915	Sinclair et al Peejay d-47-E	d-47-E/94-A-16	Halfway	
	577	Sinclair et al Peejay d-48-E	d-48-E/94-A-16	Halfway	
	588	Sinclair et al Peejay d-49-E	d-49-E/94-A-16	Halfway	
	914	Sinclair et al Peejay d-58-E	d-58-E/94-A-16	Halfway	
	881	Sinclair et al Peejay d-59-E	d-59-E/94-A-16	Halfway	
	1030	Pacific SR CanDel Peejay d-100-E	d-100-E/94-A-16	Halfway	

	725	Pacific SR West Cdn Peejay d-33-I	d-33-I/94-A-15	Halfway	5
Peejay West	1008	Pacific SR CanDel W Peejay d-44-G	d-44-G/94-A-15	Halfway	192
	956	Pacific SR West Cdn W Peejay d-54-G	d-54-G/94-A-15	Halfway	149
Wildmint	919	Union HB Wildmint d-25-A	d-25-A/94-H-2	Halfway	
	810	Union HB Wildmint d-45-A	d-45-A/94-H-2	Halfway	
	1387	Union HB Wildmint b-46-A	b-46-A/94-H-2	Halfway	1,191[1]
	530	Union HB Wildmint d-46-A	d-46-A/94-H-2	Halfway	
	945	Union HB Wildmint b-56-A	b-56-A/94-H-2	Halfway	
	584	Union HB Wildmint d-56-A	d-56-A/94-H-2	Halfway	
	840	Union HB Wildmint b-24-A	b-24-A/94-H-2	Halfway	27[2]
	1195	Union HB Wildmint b-34-A	b-34-A/94-H-2	Halfway	166[2]
	1191	Tenn Wildmint d-95-I	d-95-I/94-A-15	Halfway	47
	1121	Tenn Wildmint d-5-A	d-5-A/94-H-2	Halfway	70
	1289	Texcan Wildmint d-94-I	d-94-I/94-A-15	Halfway	167
	984	Union HB Wildmint d-15-A	d-15-A/94-H-2	Halfway	102
	1226	Union HB Wildmint d-24-A	d-24-A/94-H-2	Halfway	185
	963	Union HB Wildmint d-26-A	d-26-A/94-H-2	Halfway	51
Willow	449	Union HB Willow d-20-H	d-20-H/94-H-2	Bluesky-Gething	122
Other areas	1487	Baysel SR Nancy d-96-H	d-96-H/94-A-15	([3])	([3])
	1515	CanDel SR Nancy d-44-H	d-44-H/94-A-15	([3])	([3])
	1516	CanDel SR Nancy d-45-H	d-45-H/94-A-15	([3])	([3])
	1498	CanDel SR Nancy d-53-H	d-53-H/94-A-15	([3])	([3])
	1503	CanDel SR Nancy d-54-H	d-54-H/94-A-15	([3])	([3])
	1507	CanDel SR Nancy d-55-H	d-55-H/94-A-15	([3])	([3])
	1521	CanDel SR Nancy d-63-H	d-63-H/94-A-15	([3])	([3])
	1483	CanDel SR Nancy d-64-H	d-64-H/94-A-15	([3])	([3])
	1476	CanDel SR Nancy d-65-H	d-65-H/94-A-15	([3])	([3])
	1525	Pacific Sinclair Nancy d-33-H	d-33-H/94-A-15	([3])	([3])
	1514	Pacific Sinclair Nancy d-42-H	d-42-H/94-A-15	([3])	([3])
	1497	Pacific Sinclair Nancy d-43-H	d-43-H/94-A-15	([3])	([3])
	1512	Pacific SR CanDel Nancy d-66-H	d-66-H/94-A-15	([3])	([3])
	1522	Pacific SR CanDel Nancy d-A74-H	d-74-H/94-A-15	([3])	([3])
	1467	Pacific SR CanDel Nancy d-75-H	d-75-H/94-A-15	([3])	([3])
	1407	Pacific SR CanDel Nancy d-85-H	d-85-H/94-A-15	([3])	([3])
	1474	Pacific SR CanDel Nancy d-95-H	d-95-H/94-A-15	([3])	([3])
	831	Sinclair et al Flatrock 9-22-83-14	9-22-83-14 W6M	Boundary Lake	31
	1478	Tenn Nancy d-76-H	d-76-H/94-A-15	([3])	([3])
	1491	Tenn Nancy d-77-H	d-77-H/94-A-15	([3])	([3])
	1505	Tenn Nancy d-78-H	d-78-H/94-A-15	([3])	([3])
	1461	Tenn Nancy d-86-H	d-86-H/94-A-15	([3])	([3])
	1490	Tenn Nancy d-87-H	d-87-H/94-A-15	([3])	([3])
	1519	Uno-Tex et al Stoddart 10-31-85-19	10-31-85-19 W6M	([3])	([3])

[1] Pool.
[2] Included in pool M.P.R. but not to exceed individual M.P.R.
[3] Confidential at December 31, 1964.

TABLE 8.—AUTHORIZED ABSOLUTE OPEN-FLOW POTENTIAL TESTS AND PRODUCTION RATE LIMITS TO DECEMBER 31, 1964

Field	Drilling Authority No.	Well Name	Pool	Date of Test	A.O.F.P.	P.R.L.
Aitken Creek	400	Union Aitken a-53-L (3)	Gething	31-10-63	19,500	(1)
	1310	Union Aitken Creek d-45-L	Gething	24-10-64	56,000	(1)
	1338	Union Aitken d-25-L	Gething	19-10-64	34,250	(1)
Beg	539	Pacific et al Beg b-17-K	Baldonnel	8-7-64	5,700	2,000
	541	Pacific et al Beg d-10-G	Baldonnel	8-7-64	4,160	2,000
	711	Pacific et al Beg a-21-F	Baldonnel	21-8-63	390	2,000
	733	Pacific et al Beg d-64-F	Baldonnel	10-7-64	2,250	2,000
	740	Pacific et al Beg b-6-K	Baldonnel	6-7-64	1,050	2,000
	741	Pacific et al Beg b-84-F	Baldonnel	7-7-64	6,000	2,000
	747	Pacific et al Beg b-95-F	Baldonnel	9-7-64	3,670	2,000
	748	Pacific et al Beg b-42-F	Baldonnel	13-7-64	2,330	2,000
	749	Pacific et al Beg a-28-K	Baldonnel	6-7-64	4,120	2,000
	766	Pacific Pan Am Dome Beg a-4-D	Baldonnel	18-8-64	28,000	7,595
	806	Pacific Imperial Beg d-46-B	Baldonnel	17-6-64	18,200	4,755
	855	Pacific Pan Am Dome Beg d-15-D	Baldonnel	12-6-63	3,600	2,000
	1095	Pacific Imperial Beg d-57-B	Baldonnel	17-7-64	2,280	2,000
	1132	Pacific et al Beg b-82-L	Baldonnel	18-8-64	2,150	2,000
	1154	Pacific Imperial Beg d-35-B	Baldonnel	17-6-64	2,750	2,000
	1359	Pacific Imperial Beg c-24-B	Baldonnel	30-9-64	1,020	2,000
	541	Pacific et al Beg d-10-G	Halfway	9-7-64	9,400	2,392
	711	Pacific et al Beg a-21-F	Halfway	10-9-64	1,880	2,000
	733	Pacific et al Beg d-64-F	Halfway	9-7-64	4,000	2,000
	739	Pacific et al Beg b-A99-B	Halfway	26-8-64	3,550	2,000
	740	Pacific et al Beg b-6-K	Halfway	7-7-64	3,860	2,000
	741	Pacific et al Beg b-84-F	Halfway	7-7-64	2,770	2,000
	747	Pacific et al Beg b-95-F	Halfway	8-7-64	2,140	2,000
	748	Pacific et al Beg b-42-F	Halfway	29-8-61	2,100	2,000
	786	Pacific et al Beg b-59-K	Halfway	23-1-62		2,000[2]
	806	Pacific Imperial Beg d-46-B	Halfway	18-6-64	4,100	2,000
	1095	Pacific Imperial Beg d-57-B	Halfway	16-6-64	22,800	6,088
	1154	Pacific Imperial Beg d-35-B	Halfway	16-6-64	8,000	2,226
	1350	Pacific et al Beg b-88-B	Halfway	8-7-64	6,300	2,000
	1359	Pacific Imperial Beg c-24-B	Halfway	28-9-64	7,400	2,000
	1233	Richfield Sohio Beg d-77-B	Halfway	27-11-63	2,030	2,000
	1268	Richfield Sohio Beg d-13-B	Halfway	4-11-64	11,700	3,314
Beg West	620	Pacific et al W Beg a-79-F	Baldonnel	7-7-64	1,800	2,000
	622	Pacific et al W Beg c-84-C	Baldonnel	7-8-63	1,060	2,000
Bernadet	1106	West Nat et al Bernadet 8-1-88-25	Bluesky-Gething	30-6-64	3,840	2,000
Blueberry	70	West Nat et al Blueberry c-32-D	Dunlevy	22-12-58	285	2,000
	94	West Nat et al Blueberry d-A87-D	Dunlevy	3-9-64	1,780	2,000

	279	West Nat et al Blueberry 16-24-88-25	Dunlevy	2-9-64	3,080	2,000
	330	West Nat et al Blueberry a-29-K	Dunlevy	2-7-63	500	2,000
	357	West Nat et al Blueberry d-A50-K	Dunlevy	27-8-63	640	2,000
	581	West Nat et al Blueberry d-97-D	Dunlevy	4-9-64	6,700	2,000
	64	West Nat et al Blueberry d-87-D	Baldonnel	3-9-64	900	2,000
	71	West Nat et al Blueberry c-65-D	Baldonnel	5-6-63	1,850	2,000
	357	West Nat et al Blueberry d-A50-K	Baldonnel	1-11-62	183	2,000
	581	West Nat et al Blueberry d-97-D	Baldonnel	12-9-60	5,600	2,000
Blueberry East	103	West Nat et al E Blueberry b-38-C	Baldonnel	16-7-64	2,500	2,000
	331	West Nat et al E Blueberry b-36-C	Mississippian	28-10-58	3,256	2,000
Blueberry West	165	West Nat et al W Blueberry d-82-I	Dunlevy	26-6-64	3,300	2,000
	278	West Nat et al W Blueberry 2-20-88-25	Dunlevy	16-12-64	560	2,000
	241	West Nat et al W Blueberry d-19-L	Baldonnel	18-9-62	1,425	2,000
Boundary Lake	270	Pacific Boundary 8-15-85-14	Bluesky-Gething	27-9-62	830	2,000
	352	Pacific Boundary 12-10-85-14	Gething	12-8-64	13,000	4,121
	655	Pacific Boundary Lake A16-4-85-14	Gething	12-6-61	4,700	2,000
	799	Amerada Boundary 8-5-85-14	Dunlevy	27-10-61	11,200	2,800
	270	Pacific Boundary 8-15-85-14	Baldonnel	12-8-64	7,000	2,000
	667	Pacific Boundary Lake 11-14-85-14	Baldonnel	29-5-63	1,650	2,000
	687	Texaco NFA Boundary Lake 6-25-85-14	Baldonnel	2-6-64	6,500	2,000
	1137	Texaco NFA Boundary 6-30-85-13	Baldonnel	2-6-64	3,300	2,000
	1501	Huber et al Boundary 6-4-87-13	Halfway	12-11-64	360	2,000
Bubbles	464	Dome Basco Bubbles b-19-A	Baldonnel	15-8-64	5,020	2,000
	526	Dome Provo Bubbles c-20-A	Baldonnel	15-8-64	1,560	2,000
	674	McCoy Dome Bubbles b-A62-B	Baldonnel	13-7-64	5,130	2,000
	791	McCoy Dome Bubbles d-42-B	Baldonnel	12-7-64	4,500	2,000
	451	Pacific Imperial Bubbles b-33-I	Baldonnel	19-5-64	15,000	4,358
	462	Pacific Imperial Bubbles d-88-I	Baldonnel	22-5-64	43,000	13,524
	466	Pacific Imperial Bubbles b-44-I	Baldonnel	19-5-64	17,700	5,571
	478	Pacific Imperial Bubbles d-77-I	Baldonnel	20-5-64	4,600	2,000
	480	Pacific Imperial Bubbles b-66-I	Baldonnel	19-5-64	6,400	2,000
	615	Pacific Dome et al Bubbles d-99-I	Baldonnel	21-5-64	5,100	2,000
Buick Creek	1360	Altair W Mineral Buick c-32-C	Dunlevy	9-8-63	24,300	6,075
	457	Pacific Buick Creek b-4-B	Dunlevy	30-4-64	2,450	2,000
	469	Pacific Buick Creek c-14-B	Dunlevy	29-4-64	2,650	2,000
	1323	Pacific Buick a-85-I	Dunlevy	14-8-64	11,600	3,000
	744	Sun Buick c-16-B	Dunlevy	8-10-62	1,970	2,000
	756	Sun Buick d-19-B	Dunlevy	12-9-64	3,500	2,000
	818	Sun Buick d-11-C	Dunlevy	10-9-64	13,250	4,150
	45	Texaco NFA Buick Creek d-98-I (1)	Dunlevy	7-5-64	9,000	2,768
	65	Texaco NFA Buick Creek c-10-A (2)	Dunlevy	6-12-63	466	2,000
	96	Texaco NFA Buick Creek d-83-J (4)	Dunlevy	13-9-64	16,000	6,584
	110	Texaco NFA Buick Creek c-78-J (6)	Dunlevy	29-10-64	3,500	2,000
	728	Texaco NFA Buick d-93-J	Dunlevy	28-8-63	25,800	7,679
	787	Texaco NFA Buick d-96-I	Dunlevy	25-6-64	18,750	4,866

[1] P.R.L. not authorized.
[2] Interim.

TABLE 8.—AUTHORIZED ABSOLUTE OPEN-FLOW POTENTIAL TESTS AND PRODUCTION RATE LIMITS TO DECEMBER 31, 1964—*Cont'd*

Field	Drilling Authority No.	Well Name	Pool	Date of Test	A.O.F.P.	P.R.L.
Buick Creek	1179	Texaco NFA Buick b-10-B	Dunlevy	28-10-64	3,700	2,000
	1213	Texaco NFA Buick c-40-B	Dunlevy	17-9-64	2,830	2,000
	96	Texaco NFA Buick Creek d-83-J (4)	Charlie Lake	15-9-64	2,300	2,000
Buick Creek East	1087	Texaco NFA E Buick c-80-D	Bluesky-Gething	3-10-64	1,000	2,000
	1286	Mic Mac et al E Buick d-17-D	Dunlevy	7-6-63	5,400	2,000
	295	Texaco NFA E Buick a-31-A	Dunlevy	12-9-63	19,825	4,956
	1087	Texaco NFA E Buick c-80-D	Dunlevy	3-10-64	6,800	2,000
	1088	Texaco NFA E Buick c-98-L	Dunlevy	7-12-63	2,330	2,000
	1185	Texaco NFA E Buick c-18-D	Dunlevy	10-8-64	6,400	2,000
	1303	Whitehall E Buick b-61-A	Dunlevy	8-9-64	4,250	2,000
	1336	Whitehall E Buick c-34-A	Dunlevy	11-9-64	4,800	2,000
Buick Creek West	89	Pacific West Buick Creek b-78-C (2)	Dunlevy	12-5-64	4,120	2,000
	95	Pacific West Buick Creek c-14-C (3)	Dunlevy	19-7-62	5,100	2,956
	99	Pacific West Buick Creek d-95-K (4)	Dunlevy	21-5-64	6,000	2,625
	239	Pacific West Buick Creek c-2-E (6)	Dunlevy	21-5-64	7,400	2,422
	255	Pacific West Buick Creek b-91-D (9)	Dunlevy	5-9-64	3,880	2,000
	264	Pacific West Buick Creek c-5-C (11)	Dunlevy	20-5-64	2,870	2,000
	268	Pacific West Buick Creek d-89-C (12)	Dunlevy	9-5-64	2,250	2,000
	384	Pacific West Buick Creek d-17-C (17)	Dunlevy	13-8-64	20,000	7,115
	644	Pacific West Buick Creek a-78-C	Baldonnel	10-5-64	2,160	2,000
	86	Pacific West Buick Creek b-23-E (1)	Halfway	19-7-62	2,450	2,000
Clarke Lake	344	West Nat Imp Clarke Lake d-88-L	Slave Point	18-1-63	112,000	28,000
	397	West Nat Imp Clarke Lake c-94-L	Slave Point	14-1-63	35,600	8,900
	503	West Nat Imp Clarke Lake c-8-D	Slave Point	24-1-63	73,200	18,300
	505	West Nat et al Clarke c-78-I	Slave Point	16-2-60	135,000	33,750
	585	West Nat Imp Clarke Lake d-91-L	Slave Point	11-1-63	12,000	3,000
	688	West Nat et al Clarke b-70-I	Slave Point	23-1-63	48,500	12,125
	856	West Nat et al Clarke a-52-J	Slave Point	14-3-62	21,000	5,250
Dawson Creek	293	Pacific Sc Dawson Ck 1-15-79-15 (1)	Cadotte	5-11-58	2,288	2,000
	302	Pacific Sc Dawson Ck 3-22-79-15 (2)	Cadotte	23-7-64	1,440	2,000
	319	Pacific Sc Dawson Ck 13-14-79-15 (4)	Cadotte	2-10-62	3,050	2,000
Fort St. John	75	Pacific Ft St John A3-29-83-18 (31)	Cadomin	19-7-53	29,000	7,250
	67	Pacific Ft St John 4-32-83-18 (26)	Baldonnel A	6-5-64	860	2,000
	82	Pacific Ft St John 13-23-83-18 (34)	Baldonnel A	5-5-64	5,800	2,000
	194	Pacific Ft St John 13-14-83-18 (54)	Baldonnel A	6-5-64	2,900	2,000
	210	Pacific Ft St John 6-17-83-18 (72)	Baldonnel A	22-9-64	7,600	2,907
	233	Pacific Ft St John 16-8-83-18 (83)	Baldonnel A	22-9-64	4,150	2,000
	32	Pacific Ft St John 14-15-83-18 (7)	Baldonnel A/B	7-10-63	5,900	2,000
	76	Pacific Ft St John 14-22-83-18 (32)	Baldonnel A/B	5-5-64	5,700	2,080
	170	Pacific Ft St John 8-20-83-18 (43)	Baldonnel A/B	6-5-64	5,850	2,311
	186	Pacific Ft St John C3-29-83-18 (56)	Baldonnel A/B	7-5-64	3,000	2,000

	193	Pacific Ft St John B14-21-83-18 (62)	Baldonnel A/B	5-5-64	4,350	2,000
	212	Pacific Ft St John A6-16-83-18 (73)	Baldonnel A/B	5-5-64	4,900	2,000
	74	Pacific Ft St John 1-20-83-18 (30)	Halfway	6-5-64	4,290	2,022
	172	Pacific Ft St John 2-21-83-18 (46)	Halfway	6-5-64	6,150	2,778
	178	Pacific Ft St John A14-21-83-18 (51)	Halfway	5-5-64	5,300	2,918
	179	Pacific Ft St John B3-29-83-18 (52)	Halfway	2-12-64	4,300	2,029
	181	Pacific Ft St John 10-30-83-18 (53)	Halfway	16-12-64	2,100	2,000
	192	Pacific Ft St John A14-22-83-18 (61)	Halfway	29-7-60	2,650	2,000
	29	Pacific Ft St John 14-21-83-18 (4)	Belloy	5-5-64	695	2,000
	58	Pacific Ft St John 3-29-83-18 (23)	Belloy	7-5-64	870	2,000
Fort St. John Airport	27	Pacific Airport 8-32-83-17 (3)	Cadomin	8-9-53	1,150	2,000
	35	Pacific Airport 12-34-83-17 (10)	Halfway	27-7-57	1,400	2,000
Fort St. John Southeast	220	Pac Ft St John SE 10-31-82-17 (80)	Cadomin	12-5-64	2,950	2,000
	184	Pac Ft St John SE A4-10-83-17 (55)	Baldonnel A	11-5-64	3,125	2,000
	213	Pac Ft St John SE 13-2-83-17 (74)	Baldonnel A	11-5-64	5,100	2,000
	60	Pac Ft St John SE 10-33-82-17 (22)	Halfway	25-10-56	9,000	2,250
	174	Pacific Ft St John SE 7-3-83-17 (49)	Halfway	5-8-58	3,814	2,000
	191	Pac Ft St John SE A10-4-83-17 (60)	Halfway	15-5-64	2,375	2,000
	197	Pac Ft St John SE 16-3-83-17 (66)	Halfway	15-5-64	8,600	4,053
	202	Pac Ft St John SE 7-5-83-17 (69)	Halfway	18-6-57	2,050	2,000
	320	Pac Ft St John SE A10-10-83-17 (98)	Halfway	11-5-64	2,675	2,000
	42	Pac Ft St John SE 4-10-83-17 (12)	Belloy	21-7-61	5,700	2,000
	52	Pacific Ft St John SE 8-5-83-17 (20)	Belloy	1-10-53	4,980	2,000
	166	Pacific Ft St John SE 4-9-83-17 (44)	Belloy	5-5-64	13,000	6,240
	173	Pac Ft St John SE 10-4-83-17 (47)	Belloy	11-5-64	15,600	5,815
	201	Pac Ft St John SE 11-32-82-17 (68)	Belloy	12-5-64	5,500	2,514
	219	Pac Ft St John SE 10-10-83-17 (79)	Belloy	11-5-64	7,500	2,623
Gundy Creek	367	West Nat Gundy Creek d-2-G	Baldonnel	22-8-62	2,250	2,000
	253	West Nat Gundy Creek b-69-A	Baldonnel/Charlie Lake	15-4-59	5,000	2,000
Halfway	107	West Nat et al Halfway 5-1-87-25	Baldonnel	26-6-64	3,400	2,000
	351	West Nat et al Halfway 11-35-86-26	Baldonnel	29-10-58	8,200	2,086
	182	West Nat et al Halfway 8-11-87-25	Halfway	20-8-63	720	2,000
Highway	168	West Nat et al Highway b-3-I	Dunlevy	17-7-64	920	2,000
	112	Pacific Highway b-25-I (1)	Baldonnel	27-8-58	6,600	2,000
	180	Pacific Highway a-47-I (2)	Baldonnel	26-11-57	3,600	2,000
	229	Pacific Highway a-90-I (4)	Baldonnel	23-11-64	920	2,000
	274	Pacific Highway a-69-I (3)	Baldonnel	28-11-57	3,150	2,000
	229	Pacific Highway a-90-I (4)	Mississippian	13-7-64	2,820	2,000
Jedney	1366	Pacific Imperial Jedney a-95-C	Gething	17-10-63	13,600	3,400
	382	Pacific Imp Jedney d-99-J	Baldonnel	10-6-64	3,000	2,000
	427	Pacific et al Jedney b-88-J	Baldonnel	26-5-64	23,900	7,176
	460	Pacific Imperial Jedney b-30-B	Baldonnel	27-5-64	4,760	2,000
	473	Pacific Imperial Jedney b-10-B	Baldonnel	27-5-64	27,500	7,769
	475	Pacific Imperial Jedney b-66-J	Baldonnel	25-5-64	14,700	4,200
	484	Pacific Imperial Jedney d-77-J	Baldonnel	25-5-64	3,080	2,000
	498	Pacific et al Jedney b-68-J	Baldonnel	14-7-64	1,500	2,000
	651	Pacific et al Jedney d-97-C	Baldonnel	19-6-64	16,600	4,275

TABLE 8.—AUTHORIZED ABSOLUTE OPEN-FLOW POTENTIAL TESTS AND PRODUCTION RATE LIMITS TO DECEMBER 31, 1964—*Cont'd*

Field	Drilling Authority No.	Well Name	Pool	Date of Test	A.O.F.P.	P.R.L.
Jedney	778	Pacific et al Jedney c-86-C	Baldonnel	12-6-64	3,500	2,000
	820	Pacific Imperial Jedney d-53-C	Baldonnel	5-6-64	2,700	2,000
	868	Pacific Imperial Jedney b-73-C	Baldonnel	10-6-64	3,200	2,000
	944	Pacific Pan Am Dome Jedney b-28-F	Baldonnel	12-6-64	2,080	2,000
	1054	Pacific Imperial Jedney b-99-H	Baldonnel	10-6-64	3,100	2,000
	1082	Pacific Imperial Jedney c-100-H	Baldonnel	10-6-64	4,200	2,000
	1129	Pacific Imperial Jedney c-78-H	Baldonnel	24-6-63	1,450	2,000
	1178	Pacific Imperial Jedney d-31-C	Baldonnel	27-5-64	3,300	2,000
	1375	Pacific Imperial Jedney d-44-C	Baldonnel	26-8-64	5,600	2,000
	1334	Skelly Jedney a-39-F	Baldonnel	16-9-63		2,000[2]
	382	Pacific Imp Jedney d-99-J	Halfway	27-5-64	6,700	2,000
	453	Pacific Imperial Jedney d-42-C	Halfway	28-5-64	10,100	2,879
	461	Pacific Imperial Jedney a-65-J	Halfway	5-6-64	6,550	2,000
	475	Pacific Imperial Jedney b-66-J	Halfway	26-5-64	6.250	2,000
	484	Pacific Imperial Jedney d-77-J	Halfway	25-5-64	20,500	6,586
	651	Pacific et al Jedney d-97-C	Halfway	11-6-64	4,000	2,000
	691	Pacific Imperial Jedney b-84-C	Halfway	10-6-64	3,500	2,000
	778	Pacific et al Jedney c-86-C	Halfway	11-6-64	3,000	2,000
	779	Pacific et al Jedney a-17-F	Halfway	14-7-64	4,160	2,000
	820	Pacific Imperial Jedney d-53-C	Halfway	4-6-64	13,200	4,175
	868	Pacific Imperial Jedney b-73-C	Halfway	10-6-64	2,930	2,000
	944	Pacific Pan Am Dome Jedney b-28-F	Halfway	12-6-64	4,400	2,000
	1054	Pacific Imperial Jedney b-99-H	Halfway	8-6-64	11,900	3,255
	1082	Pacific Imperial Jedney c-100-H	Halfway	8-6-64	7,100	2,000
	1129	Pacific Imperial Jedney c-78-H	Halfway	9-6-64	16,600	4,582
	1152	Pacific Pan Am Dome Jedney c-8-F	Halfway	5-12-62	1,550	2,000
	1178	Pacific Imperial Jedney d-31-C	Halfway	4-6-64	11,900	3,207
	1183	Pacific Imperial Jedney c-57-H	Halfway	13-11-64	3,350	2,000
	1256	Pacific Imperial Jedney d-68-H	Halfway	9-6-64	10,700	3,092
	1366	Pacific Imperial Jedney a-95-C	Halfway	11-6-64	2,600	2,000
	1334	Skelly Jedney a-39-F	Halfway	18-9-63	——	2,000[2]
Jedney West	1081	Pacific et al W Jedney b-84-K	Baldonnel	11-6-63	750	2,000
	1081	Pacific et al W Jedney b-84-K	Halfway	7-6-63	1,500	2,000
	1276	Pacific et al W Jedney b-6-C	Halfway	16-8-63	2,300	2,000
Kobes-Townsend	372	Pacific Kobes a-3-A (4)	Dunlevy	22-6-64	3,340	2,000
	489	Pacific Kobes b-24-A	Dunlevy	23-3-64	1,090	2,000
	496	Pacific Kobes b-82-I	Dunlevy	24-6-64	950	2,000
	141	Pacific Kobes d-94-I (1)	Charlie Lake	22-6-64	3,600	2,000
	177	Pacific Kobes b-35-A (1-A)	Charlie Lake	22-6-64	1,800	2,000
	251	Pacific Townsend d-21-G (A-2)	Charlie Lake	22-6-64	1,420	2,000
	299	Pacific Kobes c-73-I (2)	Charlie Lake	28-6-63	1,350	2,000
	314	Pacific Kobes a-99-A (B-1)	Charlie Lake	24-6-64	880	2,000

	141	Pacific Kobes d-94-I (1)	Halfway	23-6-64	14,000	3,633
	177	Pacific Kobes b-35-A (1-A)	Halfway	24-6-64	15,000	3,881
	164	Pacific Townsend a-20-H (A-1)	Mississippian	26-11-64	910	2,000
	314	Pacific Kobes a-99-A (B-1)	Mississippian	23-6-64	11,500	3,971
Kotcho Lake	404	West Nat Kotcho Lake c-67-K	Slave Point	13-2-60	825,000	206,250
Laprise Creek	1177	Amerada Laprise c-56-D	Baldonnel	4-7-64	5,400	2,000
	1337	Amerada Laprise a-7-E	Baldonnel	8-11-63	5,300	2,000
	1378	Amerada Laprise d-77-D	Baldonnel	21-7-64	6,700	2,000
	1468	Amerada Laprise d-55-D	Baldonnel	7-7-64	19,300	4,825
	1477	Amerada Laprise d-95-D	Baldonnel	1-8-64	7,600	2,000
	327	Dome Basco Laprise a-35-H	Baldonnel	14-8-64	9,800	2,470
	474	Dome Basco Laprise Creek d-13-H	Baldonnel	15-8-64	8,050	2,013
	483	Dome Provo Laprise Creek b-2-H	Baldonnel	12-8-64	10,920	2,798
	490	Dome Basco Laprise Creek a-81-A	Baldonnel	13-8-64	9,080	2,293
	653	Dome Provo Laprise Creek d-91-A	Baldonnel	15-8-64	4,460	2,000
	654	Dome Provo Laprise Creek a-25-H	Baldonnel	15-8-64	3,880	2,000
	665	Dome Provo Laprise a-46-H	Baldonnel	15-8-64	5,000	2,000
	666	Dome Provo Laprise Creek a-33-H	Baldonnel	14-8-64	6,535	2,000
	809	Dome Provo Laprise d-91-H	Baldonnel	10-7-64	10,600	2,650
	837	Dome Provo Laprise a-81-H	Baldonnel	12-7-64	6,660	2,000
	1056	Dome Provo Laprise c-92-H	Baldonnel	10-7-64	9,000	2,250
	1225	Dome Provo Laprise c-70-E	Baldonnel	9-7-64	9,000	2,250
	1251	Dome Provo Laprise c-40-E	Baldonnel	8-7-64	16,000	4,032
	1445	Dome Provo Laprise a-52-H	Baldonnel	14-8-64	4,878	2,000
	516	Pacific Imperial Laprise d-68-E	Baldonnel	2-6-64	8,500	2,172
	551	Pacific Imperial Laprise c-78-E	Baldonnel	3-6-64	8,000	2,056
	650	Pacific Imperial Laprise c-56-E	Baldonnel	2-6-64	6,100	2,000
	659	Pacific Imperial Laprise b-44-E	Baldonnel	1-6-64	22,200	5,972
	670	Pacific Imperial Laprise d-55-E	Baldonnel	2-6-64	12,700	3,331
	678	Pacific Imperial Laprise a-46-E	Baldonnel	2-6-64	3,350	2,000
	690	Pacific Imperial Laprise a-33-E	Baldonnel	1-6-64	12,600	3,264
	715	Pacific Imperial Laprise a-22-E	Baldonnel	1-6-64	5,000	2,000
	1341	Pacific Imperial Laprise a-99-E	Baldonnel	3-6-64	10,200	2,563
	1488	Pacific Imperial Laprise a-49-E	Baldonnel	20-8-64	14,700	3,675
	1511	Pacific Imperial Laprise c-24-E	Baldonnel	24-11-64	3,400	2,000
	1371	Tenn Monsanto Laprise d-79-C	Baldonnel	5-11-63	3,900	2,000
	1392	Triad et al Laprise d-37-C	Baldonnel	27-12-63	5,700	2,000
Laprise Creek West	873	Dome CDP C&E W Laprise c-82-G	Baldonnel	15-8-64	2,305	2,000
Montney	119	Pac Sunray Montney 16-32-86-19 (3)	Bluesky-Gething	25-9-58	814	2,000
	104	Pac Sunray Montney 14-36-86-19 (2)	Charlie Lake	4-7-58	2,200	2,000
	289	Pac Sunray Montney 14-31-86-19 (5)	Halfway	26-7-61	2,250	2,000
	801	Pac White Rose Sec Montney 6-5-87-18	Halfway	8-5-64	3,550	2,000
Nig Creek	1004	Atlantic Nig d-13-B	Baldonnel	7-9-64	4,800	2,000
	1139	Dome Provo Nig d-35-B	Baldonnel	5-12-64	7,200	2,000
	1475	Monsanto Nig a-21-B	Baldonnel	11-8-64	6,150	2,000
	61	Texaco NFA Nig Creek a-79-B (1)	Baldonnel	13-8-64	17,800	4,476

[2] Interim.

TABLE 8.—AUTHORIZED ABSOLUTE OPEN-FLOW POTENTIAL TESTS AND PRODUCTION RATE LIMITS TO DECEMBER 31, 1964—*Cont'd*

Field	Drilling Authority No.	Well Name	Pool	Date of Test	A.O.F.P.	P.R.L.
Nig Creek	131	Texaco NFA Nig Creek a-12-G (6)	Baldonnel	28-5-64	8,800	2,315
	383	Texaco NFA Nig Creek b-70-B (9)	Baldonnel	9-7-64	20,000	5,050
	447	Texaco NFA Nig Creek b-2-G	Baldonnel	27-5-64	32,000	8,300
	456	Texaco NFA Nig Creek a-1-G	Baldonnel	31-5-64	14,800	3,852
	729	Texaco NFA Nig c-36-B	Baldonnel	5-7-64	8,100	2,050
	790	Texaco NFA Nig d-71-B	Baldonnel	22-6-64	2,950	2,000
	819	Texaco NFA Nig a-69-A	Baldonnel	22-6-64	1,830	2,000
	967	Texaco NFA Nig a-8-G	Baldonnel	18-6-64	32,500	8,272
	1161	Texaco NFA Nig c-90-B	Baldonnel	13-7-64	7,900	2,019
	1180	Texaco NFA Nig d-15-B	Baldonnel	7-7-64	10,600	2,708
	1373	West Nat Nig a-3-B	Baldonnel	10-11-64	4,000	2,000
Parkland	153	Pacific Imp Parkland 6-29-81-15	Wabamun	31-8-64	32,200	8,759
	1153	Pacific Imp Parkland 10-28-81-15	Wabamun	31-8-64	9,800	2,504
Petitot River	533	West Nat Petitot River b-1-D	Slave Point	11-2-60	185,000	46,250
Red Creek	93	Pacific Red Creek 5-27-85-21 (36)	Charlie Lake	16-9-64	2,200	2,000
	93	Pacific Red Creek 5-27-85-21 (36)	Halfway	15-9-64	1,775	2,000
Rigel	1372	Denison Rigel 6-31-87-16	Dunlevy	22-6-64	7,700	2,000
	1494	IOE Fina Rigel 11-11-88-18	Dunlevy	21-8-64	22,200	5,550
	130	Imp Fina Rigel 4-27-88-17	Dunlevy	14-8-64	6,500	2,000
	828	Imp et al Rigel 6-27-88-18	Dunlevy	13-8-64	13,800	3,759
	1032	Imp et al Rigel 6-30-88-17	Dunlevy	20-8-64	24,250	6,172
	1090	Imp Fina Rigel 6-10-88-17	Dunlevy	10-8-64	12,500	3,210
	1107	Imp et al Rigel 7-19-88-17	Dunlevy	20-8-64	19,000	4,912
	1118	Imp et al Rigel 6-21-88-18	Dunlevy	16-8-64	11,500	2,906
	1163	Imp et al Rigel 7-23-88-18	Dunlevy	15-8-64	6,700	2,000
	1187	Imp Fina Rigel 6-3-88-17	Dunlevy	11-8-64	22,000	5,836
	1208	Imp Fina Rigel 6-8-88-17	Dunlevy	12-8-64	5,100	2,000
	1465	Imp Fina Rigel 10-14-88-18	Dunlevy	16-8-64	12,000	3,000
	1354	Monsanto Rigel 6-36-87-17	Dunlevy	20-8-64	14,250	3,588
	1293	Pacific Rigel 6-35-87-17	Dunlevy	11-5-64	14,500	3,897
	1324	Sun Rigel 10-24-88-18	Dunlevy	9-10-63	4,200	2,000
	195	Texaco NFA Rigel 9-31-88-18 (10)	Dunlevy	2-7-64	12,400	3,469
	1222	Texaco NFA Rigel 10-29-88-18	Dunlevy	21-2-63	4,850	2,000
	1370	Texaco NFA Rigel a-28-K	Dunlevy	30-6-64	2,000	2,000
	1148	Whitehall Rigel 6-15-88-17	Dunlevy	17-8-64	46,500	12,974
	1365	Wintershall Rigel 10-34-87-17	Dunlevy	18-8-64	13,000	3,289
Snyder Creek	185	Union Snyder Creek a-28-K (1)	Dunlevy	7-11-63	2,300	2,000
Stoddart	244	Pacific Stoddart 4-24-86-20 (85)	Belloy	7-5-64	21,250	6,285
	262	Pacific Stoddart 2-13-86-20 (90)	Belloy	7-5-64	13,750	4,988
Stoddart West	1190	Pacific W Stoddart 11-10-86-20	Belloy	2-3-64	9,300	2,446
Other areas	410	Imp Fina Altares a-83-A	Bluesky-Gething	21-1-60	22,000	5,500

641	Imp Pac Sunray Wargen c-58-C	Bluesky-Gething	5–10–60	14,500	3,625
707	Pure RO Corp Firebird d-89-D	Gething	1–3–63	14,000	3,500
1192	Texaco NFA N LaGarde 10-12-88-16	Dunlevy	10–2–63	3,270	2,000
386	FPC Richfield Daiber c-76-D (1)	Baldonnel	9–1–59	10,000	2,500
737	HB Cypress a-28-F	Baldonnel	20–11–61	30,000	7,500
1326	HB Cypress d-87-C	Baldonnel	12–6–63	25,000	6,250
1339	HB Cypress a-65-C	Baldonnel	1–8–63	11,200	2,800
1335	Pan Am Dome Sikanni b-43-B	Baldonnel	25–9–63	5,500	2,000
304	Sinclair Julienne a-50-D (B13-2)	Baldonnel	15–9–58	4,950	2,000
1200	Tenn Osborn 6-35-87-15	Baldonnel	9–11–63	1,250	2,000
1130	White Rose Sec Montney 10-29-86-18	Baldonnel	24–9–62	1,640	2,000
62	Pacific Ft St John 12-7-84-18 (19)	Baldonnel A	17–7–53	2,100	2,000
412	West Nat et al W Jeans a-22-B	Charlie Lake	15–5–59	5,050	2,000
470	West Nat et al W Jeans b-10-A	Charlie Lake	19–9–60	2,650	2,000
1194	Texaco NFA LaGarde 10-29-87-15	Boundary Lake	5–3–63	23,280	5,820
176	Ft St John Petroleums Farrell a-9-L	Halfway	18–11–61	5,600	2,000
47	Pacific Wilder 13-1-84-20 (14)	Halfway	1–12–53	5,500	2,000
750	Pac Imp N Bubbles d-95-B	Halfway	8–8–61	2,500	2,000
1271	Pacific SR CanDel W Dede b-45-K	Halfway	11–3–63	5,600	2,000
1266	Pure et al W Milligan c-50-G	Halfway	11–3–63	14,000	3,500
304	Sinclair Julienne a-50-D (B13-2)	Halfway	31–9–58	7,000	2,000
658	Sinclair Pac Julienne Creek b-39-D	Halfway	24–6–61	4,000	2,000
709	Sinclair Pacific Weasel d-50-A	Halfway	1–3–61	21,500	5,375
348	Pacific S Ft Nelson b-96-B (1)	Mississippian	9–5–58	2,350	2,000
468	Pacific Pocketknife c-37-L	Mississippian	19–7–60	26,600	6,650
385	Sinclair et al Lily d-12-K (XB18-1)	Mississippian	23–4–59	24,900	6,225
507	West Nat et al Jeans a-57-A	Mississippian	21–9–60	2,050	2,000
926	Imp Junior c-98-C	Slave Point	21–3–62	90,000	22,500
562	Pacific North Kotcho b-44-C	Slave Point	5–4–60	105,000	26,250
1071	Pacific Apache Fort Nelson b-76-G	Slave Point	24–7–62	15,100	3,775
877	Pan Am et al Dilly a-30-K	Slave Point	16–3–62	14,700	3,675
704	Texaco NFA Tsea b-68-K	Slave Point	16–3–62	76,650	19,163
677	West Nat Kathy b-30-F	Slave Point	15–2–61	148,000	37,000
887	West Nat et al Yoyo a-74-H	Slave Point	21–3–62	185,000	46,250
1147	West Nat Kotcho d-12-C	Slave Point	12–2–63	42,000	10,500
1245	West Nat Cabin b-40-A	Slave Point	2–3–63	28,900	7,225
1274	West Nat IOE S Clarke d-29-K	Slave Point	22–1–64	(3)	(3)
1249	IOE Junior c-3-C	Slave Point/Sulphur Point	26–3–63	12,700	3,175
1230	West Nat et al Yoyo b-29-I	Pine Point	20–1–64	(3)	(3)
1313	West Nat et al Yoyo b-24-L	Pine Point	16–1–64	(3)	(3)
682	Pan Am Beaver River d-73-K	Nahanni	6–3–62	85,000	21,250

[3] Confidential at December 31, 1964.

TABLE 9.—WELLS DRILLED AND DRILLING, 1964

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1964 Footage	Status at Dec. 31, 1964
1492	Altair W Mineral Buick b-22-C	Oct. 7, 1964	Oct. 23, 1964	3,810	3,810	Lower Cretaceous Dunlevy gas well.
1510	Altair FPC Red Creek 6-14-85-21	Oct. 5, 1964	Nov. 9, 1964	6,836	6,836	Abandoned—dry.
1536	Amax Co-op N Boundary 6-31-86-14	Nov. 7, 1964	Nov. 20, 1964	4,562	4,562	Abandoned—dry.
1454	Amerada Boundary A6-24-85-14	Feb. 27, 1964	Mar. 14, 1964	4,630	4,630	Triassic Baldonnel and Halfway multi-gas well.
1468	Amerada Laprise d-55-D	June 9, 1964	June 22, 1964	4,100	4,100	Triassic Baldonnel gas well.
1477	Amerada Laprise d-95-D	June 30, 1964	July 15, 1964	4,280	4,280	Triassic Baldonnel gas well.
1377	Apache C & E Sohio Pure Louise d-42-I	Feb. 5, 1964	Mar. 19, 1964	7,342	7,342	Abandoned—dry.
1542	Atlantic Tees c-15-J	Dec. 27, 1964			640	Drilling.
1544	BA Shell Klua b-68-C	Nov. 30, 1964	Dec. 31, 1964	7,000	7,000	Abandoned—dry.
1427	BA Shell Klua a-14-F	Jan. 24, 1964	Mar. 8, 1964	7,055	7,055	Abandoned—dry.
1443	BA et al Moberly 6-9-83-22	Feb. 12, 1964	May 2, 1964	9,123	9,123	Abandoned—dry.
1472	BA HB W Pocketknife b-6-I	Aug. 13, 1964	Oct. 10, 1964	6,360	6,360	Abandoned—dry.
1393	BA HB W Pocketknife d-33-I	Nov. 29, 1963	Apr. 4, 1964	7,362	5,422	Permo Carboniferous gas well.
1550	Baysel SR Milligan d-66-G	Dec. 15, 1964	Dec. 27, 1964	3,770	3,770	Abandoned—dry.
1487	Baysel SR Nancy d-96-H	July 12, 1964	July 25, 1964	3,884	3,884	Triassic Halfway oil well.
1538	Baysel SR Nancy d-97-H	Nov. 10, 1964	Nov. 24, 1964	3,886	3,886	Triassic Halfway oil well.
1496	Baysel SR Nancy d-7-I	July 26, 1964	Aug. 5, 1964	3,865	3,865	Abandoned—dry.
1515	CanDel SR Nancy d-44-H	Oct. 6, 1964	Oct. 21, 1964	3,938	3,938	Triassic Halfway oil well.
1516	CanDel SR Nancy d-45-H	Oct. 23, 1964	Nov. 5, 1964	3,970	3,970	Triassic Halfway oil well.
1498	CanDel SR Nancy d-53-H	July 26, 1964	Aug. 6, 1964	3,905	3,905	Triassic Halfway oil well.
1503	CanDel SR Nancy d-54-H	Aug. 25, 1964	Sept. 3, 1964	3,905	3,905	Triassic Halfway oil well.
1507	CanDel SR Nancy d-55-H	Sept. 13, 1964	Sept. 23, 1964	3,920	3,920	Triassic Halfway oil well.
1521	CanDel SR Nancy d-63-H	Nov. 7, 1964	Nov. 20, 1964	3,902	3,902	Triassic Halfway oil well.
1483	CanDel SR Nancy d-64-H	July 9, 1964	July 19, 1964	3,910	3,910	Triassic Halfway oil well.
1476	CanDel SR Nancy d-65-H	June 24, 1964	July 4, 1964	3,925	3,925	Triassic Halfway oil well.
1397	Cdn Sup Fina Alminex Trutch a-75-C	Dec. 24, 1963	Mar. 5, 1964	9,650	8,380	Abandoned—dry.
1428	CDR HB Union Chinchaga c-2-B	Jan. 18, 1964	Mar. 10, 1964	9,228	9,228	Abandoned—dry.
1404	CDR Prophet a-61-J	Dec. 17, 1963	Mar. 30, 1964	9,576	7,192	Abandoned—dry.
1466	C & E Helmet c-54-F	Mar. 28, 1964			4,933	Drilling.
1470	Dome Boundary 14-34-85-14	June 28, 1964	July 6, 1964	4,330	4,330	Triassic Boundary Lake oil well.
1471	Dome Boundary WW 4-35-85-14	June 11, 1964	June 26, 1964	4,360	4,360	Water source.
1440	Dome Boundary 6-2-86-14	Mar. 9, 1964	Mar. 25, 1964	4,465	4,465	Triassic Boundary Lake oil well.
1445	Dome Provo Laprise a-52-H	Mar. 27, 1964	June 11, 1964	4,428	4,428	Triassic Baldonnel gas well.
1532	Dome Provo Milligan d-56-G	Nov. 6, 1964	Nov. 14, 1964	3,765	3,765	Abandoned—dry.
611	Fraser Valley Chilliwack 14-19-26	Nov. 30, 1959			326	Suspended.
1431	Frontier Yoyo c-18-L	Jan. 27, 1964	Mar. 23, 1964	7,420	7,420	Devonian Pine Point gas well.
1396	Gray Oil PRP NW Grizzly c-25-A	Nov. 29, 1963	Mar. 6, 1964	8,752	2,662	Lower Cretaceous Dunlevy gas well.
1499	Gray Oil PRP NW Grizzly d-59-A	Nov. 22, 1964			4,662	Drilling.
1421	HB Bat a-16-G	Jan. 28, 1964	Mar. 14, 1964	3,503	3,503	Abandoned—dry.
1501	Huber et al Boundary 6-4-87-13	Sept. 17, 1964	Sept. 30, 1964	4,780	4,780	Triassic Halfway gas well.
1414	Imp Pac Boundary 8-20-84-13	Dec. 28, 1963	Jan. 8, 1964	4,484	1,276	Abandoned—dry.
1425	Imp Pac Boundary 16-29-84-13	Jan. 27, 1964	Feb. 6, 1964	4,380	4,380	Triassic Boundary Lake oil well.

1450	Imp Pac Boundary 14-7-84-14	June 15, 1964	June 24, 1964	4,190	4,190	Triassic Boundary Lake oil well.
1513	Imp Pac Boundary 16-9-85-14	Sept. 22, 1964	Oct. 1, 1964	4,210	4,210	Triassic Boundary Lake oil well.
1545	Imp Pac Boundary 3-10-85-14	Nov. 27, 1964	Dec. 20, 1964	4,080	4,080	Triassic Boundary Lake oil well.
1495	Imp Pac Boundary 9-10-85-14	Aug. 11, 1964	Aug. 19, 1964	4,200	4,200	Triassic Boundary Lake oil well.
1527	Imp Nancy d-79-H	Oct. 22, 1964	Nov. 3, 1964	3,920	3,920	Abandoned—dry.
1465	Imp Fina Rigel 10-14-88-18	Mar. 22, 1964	Apr. 3, 1964	3,545	3,545	Lower Cretaceous Dunlevy gas well.
1403	IOE et al Beg b-2-B	Dec. 12, 1963	Jan. 28, 1964	5,690	1,000	Triassic Halfway gas well.
1331	IOE Dunedin d-75-E	Mar. 22, 1963	Jan. 23, 1964	12,789	....	Abandoned—dry.
1489	IOE Laprise a-83-D	July 28, 1964	Aug. 12, 1964	4,520	4,520	Abandoned—dry.
1355	IOE Pac Parkland 10-26-81-16	July 8, 1963	Apr. 11, 1964	11,860	4,169	Permo Carboniferous Belloy gas well.
1494	IOE Fina Rigel 11-11-88-18	July 21, 1964	Aug. 2, 1964	3,534	3,534	Lower Cretaceous Dunlevy gas well.
1537	IOE Fina N Rigel d-57-I	Nov. 6, 1964	Nov. 21, 1964	4,458	4,458	Lower Cretaceous Dunlevy gas well.
1416	IOE Union Shekilie a-94-G	Jan. 3, 1964	Mar. 16, 1964	6,675	6,675	Abandoned—dry.
1528	Marathon Fort Nelson a-65-G	Nov. 3, 1964	....	....	6,655	Drilling.
1464	Mic Mac Ashland Wildmint b-68-A	Mar. 14, 1964	Mar. 26, 1964	3,753	3,753	Abandoned—dry.
1475	Monsanto Nig a-21-B	June 28, 1964	July 16, 1964	4,413	4,413	Triassic Baldonnel gas well.
1546	Monsanto et al Pingel 13-1-82-18	Dec. 8, 1964	....	....	5,137	Drilling.
1430	Monsanto IOE Fina Rigel 11-30-87-16	Feb. 22, 1964	Mar. 3, 1964	3,690	3,690	Abandoned—dry.
1555	Monsanto IOE Fina Rigel 6-13-87-17	Dec. 24, 1964	....	....	3,633	Drilling.
1486	Monsanto IOE Fina Rigel 11-26-87-17	Jan. 22, 1964	Aug. 6, 1964	3,651	3,651	Lower Cretaceous Dunlevy gas well.
1534	Pacific SR CanDel Blue Jay d-48-I	Oct. 31, 1964	Nov. 9, 1964	3,763	3,763	Abandoned—dry.
1460	Pacific Imperial N Bubbles b-84-B	Mar. 6, 1964	Mar. 17, 1964	4,675	4,675	Abandoned—dry.
1511	Pacific Imperial Laprise c-24-E	Oct. 9, 1964	Oct. 28, 1964	4,531	4,531	Triassic Baldonnel gas well.
1488	Pacific Imperial Laprise a-49-E	July 14, 1964	Aug. 16, 1964	4,488	4,488	Triassic Baldonnel gas well.
1533	Pacific Sinclair Nancy d-84-A	Nov. 5, 1964	Nov. 25, 1964	3,741	3,741	Abandoned—dry; junked.
1547	Pacific Sinclair Nancy d-A84-A	Nov. 26, 1964	Dec. 13, 1964	4,118	4,118	Abandoned—dry.
1525	Pacific Sinclair Nancy d-33-H	Nov. 4, 1964	Nov. 16, 1964	3,950	3,950	Triassic Halfway oil well.
1514	Pacific Sinclair Nancy d-42-H	Sept. 20, 1964	Oct. 2, 1964	3,915	3,915	Triassic Halfway oil well.
1497	Pacific Sinclair Nancy d-43-H	July 24, 1964	Aug. 4, 1964	3,934	3,934	Triassic Halfway oil well.
1548	Pacific SR Can Del Nancy d-56-H	Dec. 6, 1964	Dec. 19, 1964	3,940	3,940	Abandoned—dry.
1512	Pacific SR CanDel Nancy d-66-H	Sept. 21, 1964	Oct. 3, 1964	3,926	3,926	Triassic Halfway oil well.
1540	Pacific SR Can Del Nancy d-67-H	Nov. 18, 1964	Nov. 30, 1964	3,922	3,922	Triassic Halfway oil well.
1522	Pacific SR CanDel Nancy d-A74-H	Oct. 14, 1964	Oct. 24, 1964	3,900	3,900	Triassic Halfway oil well.
1467	Pacific SR CanDel Nancy d-75-H	May 29, 1964	June 12, 1964	3,900	3,900	Triassic Halfway oil well.
1407	Pacific SR CanDel Nancy d-85-H	Jan. 31, 1964	Feb. 18, 1964	3,870	3,870	Triassic Halfway oil well.
1474	Pacific SR CanDel Nancy d-95-H	June 26, 1964	July 7, 1964	3,867	3,867	Triassic Halfway oil well.
1531	Pacific SR CanDel Ptarmigan d-90-I	Nov. 3, 1964	Nov. 20, 1964	3,840	3,840	Triassic Halfway oil well.
1473	Pacific et al Stoddart 11-16-86-19	June 22, 1964	July 18, 1964	5,943	5,943	Permo Carboniferous Belloy gas well.
1412	Pure et al W Milligan b-30-G	Jan. 1, 1964	Jan. 17, 1964	3,925	3,925	Abandoned—dry.
1439	ROC E Beg d-15-G	Feb. 9, 1964	Feb. 27, 1964	5,440	5,440	Abandoned—dry.
1424	Shell E Grayling d-95-F	Feb. 4, 1964	May 17, 1964	10,242	10,242	Abandoned—dry.
1455	SOBC Calstan Peggo b-74-A	Mar. 1, 1964	Mar. 28, 1964	6,815	6,815	Abandoned—dry.
1418	SOBC Calstan Yeka a-69-D	Jan. 4, 1964	Feb. 24, 1964	7,604	7,604	Abandoned—dry.
1420	Sohio Triad Ebony b-93-K	Jan. 13, 1964	Jan. 26, 1964	3,795	3,795	Abandoned—dry.
1438	Sohio Triad Elder b-94-D	Feb. 5, 1964	Feb. 15, 1964	3,925	3,925	Abandoned—dry.
1429	Sohio Triad Elm d-37-C	Jan. 28, 1964	Feb. 8, 1964	3,875	3,875	Abandoned—dry.
1447	Sohio Triad Eucalyptus b-3-E	Feb. 22, 1964	Mar. 5, 1964	3,915	3,915	Abandoned—dry.

TABLE 9.—WELLS DRILLED AND DRILLING, 1964—*Continued*

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1964 Footage	Status at Dec. 31, 1964
1442	Sohio Triad Evergreen b-16-B	Feb. 10, 1964	Feb. 19, 1964	3,700	3,700	Abandoned—dry.
1478	Tenn Nancy d-76-H	July 5, 1964	July 16, 1964	3,905	3,905	Triassic Halfway oil well.
1491	Tenn Nancy d-77-H	July 18, 1964	July 29, 1964	3,910	3,910	Triassic Halfway oil well.
1505	Tenn Nancy d-78-H	Sept. 27, 1964	Oct. 9, 1964	3,920	3,920	Triassic Halfway oil well.
1461	Tenn Nancy d-86-H	Mar. 12, 1964	Mar. 29, 1964	3,902	3,902	Triassic Halfway oil well.
1490	Tenn Nancy d-87-H	Aug. 11, 1964	Aug. 22, 1964	3,895	3,895	Triassic Halfway oil well.
1502	Tenn Nancy d-88-H	Aug. 22, 1964	Sept. 4, 1964	3,890	3,890	Triassic Halfway oil well.
1479	Tenn Monsanto Nig c-32-C	June 30, 1964	July 8, 1964	2,178	2,178	Abandoned—dry; junked.
1484	Tenn Monsanto Nig c-A32-C	July 10, 1964	Aug. 2, 1964	4,636	4,636	Triassic Baldonnel gas well.
1448	Tenn Monsanto Nig d-39-C	Feb. 23, 1964	Mar. 22, 1964	4,720	4,720	Triassic Baldonnel gas well.
1459	Texaco NFA Balsam 6-28-87-14	Mar. 9, 1964	Mar. 24, 1964	4,645	4,645	Abandoned—dry.
1481	Texaco NFA Boundary 16-30-85-13	July 7, 1964	July 19, 1964	4,295	4,295	Triassic Boundary Lake oil well.
1539	Texaco NFA Boundary 8-25-85-14	Nov. 16, 1964	Nov. 27, 1964	4,280	4,280	Triassic Boundary Lake oil well.
1543	Texaco NFA Boundary 16-28-85-14	Nov. 30, 1964	Dec. 25, 1964	4,317	5,772	Triassic Boundary Lake oil well.
1482	Texaco NFA Boundary 16-30-86-13	July 24, 1964	Aug. 9, 1964	4,750	4,750	Triassic Boundary Lake oil well.
1558	Texaco NFA Boundary 8-25-86-14	Dec. 30, 1964	———	———	519	Drilling.
1529	Texaco NFA N Boundary 6-8-87-14	Oct. 27, 1964	Nov. 13, 1964	4,620	4,620	Triassic Halfway gas well.
1451	Texaco NFA N Boundary 10-9-87-14	Feb. 28, 1964	Mar. 19, 1964	4,596	4,596	Triassic Halfway gas well.
1523	Texaco NFA W Boundary 13-24-86-15	Oct. 15, 1964	Nov. 9, 1964	4,737	4,737	Abandoned—dry.
1500	Texaco NFA E Buick c-32-A	Aug. 17, 1964	Sept. 5, 1964	3,686	3,686	Lower Cretaceous Dunlevy gas well.
1506	Texaco NFA E Buick b-46-A	Sept. 7, 1964	Sept. 11, 1964	690	690	Abandoned—dry; junked.
1508	Texaco NFA E Buick b-A46-A	Sept. 11, 1964	Oct. 2, 1964	3,745	3,745	Lower Cretaceous Dunlevy gas well.
1456	Texaco NFA E Buick c-100-D	Mar. 8, 1964	Mar. 24, 1964	3,607	3,607	Abandoned—dry.
1319	Texaco NFA E Osborn 6-33-88-14	Dec. 26, 1963	Jan. 18, 1964	5,220	1,653	Triassic Baldonnel gas well.
1549	Texaco NFA Redeye d-69-I	Dec. 7, 1964	Dec. 27, 1964	4,210	4,210	Triassic Charlie Lake gas well.
1432	Texaco Tepee d-99-G	Feb. 1, 1964	Mar. 21, 1964	4,950	4,950	Triassic Halfway gas well.
1426	Texaco NFA Tsea b-99-K	Jan. 21, 1964	Mar. 3, 1964	7,185	7,185	Devonian Slave Point gas well.
1524	Texcan Boundary 16-12-84-15	Oct. 16, 1964	Oct. 30, 1964	4,285	4,285	Abandoned—dry.
1535	Texcan Wildmint d-99-I	Oct. 31, 1964	Nov. 12, 1964	3,680	3,680	Abandoned—dry.
1413	Triad Beatton d-18-J	Jan. 8, 1964	Jan. 18, 1964	3,790	3,790	Injection—water.
1399	Triad Beatton b-46-J	Dec. 20, 1963	Jan. 6, 1964	3,729	169	Abandoned—dry.
1419	Triad Beatton b-49-J	Jan. 20, 1964	Feb. 1, 1964	3,780	3,780	Triassic Halfway oil well.
1444	Triad Beatton b-50-J	Feb. 23, 1964	Mar. 3, 1964	3,775	3,775	Abandoned—dry.
1552	Triad Beatton b-58-J	Dec. 23, 1964	———	———	3,070	Drilling.
1402	Triad Sohio Jackfish c-21-K	Dec. 23, 1963	Apr. 2, 1964	7,500	5,114	Abandoned—dry.
1520	Triad ROC CanDel Laprise b-26-C	Oct. 31, 1964	Nov. 7, 1964	2,162	2,162	Abandoned—dry; junked.
1541	Triad ROC CanDel Laprise b-A26-C	Nov. 8, 1964	Dec. 23, 1964	4,550	4,550	Abandoned—dry.
1462	Triad ROC CanDel Laprise c-76-K	Mar. 9, 1964	Mar. 25, 1964	4,240	4,240	Abandoned—dry.
1437	Triad Uno Tex Nogah c-78-H	Feb. 10, 1964	———	———	2,438	Suspended.
1517	Triad BP Sukunka a-43-B	Oct. 18, 1964	———	———	6,700	Drilling.
1446	Union HB Alder d-48-I	Feb. 18, 1964	Feb. 29, 1964	3,780	3,780	Abandoned—dry.
1457	Union HB Beaverdam d-1-L	Mar. 6, 1964	Mar. 18, 1964	3,858	3,858	Abandoned—dry.

1436	Union HB BA Bogbean b-72-J	Jan. 31, 1964	Feb. 8, 1964	3,420	3,420	Abandoned—dry.
1417	Union HB Bulrush d-90-E	Jan. 4, 1964	Jan. 15, 1964	3,824	3,824	Abandoned—dry.
1551	Union HB Sinc Pac Bulrush d-99-F	Dec. 16, 1964	Dec. 27, 1964	3,840	3,840	Triassic Halfway oil well.
1449	Union HB BA Foxglove d-15-A	Feb. 24, 1964	Mar. 2, 1964	3,325	3,325	Abandoned—dry.
1422	Union HB BA Groundpine d-56-K	Jan. 15, 1964	Jan. 24, 1964	3,595	3,595	Abandoned—dry.
1433	Union HB BA Ladyfern d-48-H	Feb. 10, 1964	Feb. 23, 1964	3,530	3,530	Lower Cretaceous Bluesky-Gething oil well.
1526	Union HB Milligan b-54-G	Oct. 25, 1964	Nov. 4, 1964	3,770	3,770	Injection—water.
1509	Union HB Milligan b-64-G	Sept. 24, 1964	Oct. 2, 1964	3,760	3,760	Abandoned—dry.
1493	Union HB Milligan b-65-G	July 24, 1964	Aug. 7, 1964	3,845	3,845	Triassic Halfway oil well.
1463	Union HB ROC Milligan d-3-J	Mar. 20, 1964	Apr. 1, 1964	3,757	3,757	Injection—gas.
1435	Union KCL ROC Nettle b-48-A	Jan. 25, 1964	Feb. 6, 1964	3,858	3,858	Abandoned—dry.
1411	Union KCL ROC Nettle d-58-A	Jan. 4, 1964	Jan. 13, 1964	3,919	3,919	Triassic Halfway gas well.
1434	Union KCL ROC Nettle d-76-A	Feb. 7, 1964	Feb. 18, 1964	3,870	3,870	Lower Cretaceous Bluesky-Gething gas well.
1423	Union HB Skwat b-69-I	Jan. 15, 1964	Jan. 30, 1964	3,695	3,695	Abandoned—dry.
1559	Union HB Spruce d-84-E	Dec. 31, 1964			517	Drilling.
1458	Union HB Wildmint d-55-A	Mar. 2, 1964	Mar. 12, 1964	3,745	3,745	Injection—gas.
1519	Uno-Tex et al Stoddart 10-31-85-19	Oct. 8, 1964	Nov. 8, 1964	6,527	6,527	Permo Carboniferous Belloy oil well.
1504	West Nat et al Blueberry d-A57-D	Sept. 29, 1964	Oct. 19, 1964	4.619	4,619	Lower Cretaceous Dunlevy gas well.
943	West Nat et al Blueberry d-9-K	June 15, 1964	June 30, 1964	6,665	99	Water-disposal well; deepened.
1406	West Nat Cabin a-19-G	Dec. 20, 1963	Feb. 6, 1964	7,133	3,895	Devonian Slave Point gas well.
1469	West Nat et al Highway b-36-I	June 28, 1964			12,107	Drilling.
1405	West Nat Yoyo b-98-E	Dec. 18, 1963	Feb. 14, 1964	7,371	4,195	Devonian Pine Point gas well.
1441	West Nat et al Yoyo d-97-H	Feb. 10, 1964	Mar. 27, 1964	7,392	8,709	Abandoned—dry.
1408	Whitehall et al W Beatton d-21-L	Jan. 13, 1964	Jan. 26, 1964	3,843	3,843	Lower Cretaceous Bluesky-Gething oil well.
1336	Whitehall E Buick c-34-A	Mar. 24, 1964	Apr. 3, 1964	3,489	3,489	Lower Cretaceous Dunlevy gas well.
1263	White Rose IOE et al Slave b-57-B	Jan. 15, 1963	Mar. 21, 1964	8,860	4,300	Abandoned—dry.
1453	Wintershall Rigel 5-5-88-16	Mar. 4, 1964	Mar. 12, 1964	3,580	3,580	Abandoned—dry.

TABLE 10.—OIL AND GAS FIELDS DESIGNATED AS OF DECEMBER 31, 1964

Field	Date Designated	Date(s) Revised	Field Location	Pool(s)	Number of Wells Capable of Production	Discovery Well(s)	Pool(s) Discovered
Aitken Creek	Feb. 15, 1960	Jan. 1, 1961 Oct. 1, 1963	N.T.S. 94-A-13	3	8	Union Aitken Creek b-42-L, oil Union Aitken Creek a-53-L, gas	3 3
Beatton River	Aug. 7, 1959	Jan. 1, 1962	N.T.S. 94-H-2	9	11	Triad Beatton River b-38-J, oil Triad Beatton d-60-J, gas	9 9
Beatton River West	Aug. 7, 1959	Jan. 1, 1962 Oct. 1, 1964	N.T.S. 94-H-2	2	8	Triad West Beatton River d-39-K, oil	2
Beg	July 1, 1961	Jan. 1, 1962 Apr. 1, 1962 July 1, 1962 Apr. 1, 1963 Apr. 1, 1964	N.T.S. 94-B-16, 94-G-1, 94-G-8	6, 9	34	Pacific et al Beg b-17-K, gas Pacific et al Beg d-10-G, gas	6 9
Beg West	Apr. 1, 1962	Oct. 1, 1963	N.T.S. 94-G-1	6	3	Pacific et al W Beg a-79-F, gas	6
Bernadet	Oct. 1, 1963		Tp. 87, 88, R. 13, W. of 6th M. Tp. 87, 88, R. 14, W. of 6th M.	2	1	West Nat et al Bernadet 8-1-88-25, gas	2
Blueberry	Feb. 7, 1958	Dec. 22, 1958 Feb. 15, 1960 May 27, 1960 Oct. 1, 1961 Jan. 1, 1963	N.T.S. 94-A-12, 94-A-13 Tp. 88, R. 25, W. of 6th M.	5, 6, 7, 11	32	West Nat et al Blueberry c-32-D (2), gas West Nat et al Blueberry d-87-D (1), gas West Nat et al Blueberry a-61-L, gas West Nat et al Blueberry d-82-L (11), oil	5 6 7 11
Blueberry East	Dec. 22, 1958		N.T.S. 94-A-13	6, 9, 11	2	West Nat et al E Blueberry b-38-C (7), gas West Nat et al E Blueberry b-36-C (17), gas	6, 9 11
Blueberry West	Feb. 7, 1958	July 1, 1961	N.T.S. 94-A-12, 94-B-9, 94-B-16 Tp. 88, R. 25, W. of 6 th M.	5, 6	3	West Nat et al W Blueberry d-82-I (9), gas West Nat et al W Blueberry d-19-L (12), gas	5 6
Boundary Lake	Oct. 30, 1956	Feb. 7, 1958 Aug. 7, 1959 Feb. 15, 1960 Jan. 1, 1961 Apr. 1, 1961 July 1, 1961 Jan. 1, 1962 Apr. 1, 1962 Oct. 1, 1962 Oct. 1, 1963 Oct. 1, 1964	Tp. 84, 85, 86, 87, R. 13, W. of 6th M. Tp. 83, 84, 85, 86, R. 14, W. of 6th M. Tp. 84, R. 15, W. of 6th M.	2, 3, 5, 6, 7, 8, 9	267	Pacific Boundary 8-15-85-14, gas Pacific Boundary 12-10-85-14, gas Amerada Boundary 8-5-85-14, gas Texaco NFA Boundary L 6-6-86-13 (1), oil Sun Boundary Lake 6-23-85-14, oil Texaco NFA Boundary 16-31-86-13, gas	2, 6 3 5 8 9 9
Bubbles	Nov. 24, 1959	Feb. 15, 1960 May 27, 1960 Jan. 1, 1961	N.T.S. 94-G-1, 94-G-8, 94-H-4	6	13	Pacific Imperial Bubbles b-33-I, gas	6

Buick Creek	Feb. 7, 1958	Aug. 7, 1959 Jan. 1, 1961 July 1, 1961 Oct. 1, 1961 Jan. 1, 1963 July 1, 1963 Oct. 1, 1963	N.T.S. 94-A-11, 94-A-14	5, 7	19	Texaco NFA Buick Creek d-98-I (1), gas Texaco NFA Buick Creek d-83-J (4), gas	5 7
Buick Creek East	Jan. 1, 1963	Apr. 1, 1963 Oct. 1, 1963 July 1, 1964	N.T.S. 94-A-10, 94-A-11, 94-A-14, 94-A-15	2, 5	12	Texaco NFA E Buick c-80-D, gas Decalta et al E Buick c-74-A, oil Texaco NFA E Buick a-31-A, gas	2 5 5
Buick Creek West	Feb. 7, 1958	Jan. 6, 1959 Feb. 15, 1960 Jan. 1, 1963	N.T.S. 94-A-11, 94-A-14	3, 5, 6, 9	15	Pacific West Buick Creek c-2-E (6), gas Pacific W Buick Creek c-83-K (13A), oil Pacific West Buick Creek b-78-C (2), gas Pacific West Buick Creek d-58-C (8), gas Pacific West Buick Creek b-23-E (1), gas	3 5 5 6 9
Bulrush	July 1, 1964		N.T.S. 94-A-16	9	3	Union HB Sinclair Bulrush d-78-F, gas	9
Charlie Lake	Jan. 1, 1961		Tp. 84, R. 18, W. of 6th M.	3	1	Imp Pac Charlie 13-5-84-14, oil	3
Clarke Lake	Feb. 15, 1960	May 27, 1960 Jan. 1, 1961 Apr. 1, 1962	N.T.S. 94-J-9, 94-J-10, 94-J-15, 94-J-16	13	8	West Nat et al Clarke Lake c-47-J, gas	13
Dawson Creek	Feb. 7, 1958		Tp. 79, R. 15, W. of 6th M.	1	4	Pacific Sc Dawson Ck 1-15-79-15 (1), gas	1
Fort St. John	Aug. 22, 1955	Feb. 7, 1958 Feb. 15, 1960 Jan. 1, 1961	Tp. 83, R. 18, W. of 6th M.	4, 6, 7, 9, 10	28	Pacific Ft St John A3-29-83-18 (31), gas Pacific Ft St John 14-15-83-18 (7), gas Pacific Ft St John 3-14-83-18 (9), oil Pacific Ft St John 1-20-83-18 (30), gas Imp Pac Ft St John 9-19-83-18 (45), oil Pacific Ft St John 14-21-83-18 (4), gas	4 6 7 9 10 10
Fort St. John Airport	Feb. 7, 1958		Tp. 83, R. 17, W. of 6th M.	4, 6, 9	3	Pacific Airport 8-32-83-17 (3), gas Pacific Airport 9-32-83-17 (97), gas Pacific Airport 12-34-83-17 (10), gas	4 6 9
Fort St. John Southeast	Feb. 7, 1958		Tp. 82, 83. R. 17, W. of 6th M.	4, 6, 9, 10	15	Pac Ft St John SE 10-31-82-17 (80), gas Pac Ft St John SE A4-10-83-17 (55), gas Pac Ft St John SE 10-33-82-17 (22), gas Pac Ft St John SE 4-10-83-17 (12), gas	4 6 9 10
Gundy Creek	Feb. 7, 1958	Jan. 6, 1959	N.T.S. 94-B-16	6	4	West Nat Gundy Creek c-80-A, gas	6
Halfway	Dec. 22, 1958		Tp. 86, 87, R. 25, W. of 6th M.	6, 9	3	West Nat et al Halfway 5-1-87-25, gas West Nat et al Halfway 8-11-87-25, gas	6 9
Highway	Feb. 7, 1958		N.T.S. 94-B-16	5, 6, 11	6	West Nat et al Highway b-3-I, gas Pacific Highway b-25-I (1), gas Pacific Highway a-90-I (4), gas	5 6 11
Jedney	Aug. 7, 1959	Nov. 24, 1959 Feb. 15, 1960 Jan. 1, 1961 Apr. 1, 1961 Apr. 1, 1963 Oct. 1, 1963	N.T.S. 94-G-1, 94-G-8	3, 6, 9	43	Pacific Pan Am Dome Jedney c-8-F, gas Pacific et al Jedney b-88-J, gas Pacific Imp Jedney d-99-J, gas	3 6 9

TABLE 10.—OIL AND GAS FIELDS DESIGNATED AS OF DECEMBER 31, 1964—*Continued*

Field	Date Designated	Date(s) Revised	Field Location	Pool(s)	Number of Wells Capable of Production	Discovery Well(s)	Pool(s) Discovered
Jedney West	July 1, 1964	—	N.T.S. 94-G-1, 94-G-8	6, 9	3	Pacific et al W Jedney b-84-K, gas	6, 9
Kobes-Townsend	Dec. 22, 1958	Feb. 15, 1960	N.T.S. 94-B-8, 94-B-9	5, 7, 9, 11	12	Pacific Kobes a-3-A (4), gas Pacific Kobes d-94-I (1), gas Pacific Townsend a-20-H (A-1), gas	5 7, 9 11
Kotcho Lake	Apr. 1, 1962	—	N.T.S. 94-I-14	13	3	West Nat Kotcho Lake c-67-K, gas	13
Laprise Creek	Feb. 15, 1960	Jan. 1, 1961 Apr. 1, 1961 Apr. 1, 1963 Jan. 1, 1964 Apr. 1, 1964	N.T.S. 94-G-8, 94-H-4, 94-H-5	6	35	Dome Basco Laprise Ck a-35-H, gas	6
Laprise Creek West	July 1, 1962	—	N.T.S. 94-G-8	6	2	Dome CDP C&E W Laprise c-82-G, gas	6
Milligan Creek	Feb. 7, 1958	Aug. 7, 1959 Feb. 15, 1960 Jan. 1, 1961 Apr. 1, 1962 July 1, 1963	N.T.S. 94-H-2	9	23	Union-HB Milligan Creek d-73-G, oil Whitehall et al Milligan d-75-G, gas	9 9
Montney	Feb. 7, 1958	Jan. 6, 1959 Jan. 1, 1962	Tp. 87, R. 18, W. of 6th M. Tp. 86, 87, R. 19, W. of 6th M.	2, 7, 9	4	Pac Sunray Montney 16-32-86-19 (3), gas Pac Sunray Montney 14-36-86-19 (2), gas Pac Sunray Montney 14-31-86-19 (5), gas	2 7 9
Nig Creek	Aug. 7, 1959	Feb. 15, 1960 Jan. 1, 1961 Apr. 1, 1961 Jan. 1, 1962 Apr. 1, 1962	N.T.S. 94-A-13, 94-H-4	6	18	Texaco NFA Nig Creek a-79-B (1), gas	6
Parkland	Feb. 7, 1958	July 1, 1963	Tp. 81, R. 15, W. of 6th M.	12	2	Pacific Imp Parkland 6-29-81-15, gas	12
Peejay	Feb. 15, 1960	May 27, 1960 Jan. 1, 1961 Jan. 1, 1962 Apr. 1, 1962	N.T.S. 94-A-15, 94-A-16	9	23	Pacific Sinclair Peejay d-39-E (B8-3), oil Pacific SR West Cdn Peejay d-52-I, gas	9 9
Peejay West	Jan. 1, 1963	—	N.T.S. 94-A-15	9	2	Pacific SR West Cdn W Peejay d-54-G, oil	9
Petitot River	Apr. 1, 1961	—	N.T.S. 94-P-12, 94-P-13	13	3	West Nat Petitot River d-24-D, gas	13
Red Creek	Feb. 7, 1958	Aug. 7, 1959 Feb. 15, 1960	Tp. 85, R. 21, W. of 6th M.	7, 9	3	Pacific Red Creek 5-27-85-21 (36), gas	7, 9
Rigel	Oct. 1, 1962	Jan. 1, 1963 Apr. 1, 1963 Jan. 1, 1964 Oct. 1, 1964	N.T.S. 94-A-10 Tp. 87, 88, R. 16, W. of 6th M. Tp. 87, 88, R. 17, W. of 6th M. Tp. 88, R. 18, W. of 6th M. Tp. 88, R. 19, W. of 6th M.	5	28	Imp Fina Rigel 4-27-88-17, gas	5
Snyder Creek	Apr. 1, 1961	—	N.T.S. 94-A-14	5	1	Union Snyder Creek a-28-K (1), gas	5
Stoddart	Jan. 6, 1959	Feb. 15, 1960	Tp. 86, R. 20, W. of 6th M.	10	2	Pacific Stoddart 4-24-86-20 (85), gas	10

Stoddart West	Apr. 1, 1964		Tp. 86, R. 20, W. of 6th M.	10	1	Pacific W Stoddart 11-10-86-20, gas	10
Sunrise	Feb. 7, 1958	Jan. 1, 1961	Tp. 78, 79, R. 16, W. of 6th M.	1	3	Pacific Sunrise 10-7-79-16 (3), gas	1
Wildmint	Jan. 1, 1962	July 1, 1962 Jan. 1, 1963 Apr. 1, 1964	N.T.S. 94-A-15, 94-H-2	9	19	Union-HB-Wildmint d-46-A, oil Tenn Wildmint d-4-A, gas	9 9
Willow	July 1, 1963		N.T.S. 94-H-2	2, 9	3	Union HB Willow d-20-H, oil Union HB Willow b-10-H, gas	2 9

Numerical list of pools:—

1. Lower Cretaceous Cadotte sandstone.
2. Lower Cretaceous Bluesky-Gething sandstone.
3. Lower Cretaceous Gething sandstone.
4. Lower Cretaceous Cadomin sandstone.
5. Lower Cretaceous Dunlevy sandstone.
6. Triassic Baldonnel carbonate (includes Baldonnel A and B of Fort St. John area).
7. Triassic Charlie Lake sandstone and carbonate.
8. Triassic Boundary Lake carbonate.
9. Triassic Halfway sandstone.
10. Permian Belloy carbonate.
11. Mississippian Rundle carbonate.
12. Upper Devonian Wabamun carbonate.
13. Middle Devonian Slave Point carbonate.

TABLE 11.—NUMBER OF PRODUCING AND PRODUCIBLE WELLS AT DECEMBER 31, 1964[1]

Field and Pool	Oil Wells		Natural-gas Wells	
	Producing	Producible	Producing	Producible
Aitken Creek field—Gething	4	5	......	3
Beatton River field—Halfway	9	10	......	1
Beatton River West field—Bluesky-Gething	3	8	......	......
Beg field—				
Baldonnel	......	......	11	17
Halfway	......	......	11	17
Field totals	......	......	22	34
Beg West field—Baldonnel	......	......	2	3
Bernadet field—Bluesky-Gething	......	......	1	1
Blueberry field—				
Dunlevy	......	......	4	7
Baldonnel	......	......	2	4
Charlie Lake	......	......	......	2
Mississippian	19	19	......	......
Field totals	19	19	6	13
Blueberry East field—				
Baldonnel	......	......	1	1
Mississippian	......	......	......	1
Field totals	......	......	1	2
Blueberry West field—				
Dunlevy	......	......	2	2
Baldonnel	......	......	......	1
Field totals	......	......	2	3
Boundary Lake field—				
Bluesky-Gething	......	......	......	2
Gething	......	......	1	2
Dunlevy	......	......	......	1
Baldonnel	......	......	4	6
Boundary Lake	218	247	......	......
Halfway	5	7	......	2
Field totals	223	254	5	13
Bubbles field—Baldonnel	......	......	8	13
Buick Creek field—				
Dunlevy	......	......	15	18
Charlie Lake	......	......	1	1
Field totals	......	......	16	19
Buick Creek East field—				
Bluesky-Gething	......	......	1	2
Dunlevy	......	1	7	9
Field totals	......	1	8	11
Buick Creek West field—				
Gething	......	......	......	1
Dunlevy	......	......	7	9
Dunlevy	......	2	......	......
Baldonnel	......	......	1	2
Halfway	......	......	......	1
Field totals	......	2	8	13
Bulrush field—Halfway	2	3	......	......
Charlie Lake field—Gething	......	1	......	......
Clarke Lake field—Slave Point	......	......	1	8
Dawson Creek field—Cadotte	......	......	1	4
Fort St. John field—				
Cadomin	......	......	......	2
Baldonnel A	......	......	4	6
Baldonnel A/B	......	......	5	6
Charlie Lake	4	4	......	1
Halfway	......	......	5	6
Belloy	......	......	2	2
Belloy	......	1	......	......
Field totals	4	5	16	23

[1] Each zone of a multiple completion is counted as a well.

TABLE 11.—NUMBER OF PRODUCING AND PRODUCIBLE WELLS AT DECEMBER 31, 1964[1]—*Continued*

Field and Pool	Oil Wells		Natural-gas Wells	
	Producing	Producible	Producing	Producible
Fort St. John Airport field—				
Cadomin	......	......	......	1
Baldonnel A	......	......	......	1
Halfway	......	......	......	1
Field totals	......	......	......	3
Fort St. John Southeast field—				
Cadomin	......	......	1	1
Baldonnel A	......	......	1	2
Halfway	......	......	2	6
Belloy	......	......	4	6
Field totals	......	......	8	15
Gundy Creek field—				
Baldonnel	......	......	......	3
Baldonnel/Charlie Lake	......	......	......	1
Field totals	......	......	......	4
Halfway field—				
Baldonnel	......	......	1	2
Halfway	......	......	......	1
Field totals	......	......	1	3
Highway field—				
Dunlevy	......	......	1	1
Baldonnel	......	......	1	4
Mississippian	......	......	1	1
Field totals	......	......	3	6
Jedney field—				
Gething	......	......	......	2
Baldonnel	......	......	15	19
Halfway	......	......	18	22
Field totals	......	......	33	43
Jedney West field—				
Baldonnel	......	......	1	1
Halfway	......	......	1	2
Field totals	......	......	2	3
Kobes-Townsend field—				
Dunlevy	......	......	3	3
Charlie Lake	......	......	5	5
Halfway	......	......	2	2
Mississippian	......	......	2	2
Field totals	......	......	12	12
Kotcho Lake field—Slave Point	......	......	......	3
Laprise Creek field—Baldonnel	......	......	28	35
Laprise Creek West field—Baldonnel	......	......	1	2
Milligan Creek field—Halfway	17	22	......	1
Montney field—				
Bluesky-Gething	......	......	......	1
Charlie Lake	......	......	......	1
Halfway	......	......	1	2
Field totals	......	......	1	4
Nig Creek field—Baldonnel	......	......	12	18
Parkland field—Wabamun	......	......	2	2
Peejay field—Halfway	16	21	......	2
Peejay West field—Halfway	......	2	......	......
Petitot River field—Slave Point	......	......	......	3
Red Creek field—				
Charlie Lake	......	......	1	1
Halfway	......	......	1	2
Field totals	......	......	2	3
Rigel field—Dunlevy	......	......	18	28
Snyder Creek field—Dunlevy	......	......	1	1
Stoddart field—Belloy	......	......	2	2
Stoddart West field—Belloy	......	......	1	1
Sunrise field—Cadotte	......	......	......	3
Wildmint field—Halfway	13	18	......	1

[1] Each zone of a multiple completion is counted as a well.

TABLE 11.—NUMBER OF PRODUCING AND PRODUCIBLE WELLS AT DECEMBER 31 1964[1]—*Continued*

Field and Pool	Oil Wells		Natural-gas Wells	
	Producing	Producible	Producing	Producible
Willow field—				
Bluesky-Gething	1	1	......	......
Halfway	......	......	......	2
Field totals	1	1	......	2
Other areas—				
Cadotte	......	......	......	2
Notikewin	......	......	......	1
Bluesky-Gething	......	2	......	8
Gething	......	......	......	1
Dunlevy	......	......	1	9
Jurassic-Triassic	......	......	......	1
Baldonnel	......	1	......	......
Baldonnel	......	......	......	27
Baldonnel A	......	......	......	1
Charlie Lake	......	......	......	6
Boundary Lake	......	2	......	1
Halfway	......	......	......	24
Halfway	21	26	......	......
Permo-Carboniferous	......	......	......	3
Belloy	......	1	......	6
Mississippian	......	......	......	11
Kiskatinaw	......	......	......	1
Slave Point	......	......	1	19
Slave Point/Sulphur Point	......	......	......	2
Pine Point	......	......	......	5
Nahanni	......	......	......	2
Areas totals	21	32	2	130
Totals	332	404	226	494

[1] Each zone of a multiple completion is counted as a well.

TABLE 12.—MONTHLY CRUDE-OIL PRODUCTION BY FIELDS AND POOLS, 1964

(Quantities in barrels.)

Field and Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Aitken Creek field—Gething	15,573	16,995	18,042	17,507	18,046	17,571	18,062	18,105	17,497	21,033	12,964	20,374	211,769
Beatton River field—Halfway	33,841	27,486	40,840	40,290	41,473	39,924	32,884	39,476	38,105	38,712	34,753	37,979	445,763
Beatton River West field—Bluesky-Gething	5,585	6,039	7,476	8,908	8,748	8,302	7,858	7,842	7,242	7,349	8,121	4,124	87,594
Blueberry field—													
Dunlevy	138	167	—	74	82	40	202	—	28	81	42	9	863
Dunlevy[1]	23	22	26	4	23	24	19	26	19	11	26	23	246
Mississippian	105,148	99,549	105,418	96,516	98,110	83,500	87,851	91,830	88,237	99,365	96,215	97,185	1,148,924
Mississippian[1]	530	271	169	1,414	671	1,132	555	689	175	—	—	—	5,606
Field totals	105,839	100,009	105,613	98,008	98,886	84,696	88,627	92,545	88,459	99,457	96,283	97,217	1,155,639
Boundary Lake field—													
Boundary Lake	572,111	516,768	533,054	512,414	532,112	481,597	494,806	526,080	477,642	390,139	345,025	444,810	5,826,558
Halfway	5,265	5,016	5,300	7,522	9,346	9,266	8,954	7,744	6,571	6,512	7,617	6,126	85,239
Field totals	577,376	521,784	538,354	519,936	541,458	490,863	503,760	533,824	484,213	396,651	352,642	450,936	5,911,797
Buick Creek field—Dunlevy[1]	2,628	2,363	1,981	273	668	1,814	2,167	550	1,354	1,961	1,810	1,406	18,975
Bulrush field—Halfway	2,043	1,559	1,527	97	—	—	—	—	—	—	761	1,669	7,656
Charlie Lake field—Gething	211	417	88	—	135	607	174	134	131	137	120	—	2,154
Fort St. John field—Charlie Lake	2,332	2,531	2,434	2,213	2,411	2,369	2,310	2,260	2,239	2,667	2,427	2,059	28,252
Halfway field—Halfway[1]	—	—	—	—	—	1,490	—	—	—	—	—	—	1,490
Kobes-Townsend field—Charlie Lake[1]	—	—	—	—	—	—	50	—	—	—	—	—	50
Milligan Creek field—Halfway	156,006	146,964	156,813	151,822	124,785	120,822	126,628	126,795	121,620	130,642	129,311	145,785	1,637,993
Peejay field—Halfway	56,165	52,662	89,323	110,611	138,492	133,150	135,709	134,816	132,689	116,212	131,967	133,533	1,365,329
Peejay West field—Halfway	437	—	—	—	—	—	—	—	—	—	—	—	437
Wildmint field—Halfway	30,666	29,759	29,281	30,170	37,912	31,714	28,563	24,638	31,543	40,908	40,254	40,113	395,521
Willow field—Bluesky-Gething	3,343	3,938	3,679	2,821	767	557	646	1,136	1,041	1,022	1,518	1,575	22,043
Other areas—													
Bluesky-Gething	740	—	643	—	—	—	—	—	—	—	—	—	1,383
Halfway	—	249	—	1,496	2,467	2,719	7,265	9,414	27,596	51,339	58,043	95,725	256,313
Belloy	—	—	—	—	—	—	—	—	—	—	—	1,685	1,685
Areas totals	740	249	643	1,496	2,467	2,719	7,265	9,414	27,596	51,339	58,043	97,410	259,381
Totals	992,785	912,755	996,094	984,152	1,016,248	936,598	954,703	991,535	953,729	908,090	870,974	1,034,180	11,551,843

[1] Condensate.

TABLE 13.—MONTHLY NATURAL-GAS PRODUCTION BY FIELDS AND POOLS, 1964

(Quantities in M s.c.f.)

Field and Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Beg field—													
Baldonnel	581,245	414,819	365,355	273,102	314,691	401,610	427,300	455,667	187,544	491,149	628,043	555,071	5,095,596
Halfway	814,807	618,484	509,935	337,738	586,493	457,331	445,462	417,415	172,847	654,666	720,603	559,105	6,294,886
Field totals	1,396,052	1,033,303	875,290	610,840	901,184	858,941	872,762	873,082	360,391	1,145,815	1,348,646	1,114,176	11,390,482
Beg West field—Baldonnel	9,411	19,438	21,116	5,450	12,225	15,248	14,392	12,777	1,590	6,715	38,956	30,578	187,896
Bernadet field—Bluesky-Gething	*17,145*	*19,692*	*24,590*	*20,036*	*16,708*	*18,734*	*2,985*	—	*1,125*	*27,794*	*26,028*	*29,888*	*204,725*
Blueberry field—													
Dunlevy	101,453	101,444	115,098	97,239	100,769	102,500	72,354	53,923	67,697	99,711	97,816	104,703	1,114,707
Baldonnel	23,859	20,237	20,130	18,917	17,885	21,914	—		2,502	60,842	60,900	59,152	306,338
Charlie Lake	—	—	—	—	3,622	3,016	—	—	—	—	—	—	
Mississippian	—	—	—	—	—	—	—	—	—	—	—	—	6,638
Field totals	125,312	121,681	135,228	116,156	122,276	127,430	72,354	53,923	70,199	160,553	158,716	163,855	1,427,683
Blueberry East field—Baldonnel	30,145	33,727	36,017	31,348	37,771	38,667	7,457	—	4,702	28,152	32,102	35,608	315,696
Blueberry West field—Dunlevy	13,936	13,095	14,914	13,323	14,080	7,918	14,073	12,213	12,642	13,477	12,291	12,268	154,230
Boundary Lake field—													
Gething	66,729	58,151	75,496	70,932	70,883	65,408	—	25,929	62,006	58,936	16,720	70,014	641,204
Baldonnel	170,060	170,348	149,738	152,570	149,398	123,029	—	80,603	190,426	180,025	147,767	130,434	1,644,398
Field totals	236,789	228,499	225,234	223,502	220,281	188,437	—	106,532	252,432	238,961	164,487	200,448	2,285,602
Bubbles field—Baldonnel	850,736	681,309	783,142	761,464	560,078	154,768	477,400	477,843	356,515	568,309	586,461	686,440	6,944,465
Buick Creek field—													
Dunlevy	1,065,214	877,059	1,126,020	1,071,517	816,370	644,745	722,562	560,289	976,490	798,483	1,057,917	1,163,005	10,879,671
Charlie Lake	33,573	25,910	28,101	20,777	22,995	14,487	14,033	280	14,959	124,956	23,544	31,202	354,817
Field totals	1,098,787	902,969	1,154,121	1,092,294	839,365	659,232	736,595	560,569	991,449	923,439	1,081,461	1,194,207	11,234,488
Buick Creek East field—													
Bluesky-Gething	2,842	9,765	9,717	12,015	10,866	11,109	13,613	5,843	—	5,475	4,193	576	86,014
Dunlevy	326,894	180,149	289,006	303,324	253,460	231,919	158,929	178,124	170,172	211,656	239,504	188,635	2,731,772
Field totals	329,736	189,914	298,723	315,339	264,326	243,028	172,542	183,967	170,172	217,131	243,697	189,211	2,817,786
Buick Creek West field—													
Dunlevy	465,852	410,222	459,367	406,730	418,956	180,128	293,992	206,725	373,128	249,304	356,905	433,503	4,254,812
Baldonnel	51,786	43,255	49,749	46,637	46,029	21,161	—	9,286	43,044	39,127	45,232	46,388	441,694
Field totals	517,638	453,477	509,116	453,367	464,985	201,239	293,992	216,011	416,172	288,431	402,137	479,891	4,696,506
Clarke Lake field—Slave Point	14,240	12,920	16,076	10,374	10,449	8,428	7,041	7,485	8,282	13,583	21,022	28,086	157,986
Dawson Creek field—Cadotte	27,730	27,401	28,059	27,991	27,114	25,934	23,212	27,034	23,797	24,398	24,687	26,611	313,968
Fort St. John field—													
Baldonnel A	192,663	122,231	150,696	67,602	55,233	45,101	46,753	89,767	154,573	147,457	131,624	146,905	1,350,605
Baldonnel A/B	306,130	148,639	255,836	241,709	172,033	195,491	186,615	234,424	195,138	187,737	217,394	277,684	2,618,830
Halfway	213,356	96,613	177,521	158,878	122,624	129,793	112,384	142,342	108,581	144,050	136,461	240,035	1,782,638
Belloy	68,350	24,352	59,724	49,017	49,394	38,633	24,693	51,968	35,371	42,884	44,663	64,261	553,310
Field totals	780,499	391,835	643,777	517,206	399,284	409,018	370,445	518,501	493,663	522,128	530,142	728,885	6,305,383

Fort St. John Southeast field—													
Cadomin	50,749	20,607	47,691	42,370	33,299	38,507	35,036	34,227	27,864	29,902	28,018	30,196	418,466
Baldonnel A	60,781	24,842	54,155	46,772	45,947	37,177	38,390	50,069	39,527	25,206	29,996	38,446	491,308
Halfway	108,597	55,969	105,177	96,850	79,767	74,469	72,268	84,238	64,647	65,327	83,713	108,173	999,195
Belloy	446,195	355,380	404,011	371,852	352,433	343,144	339,017	387,001	313,436	368,566	361,310	441,876	4,484,221
Field totals	666,322	456,798	611,034	557,844	511,446	493,297	484,711	555,535	445,474	489,001	503,037	618,691	6,393,190
Halfway field—													
Baldonnel	41,583	36,522	37,880	37,533	37,394	33,774	8,027	—	11,257	36,786	27,078	4,309	312,143
Halfway	19,100	17,939	8,195	15,009	—	418	—	—	—	—	—	—	60,661
Field totals	60,683	54,461	46,075	52,542	37,394	34,192	8,027	—	11,257	36,786	27,078	4,309	372,804
Highway field—													
Dunlevy	13,048	9,934	10,224	14,823	4,043	12,460	2,943	—	2,425	15,011	13,652	10,145	108,708
Baldonnel	9,961	127	—	—	—	—	—	1,391	8,265	9,726	7,567	1,486	38,523
Mississippian	39,789	1,757	—	—	—	—	—	4,575	41,365	51,488	46,070	47,356	232,400
Field totals	62,798	11,818	10,224	14,823	4,043	12,460	2,943	5,966	52,055	76,225	67,289	58,987	379,631
Jedney field—													
Gething	—	22,471	—	—	—	—	—	—	—	—	—	—	22,471
Baldonnel	1,054,683	795,230	1,130,334	789,295	948,351	685,635	737,631	737,730	833,320	1,102,534	1,179,761	1,231,391	11,225,895
Halfway	933,249	910,817	930,855	959,852	865,737	614,804	701,967	437,129	644,423	1,052,341	1,090,100	1,140,582	10,281,856
Field totals	1,987,932	1,728,518	2,061,189	1,749,147	1,814,088	1,300,439	1,439,598	1,174,859	1,477,743	2,154,875	2,269,861	2,371,973	21,530,222
Jedney West field—													
Baldonnel	—	14,639	20,935	7,323	—	—	—	—	—	13,168	19,046	19,438	94,549
Halfway	4,810	34,588	38,670	8,154	—	—	—	—	—	23,660	31,924	22,687	164,493
Field totals	4,810	49,227	59,605	15,477	—	—	—	—	—	36,828	50,970	42,125	259,042
Kobes-Townsend field—													
Dunlevy	102,806	93,088	58,036	54,943	27,774	63,389	83,350	39,142	36,959	91,250	114,412	118,265	883,414
Charlie Lake	130,769	100,505	83,214	73,156	90,134	64,262	65,141	35,908	126,065	155,499	244,148	248,548	1,417,349
Halfway	194,521	233,041	249,769	231,777	166,151	227,700	252,443	151,013	180,849	225,799	232,537	265,030	2,610,630
Mississippian	171,025	173,343	188,396	182,202	179,715	148,202	177,482	102,200	6,589	179,185	26,075	23,737	1,558,151
Field totals	599,121	599,977	579,415	542,078	463,774	503,553	578,416	328,263	350,462	651,733	617,172	655,580	6,469,544
Laprise Creek field—Baldonnel	1,394,220	1,490,907	1,365,850	1,437,063	1,390,072	544,057	578,270	933,735	1,354,812	1,268,236	1,474,076	1,604,635	14,835,933
Laprise Creek West field—Baldonnel	3,492	24,300	13,682	17,403	9,329	21,886	4,988	331	13,626	23,970	17,623	8,044	158,674
Montney field—Halfway	42,544	40,465	41,733	40,028	21,301	39,309	39,320	19,938	26,746	42,512	28,885	19,476	402,257
Nig Creek field—Baldonnel	873,359	1,296,383	1,257,691	925,233	752,601	935,322	882,197	820,319	1,216,417	744,285	1,143,457	1,267,644	12,114,908
Parkland field—Wabamun	355,509	345,550	332,458	181,517	63,105	165,233	220,907	308,534	149,660	361,020	330,696	380,974	3,195,163
Red Creek field—													
Charlie Lake	32,469	31,255	11,818	2,243	19,306	164	33,895	23,203	7,999	44,910	54,829	37,613	299,704
Halfway	55,313	55,988	26,683	2,041	8,272	—	29,420	13,787	10,599	31,546	34,557	17,260	285,466
Field totals	87,782	87,243	38,501	4,284	27,578	164	63,315	36,990	18,598	76,456	89,386	54,873	585,170

TABLE 13.—MONTHLY NATURAL-GAS PRODUCTION BY FIELDS AND POOLS, 1964—*Continued*

(Quantities in M s.c.f.)

Field and Pool	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Rigel field—Dunlevy	1,041,425	1,016,195	827,417	1,001,857	1,097.945	612,991	559.865	381,812	849,992	515,168	1,157,783	1,473,162	10,535,612
Snyder Creek field—Dunlevy	36,032	22,315	31,047	30,682	17,603	20,552	16,772	—	6,886	23,756	9,100	15,372	230,117
Stoddart field—Belloy	337,733	292,328	411,261	353,909	140,921	175,203	290,951	350,614	202,786	335,834	347,174	433,069	3,671,783
Stoddart West field—Belloy	79,397	86,606	53,049	52,068	25,041	51,647	37,565	45,360	36,922	96,939	80,319	86,052	730,965
Other areas—													
Dunlevy	—	—	—	—	—	—	—	—	—	1,316	15,622	8,157	25,095
Baldonnel	—	—	—	—	—	—	—	—	—	—	—	—	—
Permo-Carboniferous	—	—	—	—	—	—	—	21,151	66,259	—	—	—	87,410
Slave Point	—	—	—	—	—	—	—	—	—	19,319	75,937	66,742	161,998
Area totals	—	—	—	—	—	—	—	21,151	66,259	20,635	91,559	74,899	274,503
Totals	13,081,315	11,732,351	12,505,634	11,174,645	10,266,367	7,867,377	8,273,095	8,033,344	9,442,826	11,133,145	12,976,298	14,090,017	130,576,414

NOTE.—Table 13 shows gas production from gas wells only and does not include associated gas.

TABLE 14.—SUMMARY OF DRILLING AND PRODUCTION STATISTICS, 1964

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Drilling Authorities—													
Issued	19	19	11	—	4	11	17	5	16	16	12	16	146
Cancelled	—	—	—	1	—	—	—	—	—	1	—	1	3
Wells spudded	22	18	17	—	1	11	15	6	10	16	17	10	143
Rigs operated during month	27	32	33	8	4	12	14	14	12	19	20	18	43[1]
Rigs operating at month's end	23	27	8	3	2	9	12	6	10	12	9	11	—
Development footage	29,312	27,009	48,254	73	861	33,368	62,517	22,848	33,605	55,327	39,422	33,078	385,676
Exploratory outpost footage	23,667	31,155	21,251	312	—	3,985	12,667	3,121	3,888	1,310	22,918	12,950	137,224
Exploratory wildcat footage	37,646	56,500	24,525	6,808	581	—	—	—	—	5,449	8,809	11,624	151,942
Total footage drilled	90,625	114,664	94,030	7,195	1,442	37,353	75,184	25,969	37,493	62,086	71,149	57,652	674,842
Wells abandoned	8	8	21	—	2	—	1	2	1	3	9	5	60
Service wells	—	—	1	—	—	2	—	—	—	—	1	—	4
Oil wells completed	2	4	3	—	—	2	8	6	3	6	8	3	45
Producible oil wells	389	393	392	392	392	375	383	388	391	393	401	404	404
Producing oil wells	352	341	346	346	336	315	321	338	340	324	310	332	—
Production in barrels	992,785	912,755	996,094	984,152	1,016,248	936,598	954,703	991,535	953,729	908,090	870,974	1,034,180	11,551,843
Average daily production	32,025	32,598	32,132	32,805	32,782	31,220	30,797	31,985	31,791	29,293	29,032	33,361	—
Gas wells completed	3	3	8	5	—	2	3	4	2	4	2	1	37
Producible gas wells	465	468	475	475	474	475	477	481	484	488	491	494	494
Producing gas wells	220	226	217	199	198	200	184	191	207	233	237	226	—
Production in M s.c.f.	13,081,315	11,732,351	12,505,634	11,174,645	10,266,367	7,867,377	8,273,095	8,033,344	9,442,826	11,133,145	12,976,298	14,090,017	130,576,414
Average daily production	421,978	419,013	403,408	372,488	331,173	262,246	266,874	259,140	314,761	359,134	432,543	454,517	—

[1] Rigs operated during 1964.

NOTE.—Each zone of a multiple completion is counted as one well.

TABLE 15.—MONTHLY CRUDE-OIL DISPOSITION, 1964

(Quantities in barrels.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Field													
Production—													
Crude oil	989,604	910,099	993,918	982,461	1,014,886	932,138	951,912	990,270	952,181	906,118	869,138	1,032,751	11,525,476
Condensate[1]	3,181	2,656	2,176	1,691	1,362	4,460	2,791	1,265	1,548	1,972	1,836	1,429	26,367
Totals	992,785	912,755	996,094	984,152	1,016,248	936,598	954,703	991,535	953,729	908,090	870,974	1,034,180	11,551,843
Opening inventory	36,784	33,655	33,837	33,408	26,668	33,038	34,365	36,870	33,533	44,740	32,814	37,624	36,784
Injection oil recovered	1,486	3,177	4,279	1,629	941	2,576		684	2,038	610	2,503	1,108	21,031
Other oil receipts					2,190		5,960	16,267	21,003	7,928	2,080	11,926	67,354
Losses and adjustments													
Transfers and well-head sales	2,529	4,994	5,510	2,052	3,137	4,992	4,846	9,642	17,999	5,580	7,705	11,772	80,758
Deliveries to transporters	994,871	910,756	995,292	990,469	1,009,872	932,855	953,312	1,002,181	947,564	922,974	863,042	1,035,078	11,558,266
Closing inventory	33,655	33,837	33,408	26,668	33,038	34,365	36,870	33,533	44,740	32,814	37,624	37,988	37,988
Reporting adjustment	590	120	—65	8			—1,188	—163		—158	—4,037	—5,954	—10,847
Transporters													
Receipts—													
B.C. crude	994,281	910,636	995,357	990,461	1,009,872	932,855	954,500	1,002,344	947,564	923,132	867,079	1,041,032	11,569,113
B.C. plant condensate	87,405	73,811	96,886	40,831	40,264	24,268	31,101	31,085	30,151	64,129	53,288	70,142	643,361
Opening inventory	1,129,607	988,488	1,072,969	1,041,267	1,195,222	1,168,703	909,072	939,120	1,086,977	1,032,253	1,012,628	969,972	1,129,607
Losses and adjustments	1,284	—9,571	750	8,712	—9,603	21,788	8,917	—23,924	17,724	3,403	72,443	—71,685	20,238
Deliveries—													
B.C. Refineries	1,164,055	800,759	1,030,975	790,355	1,043,207	1,108,790	811,718	823,799	929,517	960,272	834,213	996,294	11,293,954
Alberta													
Export	57,466	108,778	92,220	78,270	43,051	86,176	134,918	85,697	85,198	43,211	56,127	71,559	942,671
Other											240	480	720
Total deliveries	1,221,521	909,537	1,123,195	868,625	1,086,258	1,194,966	946,636	909,496	1,014,715	1,003,483	890,580	1,068,333	12,237,345
Closing inventory	988,488	1,072,969	1,041,267	1,195,222	1,168,703	909,072	939,120	1,086,977	1,032,253	1,012,628	969,972	1,084,498	1,084,498
Reporting adjustment	—24	249	—246	2		17,500	—17,500	1	1				—17
B.C. Refineries													
Receipts—													
B.C. crude	1,164,079	800,510	1,031,221	790,353	1,043,207	1,091,290	829,218	823,798	929,516	960,272	834,213	996,294	11,293,971
Alberta crude	1,545,070	1,733,743	1,696,174	1,890,712	1,810,281	1,298,510	843,762	507,474	1,485,801	1,976,271	1,783,885	2,009,138	18,580,821
Opening inventory	538,645	586,985	644,374	586,613	600,426	598,321	542,943	736,137	650,165	530,680	757,168	685,947	538,645
Losses and adjustments	1,384	421	501	982	732	—16,820	17,188	—140	1,104	223	—40	14	5,549
Refinery runs	2,659,425	2,476,443	2,784,655	2,666,270	2,854,861	2,461,998	1,462,598	1,417,384	2,533,698	2,709,832	2,689,359	3,027,790	29,744,313
Closing inventory	586,985	644,374	586,613	600,426	598,321	542,943	736,137	650,165	530,680	757,168	685,947	663,575	663,575

[1] For complete summary of condensate production and disposition *see* Table 17.

TABLE 16.—MONTHLY NATURAL-GAS DISPOSITION, 1964

(Quantities in M s.c.f.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Field													
B.C. production—													
Wet gas	12,683,836	11,346,480	12,129,041	10,954,763	10,165,699	7,667,782	8,021,935	7,690,291	9,261,087	10,734,144	12,599,893	13,654,346	126,909,297
Dry gas	397,479	385,871	376,593	219,882	100,668	199,595	251,160	343,053	181,739	399,001	376,405	435,671	3,667,117
Associated gas	1,304,278	1,206,946	1,278,570	1,240,004	1,323,317	1,237,411	1,322,038	1,635,047	1,551,819	1,399,719	1,342,714	1,480,978	16,322,841
Totals	14,385,593	12,939,297	13,784,204	12,414,649	11,589,684	9,104,788	9,595,133	9,668,391	10,994,645	12,532,864	14,319,012	15,570,995	146,899,255
Flared	1,146,000	1,056,623	1,201,107	1,195,011	1,186,002	1,157,577	960,102	1,031,969	426,896	435,045	421,331	448,990	10,666,653
Lease use	122,509	96,423	99,083	107,332	89,234	70,073	139,197	70,849	80,740	130,885	198,684	179,935	1,384,944
Gas used for drilling								21,151	66,259				87,410
Metering difference	160,058	−6,861	−110,990	−187,202	−39,095	−54,204	−60,105	−54,706	12,217	−159,562	−84,670	−56,828	−641,948
To gas-injection system			42,167	14,992	4,811	47,584	73,994	191,101	241,741	203,832	265,702	210,474	1,296,398
Delivered to gathering system	12,957,026	11,793,112	12,552,837	11,284,516	10,348,732	7,883,758	8,481,945	8,408,027	10,166,792	11,922,664	13,517,965	14,788,424	134,105,798
Reporting adjustment	141,471	122,529	29,112	2,186	1,870	1,761	8,724	−173,082	321,345	166,735	42,935	135,078	800,664
Gas-gathering System													
Received from B.C. producers	12,815,555	11,670,583	12,523,725	11,282,330	10,346,862	7,881,997	8,473,221	8,581,109	9,845,447	11,755,929	13,475,030	14,653,346	133,305,134
Line loss and metering difference										3,987	2,416	7,172	13,575
Delivered to—													
Gas plants	12,420,584	11,286,878	12,176,179	11,063,817	10,246,704	7,683,129	8,223,725	8,238,900	9,664,179	11,353,586	13,096,692	14,211,347	129,665,720
Transporters	380,731	370,785	331,340	208,139	89,709	190,440	242,455	334,724	172,986	384,773	354,900	406,741	3,467,723
Distributors	14,240	12,920	16,206	10,374	10,449	8,428	7,041	7,485	8,282	13,583	21,022	28,086	158,116
Gas Plants													
Receipts from gathering system	12,420,584	11,286,878	12,176,179	11,063,817	10,246,704	7,683,129	8,223,725	8,238,900	9,664,179	11,353,586	13,096,692	14,211,347	129,665,720
Plant fuel	262,415	214,623	218,598	181,669	185,066	173,654	193,514	204,714	218,355	278,509	255,166	262,924	2,649,207
Processing shrinkage	558,907	529,754	576,437	482,799	447,265	393,636	420,565	410,485	387,724	587,523	622,328	652,935	6,070,358
Plant waste and metering difference	531,326	346,197	426,452	516,171	386,108	155,775	176,417	206,188	300,803	494,379	703,678	946,130	5,189,624
Residual gas used on lease							79,869	2,081	1,703	21.019	11,361	17,317	133,350
Natural gas used on lease							33,025	35,105	27,630	12.677	29,706	20,014	158,157
Marketable residual gas	11,067,936	10,196,304	10,954,692	9,883,178	9,228,265	6,960,064	7,320,335	7,380,327	8,727,964	9,959,479	11,474,453	12,312,027	115,465,024
Reporting adjustment		−1					5	−348	472		192		320
Transporters													
Receipts—													
Residual gas from plants	11,067,936	10,196,305	10,954,692	9,883,178	9,228,265	6,960,064	7,320,330	7,380,675	8,727,492	9,959,479	11,474,261	12,312,027	115,464,704
Dry gas from gathering system	380,731	370,785	358,793	208,139	89,709	190,440	242,455	334,724	172,987	384.773	354,899	406,741	3,495,176
Alberta dry gas	2,994,056	2,848,532	2,889,492	2,651,051	2,475,885	2,001,935	1,543,009	2,030,449	2,390,965	2,570,556	2,615,068	2,876,105	29,887,103
Totals	14,442,723	13,415,622	14,202,977	12,742,368	11,793,859	9,152,439	9,105,794	9,745,848	11,291,444	12,914,808	14,444,228	15,594,873	148,846,983

TABLE 16.—MONTHLY NATURAL-GAS DISPOSITION, 1964—*Continued*

(Quantities in M s.c.f.)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Reporting adjustment	271,475	307,007	333,570	172,708	249,418	104,725	87,516	370,006	72,248	−1,349,998	267,365	440,625	1,326,665
Deliveries to B.C. distributors—													
Northeast	277,297	203,985	257,696	167,583	136,931	96,740	87,183	93,129	134,232	166,685	234,939	325,529	2,181,929
Interior	1,219,655	1,105,661	1,110,726	861,895	719,193	627,723	525,079	606,929	801,417	969,488	1,167,700	1,415,904	11,131,370
Lower Mainland	3,223,326	2,923,497	3,144,506	2,516,756	2,209,977	1,468,358	1,324,749	1,372,074	1,892,312	2,583,836	3,620,817	4,316,255	30,596,463
Totals	4,720,278	4,233,143	4,512,928	3,546,234	3,066,101	2,192,821	1,937,011	2,072,132	2,827,961	3,720,009	5,023,456	6,057,688	43,909,762
Deliveries to export—													
B.C. gas	7,549,105	7,048,494	7,511,212	7,195,727	6,745,592	5,402,355	5,920,608	5,822,236	6,655,413	8,831,416	7,554,696	7,488,333	83,725,187
Alberta gas	1,901,865	1,826,978	1,845,267	1,827,699	1,732,748	1,452,538	1,160,659	1,481,474	1,735,822	1,713,381	1,598,711	1,608,227	19,885,369
Total deliveries	14,171,248	13,108,615	13,869,407	12,569,660	11,544,441	9,047,714	9,018,278	9,375,842	11,219,196	14,264,806	14,176,863	15,154,248	147,520,318
Reporting adjustment	−6,757	−6,924	−4,430	−5,410	−5,381	−1,265	−162	9,437	−10,229	790	8,177	−48,121	−70,275
B.C. Distributors													
Received from transporters	4,727,035	4,240,067	4,517,358	3,551,644	3,071,482	2,194,086	1,937,173	2,062,695	2,838,190	3,719,219	5,015,279	6,105,809	43,980,037
Received from gathering system	14,240	12,920	16,076	10,374	10,449	8,428	7,041	7,485	8,282	13,583	21,022	28,086	157,986
Losses and adjustments	63,898	26,344	131,663	−95,102	−27,275	−17,178	29,509	53,747	191,541	199,732	328,319	451,176	1,336,374
Deliveries to consumers—													
Residential	2,231,994	1,962,248	1,884,467	1,449,634	971,230	614,268	467,065	456,157	663,380	1,082,176	1,853,840	2,645,889	16,282,348
Commercial	733,079	663,739	624,607	504,700	350,023	234,321	185,249	195,345	253,069	376,030	601,574	843,517	5,565,253
Industrial	1,712,304	1,600,656	1,892,697	1,702,786	1,787,953	1,371,103	1,262,391	1,364,931	1,738,482	2,074,864	2,252,568	2,193,313	20,954,048
Total sales	4,677,377	4,226,643	4,401,771	3,657,120	3,109,206	2,219,692	1,914,705	2,016,433	2,654,931	3,533,070	4,707,982	5,682,719	42,801,649
Reporting adjustment													

Table 17.—Monthly Natural-gas Liquids and Sulphur Disposition, 1964

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Condensate/Pentanes Plus													
Production (bbl.)—													
Field	3,181	2,656	2,176	1,691	1,362	4,460	2,791	1,265	1,548	1,972	1,836	1,429	26,367
Plant	84,092	80,627	83,855	75,303	73,221	54,497	62,676	68,902	72,855	82,871	93,288	90,024	922,211
Opening inventory	25,801	24,232	28,176	18,585	25,933	28,774	14,739	13,472	23,492	19,865	15,875	27,770	25,801
Receipts	...	...	...	421	1,120	800	128	...	746	450	376	...	4,041
Losses and adjustments	−2,574	−1,292	−3,401	−2,927	−9,473	4,930	−1,138	−2,935	−3,136	−3,659	−2,328	−2,104	−30,037
Transfers	...	...	...	830	112	250	50	...	...	...	...	...	1,242
Closing inventory	24,232	28,176	18,585	25,933	28,774	14,739	13,472	23,492	19,865	15,875	27,770	15,873	15,873
Sales—													
British Columbia—													
Northeast B.C. refineries	4,011	6,795	1,966	31,333	41,959	42,854	33,629	23,955	47,361	25,570	28,345	28,494	316,272
Other B.C. refineries	...	25	171	...	...	1,490	3,220	8,042	4,400	3,243	4,300	6,818	31,709
Alberta	...	...	...	...	...	...	...	...	...	...	...	...	...
Export	87,405	73,811	96,886	40,831	40,264	24,268	31,101	31,085	30,151	64,129	53,288	70,142	643,361
Total sales	91,416	80,631	99,023	72,164	82,223	68,612	67,950	63,082	81,912	92,942	85,933	105,454	991,342
Butane													
Production (bbl.)—													
Plant	37,511	37,596	41,298	31,524	30,280	33,566	35,781	40,509	41,187	46,222	42,106	44,179	461,759
Refinery	18,544	14,490	16,817	7,890	5,811	6,947	1,424	1,476	22,525	23,926	23,761	17,022	160,633
Opening inventory	11,354	13,621	12,863	13,755	15,144	14,875	15,954	11,586	8,124	13,896	8,926	7,677	11,354
Losses, transfers, consumed	23,591	26,522	35,614	27,416	26,486	28,351	26,407	25,307	28,641	36,126	33,682	37,457	355,600
Closing inventory	13,621	12,863	13,755	15,144	14,875	15,954	11,586	8,124	13,896	8,926	7,677	7,231	7,231
Sales—													
British Columbia	18,585	12,496	10,792	10,609	9,874	9,055	13,284	19,024	21,130	23,191	23,758	19,187	190,985
Alberta	...	...	...	...	...	2,028	1,882	1,116	269	952	625	...	6,872
Export	11,612	13,826	10,817	...	...	...	...	...	7,900	14,849	9,051	5,003	73,058
Total sales	30,197	26,322	21,609	10,609	9,874	11,083	15,166	20,140	29,299	38,992	33,434	24,190	270,915
Propane													
Production (bbl.)—													
Plant	21,766	18,776	16,616	13,979	10,585	8,981	11,050	21,853	26,300	31,615	29,504	33,779	244,804
Refinery	28,506	22,235	28,745	27,658	25,889	22,876	22,144	13,903	23,151	26,968	27,186	28,637	297,898
Opening inventory	4,978	3,489	4,189	4,204	4,542	5,051	4,305	3,056	3,406	6,540	7,121	10,605	4,978
Losses, transfers, consumed	1,106	5,434	615	252	51	748	4,848	11,412	10,740	15,583	8,697	8,855	68,341
Closing inventory	3,489	4,189	4,204	4,542	5,051	4,305	3,056	3,406	6,540	7,121	10,605	10,377	10,377

TABLE 17.—MONTHLY NATURAL-GAS LIQUIDS AND SULPHUR DISPOSITION, 1964—*Continued*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Sales—													
British Columbia	44,425	33,588	39,121	30,710	27,465	24,193	24,232	22,239	30,896	36,543	42,370	49,408	405,190
Alberta	248				156	44			299		212	2,281	3,240
Manitoba							181						181
Northwest Territories	555	134											689
Yukon	1,175	766	400	1,619	936	1,050	870	1,220	852	1,262	1,140	1,714	13,004
Export	4,252	389	5,210	8,718	7,357	6,568	4,312	535	3,530	4,614	787	386	46,658
Total sales	50,655	34,877	44,731	41,047	35,914	31,855	29,595	23,994	35,577	42,419	44,509	53,789	468,962
Sulphur													
Production (short tons)	6,500	5,790	6,035	4,880	5,366	4,708	5,220	4,180	2,837	6,742	7,066	6,512	65,836
Opening inventory	96,487	97,619	96,785	97,144	96,365	96,129	95,334	94,719	92,859	91,219	91,842	94,208	96,487
Losses and adjustments													
Closing inventory	97,619	96,785	97,144	96,365	96,129	95,334	94,719	92,859	91,219	91,842	94,208	93,135	93,135
Sales—													
British Columbia	901	1,278	992	1,047	1,052	994	1,399	1,007	1,134	1,041	1,143	1,052	13,040
Export	4,467	5,346	4,684	4,612	4,550	4,509	4,436	5,033	3,343	5,078	3,557	6,533	56,148
Total sales	5,368	6,624	5,676	5,659	5,602	5,503	5,835	6,040	4,477	6,119	4,700	7,585	69,188

TABLE 18.—MONTHLY VALUE OF CRUDE OIL, NATURAL GAS, NATURAL-GAS LIQUIDS, AND SULPHUR TO PRODUCER, 1964

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Crude oil	$2,015,007	$1,849,167	$2,012,733	$2,007,265	$2,046,561	$1,894,337	$1,909,623	$2,038,466	$1,923,564	$1,864,086	$1,769,801	$2,129,542	$23,460,152
Natural gas	1,169,861	1,082,284	1,158,243	1,034,607	954,802	737,640	780,611	793,229	911,882	1,056,052	1,212,081	1,301,524	12,192,816
Products—													
Natural-gas liquids[1]	$68,600	$63,687	$68,486	$61,075	$61,630	$56,792	$60,750[2]	$76,010[2]	$65,578[2]	$79,341[2]	$73,441[2]	$78,395[2]	$813,785
Sulphur	9,132	7,038	7,443	4,701	5,197	4,398	5,010	3,983	2,649	10,119	12,406	9,269	81,345
Totals	$77,732	$70,725	$75,929	$65,776	$66,827	$61,190	$65,760	$79,993	$68,227	$89,460	$85,847	$87,664	$895,130
Total values	$3,262,600	$3,002,176	$3,246,905	$3,107,648	$3,068,190	$2,693,167	$2,755,994	$2,911,688	$2,903,673	$3,009,598	$3,067,729	$3,518,730	$36,548,098

1 Includes condensate/pentanes plus, butane, and propane.
2 Includes proceeds from sale of natural-gas liquids from Boundary Lake Gas Conversion Plant.
NOTE.—This statement includes amendments received to April 15, 1965.

Table 19.—Natural-gas Pipe-lines, 1964

Company	Source of Natural Gas	Transmission-lines		Compressor Stations		Present Daily Capacity (M S.C.F.)	Gathering and Distribution Lines		Areas Served by Distributors
		Size (In.)	Mileage	Number	Horse-power		Size (In.)	Mileage	
British Columbia Hydro and Power Authority	Westcoast Transmission Co. Ltd.	30	38.6	...	...	528,000	...	2,548	Lower Mainland of British Columbia.
		24	14.1	...	...	...	...	...	
		20	43.2	...	...	...	...	...	
		18	37.2	...	...	...	...	...	
		16	21.2	...	...	...	...	...	
		12	77.5	...	...	...	...	...	
Columbia Natural Gas Ltd.	Alberta Natural Gas Co. Ltd.	6	37.7	...	...	17,130	8	1.7	Cranbrook, Fernie, Kimberley, Chapman Camp, Creston, Marysville.
		4	11.2	...	...	...	6	2.4	
		3	27.7	...	...	...	4	5.8	
		2	0.5	...	...	...	3	12.0	
							2	24.7	
							1¼	27.6	
Gas Trunk Line of British Columbia Ltd.	Beg field	...	...	...	...	...	16	27.4	To Westcoast Transmission Co. Ltd.
							6⅝	8.8	
	Boundary Lake field	...	...	...	...	...	16	31.4	
	Jedney and Bubbles fields	...	...	...	...	...	12¾	31.5	
							10¾	7.0	
	Laprise Creek field	...	...	...	...	...	12¾	23.8	
	Nig Creek	...	...	...	...	...	16	28.3	
Inland Natural Gas Co. Ltd.	Westcoast Transmission Co. Ltd.	12	152.8	...	...	50,000	8	12.2	Okanagan and West Kootenay areas.
		10	116.0	...	...	...	6	18.3	
		8	15.6	...	...	...	4	58.7	
		6	34.0	...	...	...	3	33.3	
		4	75.5	...	...	...	2	293.5	
		2	6.1	...	...	...	1½	20.7	
							1¼	20.2	
Northland Utilities (B.C.) Ltd.	Peace River Transmission	...	9.4	...	...	9,700	...	53.9	Dawson Creek, Pouce Coupe, and Rolla.
Plains Western Gas & Electric Co. Ltd.	Westcoast Transmission Co. Ltd.	6	0.3	...	...	...	4	6.9	Fort St. John, Aennofield, and Taylor.
		4	10.8	...	...	...	3	1.6	
		3	5.7	...	...	...	2	22.0	
		2	0.9	...	...	...	1¼	0.1	
Sun Oil Co. Ltd.	Buick Creek field	...	...	1	495	15,000	8	1.5	To Westcoast Transmission Co. Ltd.
							6	1.0	
							4	1.2	
Sun Oil Co. Ltd.	Rigel field	...	...	...	...	...	3½	1.2	To Westcoast Transmission Co. Ltd.

Westcoast Transmission Co. Ltd.	McMahon Plant and 26-inch line from Alberta	30	646.6	5	64,600	450,000[1]	....	....	To Plains Western Gas & Electric Co. Ltd., Inland Natural Gas. Co. Ltd., British Columbia Hydro and Power Authority, and export to the United States.
	Alberta	26	32.5	....	....	215,000	....	....	
	Alaska Highway system	—	—	—	—	—	26	37.5	
							20	19.3	
							18	17.9	
							12¾	9.9	
	Blueberry West field	....	....	....	....	....	8⅝	6.7	
	Boundary Lake field	....	....	....	....	....	16	0.5	
	Buick Creek field	....	....	....	....	....	10¾	5.6	
	Buick Creek East field	....	....	....	....	....	8	6.6	
	Buick Creek West field	....	....	1	1,980	....	20	16.2	
	Clarke Lake field	....	....	....	....	....	16	8.2	
	Dawson Creek field	....	....	....	....	....	8⅝	5.4	
	Fort St. John field	....	....	1	2,640	....	18	7.8	
							10¾	0.9	
							8⅝	0.7	
	Fort St. John Southeast field	....	....	....	....	....	12¾	4.0	
	Gundy Creek field	....	....	....	....	....	10¾	6.1	
	Kobes-Townsend field	....	....	1	6,000	....	12¾	18.9	
							8⅝	5.5	
	Montney field	....	....	....	....	....	4½	7.4	
	Parkland field	....	....	....	....	....	8⅝	6.6	
	Red Creek field	....	....	....	....	....	4½	2.9	
	Rigel field	....	....	....	....	....	{12¾ / 10¾}	19.9	
	Stoddart field	....	....	....	....	....	8⅝	6.3	
Western Natural Gas Co. (high-pressure system)	Blueberry field	—	—	—	—	—	6	2.4	To Westcoast Transmission Co. Ltd.
							4	4.6	
							3	10.7	
							2	6.2	
Western Natural Gas Co. (low-pressure system)	Blueberry field	....	....	2	1,495	15,000	10¾	2.7	To Westcoast Transmission Co. Ltd.
							8⅝	4.9	
							6⅝	2.8	
							4½	0.6	
							3½	1.6	

[1] Minimum.

Table 20.—Gas-processing Plants, 1964

Operator	Location	Fields Served	Plant Type	Date on Stream	Plant Capacity, Thousand M S.C.F./Day		Natural-gas Liquids	Residual Gas to—
					In	Out		
Gas Trunk Line of British Columbia Ltd.	N.W. ¼ Sec. 10, Tp. 85, R. 14, W. of 6th M.	Boundary Lake	Inlet separator, M.E.A. treating absorption, condensate stabilization	1962	10	9.5	Condensate	Westcoast Transmission Co. Ltd.
Imperial Oil Ltd.	S.E. ¼, Sec. 2, Tp. 85, R. 14, W. of 6th M.	Boundary Lake	Inlet separator, M.E.A. absorption treating, glycol absorption dehydration, combined refrigeration and oil absorption natural-gas liquid recovery, distillation	1964	17	15	Pentanes plus, propanes, butanes	Westcoast Transmission Co. Ltd.
Pacific Petroleums Ltd.	Taylor	All B.C. producing gas-fields except Parkland, Dawson Creek, and Boundary Lake	Inlet separator, M.E.A. treating dry dessicant, dehydration oil absorption, distillation	1957	435	400	Condensate/pentanes plus	Westcoast Transmission Co. Ltd. and Plains Western.

Table 21.—Sulphur Plants, 1964

Name	Location	Raw Material	Principal Product	Capacity (Long Tons per Day)	Remarks
Jefferson Lake Petrochemical Co. of Canada Ltd.	Taylor	Hydrogen sulphide	Sulphur	300	Began operation in November, 1957.

TABLE 22.—CRUDE-OIL PIPE-LINES, 1964

Company	Fields Served	Size and Mileage of Main and Lateral Lines		Pumping Stations		Present Capacity (Bbl./Day)	Gathering Mileage	Throughput (Bbl./Day)	Storage Capacity (Bbl.)
		Size (In.)	Mileage	Number	Capacity (Bbl./Day)				
B.C. Oil Transmission Co. Ltd.	Aitken Creek, Blueberry	8⅝ 12¾	62.8 2.2	1	*12,000*	*12,000*	*37.38*	*3,773*	*74,800*
Trans-Prairie Pipelines (B.C.) Ltd.	Beatton River, Beatton River West, Boundary Lake, Milligan Creek, Nancy, Peejay, Wildmint	4½ 6⅝ 8⅝	15.0 24.3 103.0	1	36,000	52,000[1] 24,000[2]	43.0	27,786	150,000
Western Pacific Products and Crude Oil Pipelines Ltd.		12	505	6	45,000	45,000		28,723	556,000

[1] Boundary Lake.
[2] Terminal to Western Pacific Products and Crude Oil Line.

Table 23.—Crude-oil Refineries, 1964

Name	Location of Refinery	Type of Refinery	Date of First Operation	Source of Crude	Crude-oil Capacity (Bbl. per Calendar Day)	Storage Capacity (Bbl.)	Cracking-plant Units	Cracking Capacity (Bbl. per Calendar Day)	Other Units
The British American Oil Co. Ltd.	Port Moody	Comp.	1958	B.C. and Alberta	18,000	1,500,000	Catalytic-fluid	8,480	Catalytic reformer, distillate desulphurization, alkylation-sulphuric acid.
Imperial Oil Enterprises Ltd.	Ioco	S.C.A.	1915	B.C. and Alberta	32,000	2,918,000	Catalytic-fluid	9,000	Catalytic polymerization, powerformer.
Pacific Petroleums Ltd.	Taylor	Comp.	1957, 1961	B.C.	6,500	450,000	Catalytic-fluid	2,300	Alkylation, asphalt, pentane splitter, platformer, unifiner. H.D.S. unit.
Royalite Oil Co. Ltd.[1]	Kamloops	Comp.	1954	B.C.	5,900	495,000	Catalytic-fluid	1,600	Catalytic polymerization, catalytic reformer, naphtha desulphurization, distillate desulphurization, merox.
Shell Canada Ltd.	Shellburn	Comp.	1932	B.C. and Alberta	21,000	2,455,300	Catalytic-fluid Thermal visbreaking	6,000 3,000	Catalytic polymerization platformer, vacuum flashing, solvent fractionation distillate hydrotreater.
Standard Oil Co. of British Columbia Ltd.	North Burnaby	Comp.	1936	B.C. and Alberta	18,000	1,451,700	Catalytic-fluid	8,100	Catalytic polymerization, catalytic reformer, lube-oil blending plant, asphalt.

[1] Figures for Royalite are stream-day capacities.

Symbols: S.C.A.—skimming, cracking, and asphalt; Comp.—complete.

Inspection of Lode Mines, Placer Mines, and Quarries

By J. W. Peck, Chief Inspector of Mines

CONTENTS

FATAL ACCIDENTS

During 1964 there were 15 fatal accidents connected with lode mines, placer mines, and quarries. This compares with the average for the past 10 years of 10.3.

The following table shows the mines at which fatal accidents occurred during 1964, with comparative figures for 1963:—

Mine or Place	Location	Number of Fatal Accidents	
		1964	1963
Bralorne	Bralorne	....	1
Britannia	Britannia Beach	....	1
Brynnor	Ucluelet	2	....
Cariboo Gold Quartz	Wells	1	....
Cassiar	Cassiar	1	2
Craigmont	Merritt	3	....
Dolly Varden	Alice Arm	1	....
Estella	Wasa	....	1
Horn Silver	Keremeos	1	....
Jedway	Jedway	1	1
Jersey	Salmo	1	....
Sullivan	Kimberley	2	1
Texada	Vananda	1	3
Wellington	Retallack	1	....
Totals		15	10

In addition to the above, three employees of Julian Mining Co. Ltd., Edward John Powell, Robin Dennis Gum, and John Scully, were presumed drowned when an aircraft on charter to the company crashed shortly after take-off into Trapper

Lake in northwestern British Columbia. There were also three fatalities in three separate highway accidents, namely: Donald M. Edwards, of Sheep Creek Mines Limited; Ralph Critchlow, of Utica Mines Limited; and Dennis George Sullivan, of Cassiar Asbestos Corporation Limited.

The following table classifies fatal accidents as to cause and location:—

Cause	Number	Location
Falls of rock	5	Underground.
Explosives	1	Underground.
Run of muck	2	Surface.
Vehicles	4	Surface.
Haulage	1	Underground.
Machine	1	Underground.
Bad air	1	Underground.
Total	15	

A description of all fatal accidents follows.

Cyril Alexander George, aged 47, married, and employed as a barman at the Sullivan mine of The Consolidated Mining and Smelting Company of Canada, Limited, was instantly killed by a fall of rock on February 24, 1964, at about 10.35 a.m.

The scene of the accident was in a drift near the collar of an old winze. This area had a width of about 25 feet but the roof had additional support of a concrete pillar 13 by 4 feet and 12 feet high, installed 20 years ago, parallel to and about 5 feet from one side of the drift. George and his partner had been instructed to bar down some loose near this concrete pillar, and they had completed this task and were preparing to leave the area when a quantity of rock, estimated at 3 tons, fell from the roof and struck the deceased. Medical help was obtained, but it was later determined that death would have been instantaneous and had been caused by multiple skull fractures, crushing chest injuries, and damage to numerous organs.

Both workmen were experienced barmen. The foreman had also visited the working-place a short time previous to the accident, at which time the barring had been completed and the rock tested in his presence and thought secure. At the time of the rock-fall there was a loud report. A large crack in the concrete pillar was found after the accident and several cracks and slips were observed in the roof, which evidently were not visible before the accident. The area is in close proximity to a stope where a large pillar blast was detonated in January, 1964. This had produced some signs of pressure, and a number of rock bolts had been installed in the roof in the vicinity of the concrete pillar a few days before the accident.

An inquest was held in Kimberley on March 12, 1964. The jury found no blame attached and that all precautions had been taken.

Paul Robert Carlson, aged 34, married, and employed as a miner at the Cameron-McMynn Ltd. project at the Aurum mine of The Cariboo Gold Quartz Mining Company Limited, was suffocated by a fall of ground at 9.25 a.m. on March 16, 1964.

The scene of the accident was about 300 feet back from the face of the drift being driven by Cameron-McMynn Ltd. It was in this area that there had been a cave the previous shift of about 2 tons from the back and footwall side of the drift. The back of the drift here is supported by timbers, 6 feet apart, which are placed in bull-horns which had been set in the walls of the drift about 6 feet above the floor. When the cave occurred, the ground near the top of the footwall side of the drift also caved, thus allowing one of the bull-horns to drop out along with the timber it held. It was this caved area that Carlson and his partner were directed to repair.

They had scaled down when the superintendent for Cameron-McMynn Ltd. arrived to inspect the area before he then proceeded to the face of the drift. The two men mucked out the caved rock and prepared to timber the area with standard posts and caps. Carlson was in the position of digging a hole for one of the posts when he was buried by a rock-fall, estimated at 8 tons. There was sufficient help nearby to start rescue operations at once, but it took 20 to 30 minutes to uncover Carlson. Mouth-to-mouth artificial respiration was then immediately applied and continued until the doctor arrived to pronounce death at about 10.15 a.m. Cause of death was later determined as due to suffocation.

Investigation of the accident scene showed that a fault, dipping about 70 degrees away from the face, crossed the drift more or less at right angles. Any ground failure here could loosen the bull-horns used to hold the roof-supporting timbers. Standard post-and-cap timbering would probably have prevented the first fall of rock.

An inquest was held at Wells on March 18, 1964. The jury found that death was accidental with no blame attached to anyone.

John Frederick Armitage, aged 19, single, and employed as a helper at the concentrator of Jedway Iron Ore Limited, was suffocated when he became buried in a run of fine ore on April 17th at about 1.10 p.m.

The accident occurred outside the concentrator, 190 feet to the north, where the No. 8 conveyor dumps rod-mill feed onto a stockpile and where the No. 10 conveyor moves this feed to the rod mill from a reclaiming tunnel under the stockpile.

Armitage was last seen when talking to the mill operator at 1 p.m. Shortly after this the No. 10 conveyor ran empty, and the mill operator, on going to the mill door, was able to observe the stockpile and Armitage's hard hat lying outside the pile. He stopped the conveyor and hurried into the No. 10 reclaiming tunnel. There he saw Armitage's body trapped fairly upright in the chute which feeds the stockpile onto the tunnel conveyor. Help was summoned and rescue operations were begun immediately. On the surface it was found that a cone had developed in the stockpile leading down to the chute opening and that about 4 feet of fine material covered this opening where Armitage was trapped. It was 2.30 p.m. when his head was uncovered. Artificial respiration with the aid of oxygen was given until the doctor arrived at 5.15 p.m. to pronounce death. A later autopsy indicated death was the result of suffocation and occurred very quickly.

The inquest jury found that death was accidental with no blame attached to any person. A rider was added as follows:—

" 1. We recommend that a system be instituted immediately whereby all new employees are taken by a supervisor on a tour of the area where they are to be employed. This should also be done where an employee is transferred from one area to another. Special emphasis should be placed on hazardous areas and conditions. Young persons working in a mine for the first time should be especially told of the hazards that exist.

" 2. The jury further recommends that all hazardous areas be clearly marked by large legible signs.

" 3. The jury further recommends that an immediate start be made on the training of two or more competent mine-rescue squads.

" The jury feels that the company should place all emphasis possible on safety at all times and at all levels from supervisors to labour."

The *Metalliferous Mines Regulation Act* prohibits the working on a stockpile unless there are specific precautions. However, it is evident that Armitage did climb up on the stockpile, possibly to check what feed was left above the chute, and then fell or was drawn into the chute opening. He had been warned against this practice by his fellow workman. He had been employed at the concentrator for one month previous to the accident.

Ernest Retzlaff, aged 32, single, self-employed geologist, was asphyxiated some time after 4 p.m. in the East Matheson adit of the Wellington mine, near Retallack, on June 3, 1964.

The Wellington mine adjoins the Slocan Charleston mine. The latter mine had been inactive for many years, while the last work in the Wellington mine was in the East Matheson adit in December, 1963. Retzlaff had been examining the Slocan Charleston mine and then made arrangements to enter the East Matheson adit with a view to taking samples and geological readings. On the day of the accident the watchman of the Wellington property accompanied Retzlaff to the portal of the East Matheson adit, which the deceased entered about 4 p.m., equipped with a miner's electric cap lamp. At 6 p.m. the watchman entered the portal a short distance and shouted, but on receiving no reply returned to surface. He remained there all night, and in the morning walked 2 miles to Retallack to phone the R.C.M.P. at New Denver. At 9 a.m. on June 4th two R.C.M.P. officers arrived and entered the adit but were forced by " bad air " to retreat. They then got in touch with the Department of Mines and Petroleum Resources at Nelson, and rescue operations were arranged by the Inspector of Mines and the district Instructor. A mine-rescue squad was obtained from the Bluebell mine of The Consolidated Mining and Smelting Company of Canada, Limited, at Riondel, and after being ferried across Kootenay Lake the squad was driven 35 miles to the mine. This rescue squad, captained by Ben Ramage, entered the East Matheson adit at 1.45 p.m. and returned with the body of the deceased at about 2 p.m.

The East Matheson adit consists of several thousand feet of workings with no connection for natural ventilation other than at a point 250 feet from the portal. The mine-rescue squad reported the safety lamp went out 30 feet past this point, while the body was found 270 feet past where the lamp went out. The position of the deceased indicated he had slumped gently forward while proceeding into the mine. He was found face downward in about 8 inches of cold running water.

Air samples were later taken by Department officials at the following points: (1) Where the safety lamp went out; (2) where the body was found; (3) at a point about 300 feet farther in the main drift past the body. The resulting assays were as follows:—

	Oxygen	Carbon Dioxide	Nitrogen	Carbon Monoxide	Methane
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
(1)	15.24	1.68	83.08	Tr.	*Nil*
(2)	5.29	2.09	92.62	*Nil*	*Nil*
(3)	1.88	2.20	95.91	*Nil*	0.01

It is apparent from these results that the oxygen content of the air dropped very sharply beyond the last point of natural ventilation. The reduction in oxygen content can be mainly attributed to the taking-up of oxygen by the water which flowed in abundance along the drift floor.

An inquest was held at Kaslo on June 23, 1964. The jury returned a verdict of accidental death that was due to lack of oxygen.

Michael Joseph Petrosky, aged 48, married, and employed as a miner at the Sullivan mine of The Consolidated Mining and Smelting Company of Canada, Limited, received fatal head injuries when struck by a fall of rock at about 8 p.m. on June 16, 1964.

Petrosky and a partner were in the process of completing the backfilling of a large stope with fill (called float) brought from the sink-float plant on the surface. This float was dumped down a raise near the top of the stope and spread by gravity throughout the stope, except that in the final stages a small tugger hoist and scraper were used to spread the float close to the hangingwall, which has a dip of about 40 degrees. On the day of the accident the anchor bolts holding the tail block for the scraper cable pulled out and the miners started barring a safe trail so as to reach the location of the anchor bolts, about 45 feet from the hoist. The back here was about 8 feet above the top of the float fill. Several large slabs were barred down by the miners. Petrosky had just barred down a slab and was further inspecting the back when another piece of rock fell, hitting him on the head and knocking him down. His partner immediately summoned help, but death must have happened quickly. The deceased was dead on arrival at the Kimberley hospital at 9.15 p.m., and a later autopsy disclosed a severely crushed skull with the brain visible through a large wound in the head. Cause of death was given as due to a crushed skull.

The working-place had been visited by the shiftboss about three hours previous to the accident. Cracks were visible in the back at that time, and normal instructions to bar and check were given. Both miners were experienced men.

The inquest was held on June 25, 1964. A verdict was returned of accidental death with no blame attached to anyone. The jury also recommended " that some safer method be adopted in backfilling stopes with float so that men will not have to enter these stopes."

Patrick Maxwell Dwyer, aged 51, married, and employed as a mine foreman at the Dolly Varden operations of Sunshine Exploration Limited at Alice Arm, was presumed drowned when a vehicle he was driving left the mine road and plunged into the waters of the Kitsault River at the east end of the Kitsault River suspension bridge on July 7, 1964, at about 12.35 p.m.

The accident happened near the old Torbit mine camp, which is 17 miles by road from Alice Arm. This camp is the base of operations, although most of the underground work was being done at the Wolf property, 2 miles by road farther upriver.

There was one witness to the accident—the mine manager. He was at the west end of the suspension bridge when Dwyer passed over the bridge to proceed to his duties at the Wolf property. Dwyer was driving a 1957 Willys jeep station wagon. The road at the east end of the bridge makes a sharp turn and then parallels the river, and it was at this point Dwyer appeared to overturn his steering wheel because the left front wheel dropped over the edge of the road. He endeavoured to correct the wheels, but it was too late, and the vehicle dropped 70 feet to the river below. It appeared to bounce once on a rock knob in its descent, but the doors were not seen to open. A search party was organized, but neither the vehicle nor Dwyer was located.

The Kitsault River below the suspension bridge follows a narrow and precipitous gorge in which the waters are fast and turbulent. A milky rock flour in the river obscures all visibility. The vehicle was located about the end of September, but no body was in the vehicle. No inquest has been held.

Horst Tolksdorf, aged 22, single, and employed as a dumpman at the open-pit operations of Cassiar Asbestos Corporation Limited, was killed outright at about 7.30 p.m. on August 2, 1964, when a truck in which he was riding was backed over the edge of the waste dump to tumble about 850 feet. The assigned driver was seriously injured, and thus the inquest was postponed until December 10, 1964, when he was able to give evidence.

The truck involved was one of three hauling from a loading-shovel. The accident was discovered when a driver of one of the other trucks observed there was no dumpman at the dump. The dumpman, Tolksdorf, was found shortly after down the slope about 30 feet behind the truck. He was pronounced dead on site by the doctor who had been notified, with cause of death determined as due to multiple injuries in the form of fractures and soft-tissue damage. The assigned truck-driver was found between rocks about 15 feet from the right side of the truck, which was lying on its left side and facing uphill. He had internal injuries plus a broken leg, and these injuries necessitated flying him later to a Vancouver hospital.

It was disclosed at the inquest that Tolksdorf was driving the truck at the time of the accident, with the assigned driver in the cab with him. The assigned driver had let him do this without authorization, on the stated reason that Tolksdorf wanted to be a truck-driver. Tolksdorf backed the truck to the edge of the dump in preparation to dump over the edge and apparently did not stop. There was no evidence that the truck failed in any way mechanically.

The Department's Open Pit and Quarry Regulations require that a dumpman be on site for signalling purposes when material is dumped over a bank as in this case. The company's rules further stated if no dumpman was present, the material was to be dumped back from the edge of the dump and not over it.

The inquest jury returned a verdict of accidental death and recommended " that all employees have knowledge of whereabouts of safety equipment, such as blankets and stretchers."

Robert Cullen Richardson, aged 38, single, and employed as a truck-driver by Brynnor Mines Limited, was presumed drowned on September 8, 1964, at about 1 p.m. when a truck he was driving left the mine-to-mill road and plunged into Maggie Lake.

Richardson's job at the time of the accident involved driving a Kenworth ore-hauler semi-trailer unit from the crushing plant at the mine to the concentrator at Toquart Bay, 8 miles away, and returning empty. The Kenworth units are large machines, which haul from 70 to 80 tons of iron ore. These units are controlled by air brakes and power steering and are inspected periodically by inspectors of the Department of Commercial Transport. The road to Toquart Bay is an excellent all-weather gravel road of very moderate grade, 25 to 30 feet wide throughout, and very well maintained. For topographical and safety reasons the loaded trucks travel on the left of the road. The trucks usually travel in convoys of three, and radio communication is maintained between both ends of the road. For about 2 miles the road skirts the northeast shore of Maggie Lake, and there are a number of curves varying from about 90 to 150 degrees. It was on one of these curves that the accident took place.

On September 8th, Richardson was on the day shift, and at about 1 p.m. he left the crushing plant on his eighth trip of the shift with a loaded truck. He was the middle truck in a convoy of three trucks. It was a fine day and the trucks were spread apart somewhat to avoid driving in each other's dust. On arriving at the concentrator the other drivers noted Richardson's absence, and on investigation there were indications that a truck had left the road at one of the southernmost curves on Maggie Lake about 3 miles from the crushing plant. Management was informed, and the assistance of skin divers was obtained. They located the truck at the bottom of the lake about 150 feet from the shore and in 110 feet of water. There was no sign of Richardson's body. The cab doors were shut, but the windshield and door windows were smashed. Salvage operations were difficult, and it took a week, with the assistance of professional divers, to haul the truck out of the lake.

Richardson was considered to be a good driver, was sober in his habits, and apparently in good health. There was no evidence of overtime working or excessive fatigue previous to the accident. On examining the ground after the accident it was found that the tire marks indicated that the driver had just begun to turn his vehicle into the curve but then continued straight ahead into the lake. The tire marks were quite " simple " with no indication of braking, skidding, or of the front wheels weaving. An examination of the truck after the accident indicated that the truck should have functioned normally with respect to brakes and steering. Other evidence indicated it was in good mechanical condition.

No inquest has been held.

W. E. Hendsbee, aged 30, married, and *T. J. McAuley,* aged 24, single, both employed as miners by Craigmont Mines Limited, were fatally injured by a fall of rock on September 8, 1964, sometime between 1.20 and 2 p.m.

Both miners were working in a cut-and-fill stope approximately 100 feet long and 30 feet wide. On the day of the accident they were contending with loose ground at the brow of a raise leading to the level above. Some blasting had been done in this brow about 11 a.m., and the men returned to the scene about one hour later, presumably to do scaling in the vicinity of the blast. At about 2 p.m. the working-place was visited by the shiftboss, and he found both men lying on the muck pile partially covered by pieces of rock, and to all appearances life was extinct in both bodies. The shiftboss was able to pull McAuley's body clear of danger from further rock fall, but Hendsbee's body was pinned under heavy pieces of rock. Help was then obtained, and the bodies were transported to surface. Cause of death was later established as multiple injuries with severe crushing of the chests.

The evidence available would indicate that the deceased were engaged in either scaling or examining the brow of the raise when the brow gave way to fall on them. Both men were experienced miners.

The inquest jury returned a verdict of accidental death with no blame attached to anyone. A recommendation was added that there be closer supervision where the job is dangerous.

Wesley Schneider, aged 42, married, and employed as a miner at the Jersey mine of Canadian Exploration Limited, was choked to death while operating a drilling-machine about 5.15 p.m., September 23, 1964.

Schneider was working alone on the afternoon shift in the 72G stope. This stope is flat lying, 180 feet in length, and varies from 15 to 65 feet in width. The ore is removed by slusher to a scram drift at one end of the stope. Schneider received his instructions from the underground shifters' office at about 4.10 p.m. It would appear he then proceeded to the stope, drilled one 6½-foot hole in the back of the stope with a jackleg machine, and then started a second hole when the accident occurred. Schneider was apparently holding the jackleg with one hand while guiding the drill rod with his right hand, thus bringing his upper body in close contact with the drill rod. The bit had a tendency to run downwards while collaring, so Schneider may have been supporting the drill steel with his chest. A neck band made of waste rag, which Schneider was wearing, became attached to the rotating drill steel and caused death by strangulation. The deceased was found lying face downwards across the drill steel. The rock drill was set at about one-half throttle but was not running properly due to rotation being stopped.

At about 5 p.m. an electrician entered the stope to repair Schneider's 20-horsepower electric slusher, which was about 110 feet from the scene of the accident.

Around 6 p.m. the electrician finished his job, flashed a floodlight in the direction of Schneider and left the stoping area. The electrician heard a machine operating but saw or heard nothing unusual.

At about 6.45 p.m. the shiftboss was making his regular rounds and came upon the scene. He summoned help from a nearby stope, and artificial respiration was started and kept up until the doctor arrived and pronounced death at about 8.30 p.m.

The inquest was held in Salmo on October 1, 1964. A verdict of accidental death was returned with no blame attached to anyone. There was a recommendation " that the wearing of sweat bands at the mine be prohibited."

John Roul McCormack, aged 22, single, and employed as a miner by Texada Mines Ltd., met sudden death at about 8.15 a.m. on October 27, 1964, at the foot of a raise when an ore train struck and overturned the raise skip against him.

The accident took place in North Yellow Kid crosscut on the 2055 level about 70 feet from the junction with the Lake crosscut. The raise at this point extends to the 2270 sublevel, where the tugger hoist for the service skip is located. Just previous to the accident McCormack and his partner arranged for the skip to be lowered to the 2055 level and proceeded to load supplies. About this time the train crews on the level found it necessary to exchange locomotives, and one motorman backed his train, consisting of four Granby-type ore cars and a locomotive, into the North Yellow Kid crosscut. He saw two lights moving at the foot of the raise, and as he had sounded his bell and horn he assumed there was no danger. The train, however, struck the skip, which projected out into the haulageway, and overturned it on McCormack, who was nearby. McCormack was quickly released, but his injuries, such as broken ribs, sternum, and collar bone, and massive hæmorrhages into the right and left pleural cavities, made death almost instantaneous.

It was well known that the skip projected into the haulageway in the lowered position, but it is possible McCormack did not know this as he had been working in the area only a few days. All train crews had been instructed to have someone precede the train when backing into the North Yellow Kid crosscut.

The coroner's jury attached no blame for the accident but recommended " to have a red flasher light on the train and one man walking ahead, also a sign to be placed by the skip."

Since the accident a photo-electric cell has been mounted in the skipway above the 2055 level, and when the beam is broken by the descending skip, the cell activates a switch which turns on a string of red lights in the approach to this area.

Leon Vern Reimche, aged 41, married, and employed as a miner at the Horn Silver mine of Utica Mines Ltd., was fatally injured as the result of a blasting accident which occurred at 1.30 a.m. on December 5, 1964.

The accident took place near the face of a new adit which had been advanced 140 feet from the portal. Reimche and his partner had drilled a drift round and had loaded same with explosives and standard-type fuse (burning 40 seconds to the foot). Three hot wire lighters (burning rate 90 seconds each) were then ignited for spitting the fuse. One man split the fuse ends with a knife, while the other did the spitting with one of the lighters. These lighters burned out with still three holes to ignite. Reimche then made up a short fuse spitter, even though his partner suggested they leave. This spitter malfunctioned and Reimche proceeded to make another, with another warning from his partner that time was short. Shortly after this the partner informed Reimche he was leaving and advised him to do likewise. He reached a point about 25 feet from the face when a shot went off, knocking him down. He scrambled to his feet and ran to the surface with two more shots going off before he reached the portal. The shiftboss was outside, and he was able to effect a rescue of Reimche just minutes after the last shot detonated. Reimche was still alive but bleeding freely from multiple wounds to the face, head, limbs, and body. He was semi-conscious but not coherent. He was given first aid, and within 12 minutes was in an ambulance on the way to the Penticton hospital. He died shortly after arrival at the hospital at 3.20 a.m., December 5, 1964. Cause of death was loss of blood from multiple injuries. His partner received several lacerations and minor bruises but was released from the hospital the following day.

Reimche had many years' experience in mining and in rock and tunnel work. He was the lead miner as his partner was fairly inexperienced.

The jury of the coroner's inquest found that Reimche died through misadventure with no blame attached to any other person. The jury recommended " the discontinuance of the use of spitters and that a better form of fuse lighting such as thermolite be used."

Emery Ronald Branscombe, aged 61, married, and employed as a mill operator by Brynnor Mines Limited, was fatally injured at about 3.55 p.m. on December 10, 1964, when the vehicle in which he was riding was involved in a collision with an ore-haulage vehicle on the mine-to-mill road.

At the time of the accident Branscombe was being transported by bus to his work at the mill. He was sitting in the front seat on the outside, with another passenger between him and the driver. No one else was in the vehicle. When the collision occurred, the driver received cuts and abrasions and the other passenger was knocked momentarily unconscious.

The road from the crushing plant to the mill is a good all-weather gravel road of moderate grades and is 25 to 30 feet wide over most of its 8-mile length. In addition there are wide spaces or turnouts every half-mile or so for vehicles to pull off the road if required. However, where the accident took place, the road skirts the edge of Maggie Lake and the steep spur of a mountain, and at this point there are several rather sharp curves and the road narrows to 18 feet in places. The ore is hauled from the open-pit mine in Kenworth tractor-trailer bottom-dumping units weighing 55 tons empty with a capacity of 70 to 80 tons of iron ore. They usually travel in convoys of three. All vehicles travel on the left side of the road, so that the loaded haulers are on the opposite side of the road to the lake. The vehicles are all equipped with radio transmitter and receiver sets, so that they can communicate with each other and with a radio operator at the machine-shops. Posted rules gave the ore-haulers right-of-way, and drivers of other vehicles were required to pull into the turnouts on learning by radio of the proximity of the haulers.

On the day of the accident the passenger bus (1-ton size) made radio contact at the mine end of the road (Mile 0) with the leading ore-hauler, which was then approaching Mile 6. Three other radio contacts were made as the vehicles approached each other, but there was lack of communication on the last contact, and the two vehicles met and collided on a curve in a narrow section of the road just beyond the 3-mile post. The truck struck the bus on the right side with its right bumper and pushed the bus backwards for about 80 feet. The front part of the bus was extensively damaged, especially the right side where Branscombe was sitting. He probably died instantly, as he was later found to have sustained multiple injuries including hæmorrhages of the brain.

The inquest jury did not assign blame but recommended " that all ore-haulers stop travelling in an opposite direction than the crew bus when the crew bus clears the crusher for the mill or the mill for the crusher and that a group of experienced personnel examine the right-of-way and control rules of Brynnor mine haul road and make their recommendations to Brynnor Mines Limited."

Robert Louis Gabel, aged 30, married, and employed as an open-pit foreman by Craigmont Mines Limited, died of asphyxia when buried in a run of ore of a stockpile on December 27, 1964, at about 6.15 p.m.

The accident occurred at the coarse-ore stockpile, which is fed to the secondary crusher by a conveyor tunnel under the stockpile. Prior to the accident it was reported by the conveyor operator that one feeder into the tunnel under the stockpile was not functioning properly. This was probably because there was some freezing in the stockpile to 8° F. temperature. Gabel, the foreman, received the message, but presumably investigated whether it was necessary to send a bulldozer to break the stockpile loose, as was the practice. Customarily the stockpile is examined by walking the conveyor way which feeds the stockpile and looking down from the spill point where several arc lights give visibility for this purpose. However, Gabel must have climbed the stockpile to the perimeter of the draw point in question as he was seen by one witness at this point at approximately 6.15 p.m. Shortly after, the material under his feet caved or he may have slipped, to fall into the draw point to be trapped by fine muck. He was found here about 7 p.m. when a search was instituted for him. His head was uncovered and oral resuscitation applied, but to no avail. His body was recovered with some difficulty at 9.50 p.m.

The inquest jury found no blame attached to anyone but recommended " safety signs be posted at all stockpiles and also in the control rooms warning of the dangers of climbing the stockpile. If the stockpile requires attention, the man must be accompanied by another person and have the proper safety equipment."

FATAL ACCIDENTS AND ACCIDENTS INVOLVING LOSS OF TIME

Fifteen fatal accidents and 332 accidents involving a loss of time of over three days 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 10-year period and relates these accidents to the number of persons employed.

ACCIDENTS CAUSING DEATH OR INJURY CLASSIFIED AS TO CAUSE

Cause	Number of Accidents	Percentage of Total
Atmosphere	4	1.2
Explosives	3	0.9
Falls of ground	63	18.2
Falls of persons	66	19.0
Lifting and handling material	32	9.2
Machinery and tools	96	27.6
Transportation	42	12.1
Miscellaneous	41	11.8
Totals	347	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	1.2
Haulagemen	12	3.5
Miners	120	34.6
Helpers	22	6.3
Timbermen	16	4.6
Mechanics, electricians, etc.	30	8.6
Miscellaneous	23	6.6
Surface—		
Shops	5	1.4
Mills	12	3.5
Quarries	4	1.2
Surface, general	99	28.5
Totals	347	100.0

Accidents Causing Death or Injury Classified as to the Parts of the Body Injured

Location	Number of Accidents	Percentage of Total
Head and neck	17	5.0
Eyes	24	6.9
Trunk	93	26.8
Upper extremities	82	23.6
Lower extremities	89	25.6
General	42	12.1
Totals	347	100.0

Compensable and Fatal Accidents Related to Men Employed

Year	Number of Accidents	Number of Persons Employed	Frequency per 1,000 Persons
1955	679	6,208	109
1956	615	6,507	94
1957	535	5,678	94
1958	396	4,353	91
1959	310	4,316	72
1960	395	4,389	90
1961	338	3,993	85
1962	429	4,872	88
1963	521	5,025	104
1964	547	5,400	101

DANGEROUS OCCURRENCES

Twenty-four 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 13 reported for 1963.

Of these occurrences, eight were connected with hoisting, four with explosives, three with trucks, two each with mine flooding, machinery, and fire, and one each with haulage, landslide, and gas.

On January 6, 1964, at the Sunro mine of Cowichan Copper Co. Ltd., a landslide destroyed surface installations as an aftermath of the flooding of the mine which occurred on December 5, 1963 (*see* Annual Report, 1963, p. 229). Events leading up to this incident and the subsequent recovery of the mine are described as follows:—

The collapse of the crown pillar of B stope on December 5, 1963, into the bed of Jordan River allowed the water to pour through the mine workings and exit via the main adit portal approximately 500 feet lower in elevation. The river-bed opening became enlarged to rectangular dimensions of about 100 by 170 feet. Attempts were being made to seal the underground discharge outlets by dropping trees, brush, gravel, and, by means of helicopter, car bodies into the caved opening, when on January 6, 1964, the water-flow through the main adit (5100) level practically stopped. Shortly afterward streams of water poured over the surface above the portal and across the roadway for a distance of 800 feet south of the portal. Inasmuch as this surface area was principally gravel, it soon washed into Jordan River, taking with it the portal area, trestle, tracks, two locomotives, the concentrate loading shed and loading equipment, and a storage shed. It was estimated that a total of 500,000 cubic yards of gravel was washed into the river. An investigation on the surface showed the water welling up through a gravel deposit at a point about 1,700 feet from the portal. It would appear that the high velocity of the water in the tunnel had washed away the timbers supporting the back of the tunnel in the vicinity of a contact between gabbro and greenstone. The unsupported area commenced to cave and was washed out the portal. Subsequent caving extended up to bedrock, and thence up through gravel an approximate total vertical distance of 330 feet. The tunnel waters welled up out of this cave and over the hillside down to the portal. In order to protect the portal area, the water was diverted west into the river (*see* Fig. 19, p. 170).

In mid-January an area approximately 1 acre in extent, about 300 feet north of the gravel break-through, commenced to slide toward the river. A continuous watch was kept of this area for approximately two weeks, and an alerting system was established to warn the residents of Jordan River community should a slide block the river. Fortunately the movement ceased without incident. It is believed that a combination of heavy winter rains and the blocking in the main adit, that caused the underground water to seek channels through the rock, was responsible for the movement.

As attempts to block the water at the B stope exits were not successful, a berm and diversion channel were made in the river, above and west of the opening. This directed the normal flow of water back into the main river channel.

Entry was gained to the underground workings by way of the 6000 level adit and the main ventilation raise. Pumps were installed in the mine and, as the level of the water lowered, concrete bulkheads were installed at the various entrances to B stope. A total of seven bulkheads was established, but this work was hampered on several occasions when heavy rains produced sufficiently high water-levels in the river to reflood the mine. The final bulkhead was completed early in May, and since that date the mill and crushing-plant areas on the 5100 level have been drained by pumping. Considerable amounts of gravel and muck were found to be deposited in the various drifts and in the float-cell and concentrate loading areas of the mill. Mill crews were employed excavating, cleaning, and drying the machinery and electrical equipment.

A temporary access road to the 5100 level portal was made across the washed-out area, a new portal trestle was constructed, and the portal retimbered. The reopening of the 5100 adit commenced in July. As flooding had washed out all track and timber, these were replaced as the clearing advanced. The gabbro-greenstone contact zone was reached early in September, but advance was delayed by extended caving immediately ahead of the actual break-through at 1,700 feet. Here considerable additional timbering was required. Advance across the break-through was accomplished with the aid of steel-rail spiling and close timbering. In addition, approximately 1,100 sacks of cement were used while pumping grout into the caved area. Early in January, 1965, the attempt to reopen the tunnel through the caved area was abandoned, and work was started on a by-pass on the east side of the adit.

On January 26, 1964, at the Craigmont mine, the braking system on a cable belt conveyor, which lowers the ore from the open pit to a lower terminal, failed and a runaway occurred. The machinery in the upper control room was severely damaged, and some damage was sustained to the machinery of the coarse-ore stacker at the lower terminal.

On January 30, 1964, at Western Mines Limited, Lynx mine, a small battery locomotive and a loaded muck car fell down the shaft from the lowest station level to the sump 49 feet below. The cage was not in place to receive the cars, and it was reported that the brake wheel on the locomotive jammed as the train approached the station.

On February 2, 1964, at Bralorne, a fire of unkown origin totally destroyed the mine change-house and the central heating plant.

On February 7, 1964, at the Britannia mine, the counterbalance weight in the No. 7 shaft became loose in its compartment and destroyed a number of manway landings while on descent as the cage was being hoisted. One of the guides which holds the counterbalance weight in position became dislodged due to corrosion and failure of the lag screws, and this allowed the weight to leave the guide path.

On February 13, 1964, at the Reeves MacDonald mine, the muck skip in the No. 3 shaft was hoisted through the dump position to smash into the sheave-wheel. The protecting limit switch activated properly but not in time to overcome the speed of hoisting.

On February 21, 1964, at the Cariboo Gold Quartz mine, two men suffered minor injuries from flying rock particles when an explosion occurred in or near a hole which was being drilled within the perimeter of a cut from a previous round.

On February 28, 1964, at the Sullivan mine, two trains, of 40 cars each, collided head-on on surface near the portal of the 3700 level, causing extensive damage to the cars and locomotives but no injuries to the train crews.

On March 1, 1964, at the Granduc mine, a geologist became ill underground as a result of breathing blasting fumes and smoke.

In March at the Craigmont mine, a large landslide developed in the northwest corner of the open pit. The movement was gradual, but it was necessary to remove approximately 1,000,000 tons of waste in this area to bring the slide under control.

On March 2, 1964, at the Jersey mine, a truck was backed into the surface ore-pass and became lodged in the raise a few feet below the dump.

On March 12, 1964, at the Craigmont mine, a truck was damaged but the driver escaped when it was backed over a dump at the open-pit mine.

On March 17, 1964, at the Texada mine, a skip of wet fine muck was dumped down the shaft from near the dump pocket on surface. A power failure occurred as the skip entered the dump track, and this necessitated the hoistman lowering the skip slowly. The dumping-door opened as he was doing so.

On March 17, 1964, at the Texada mine, a loaded skip, on being released from the loading-pocket, descended to the shaft bottom instead of rising to the dump pocket. The hoist was a friction type and was on automatic control at the time. The automatic weighing device at the loading-pocket had become out of adjustment, permitting an overload of at least 1.75 times normal. This excess loading forced the skip to move in a reverse position against the motor drive.

On May 5, 1964, at the Craigmont mine, two trucks were extensively damaged when they collided head-on on a slippery open-pit roadway.

On May 13, 1964, at the Cariboo Gold Quartz mine, several guides were torn out in the shaft when the worn shoe of the skip hooked into a guide.

On June 2, 1964, at the underground placer mine of Wingdam & Lightning Creek Mining Co. Ltd., the workings were flooded for a period of 10 days when the pumps failed to handle the inflow of water which had increased due to the spring run-off.

On June 4, 1964, at the Jedway mine, a large loading-shovel was extensively damaged when it ran away and went over a bank in the open-pit mine. A track pin sheared when the travel gear and safety dogs were not engaged.

On June 17, 1964, at the Chataway Exploration Co. Ltd. property, a hole being diamond drilled from surface made a blowblack of undetermined gas for several hours. No gas was encountered in subsequent drilling.

On August 4, 1964, at about 10.30 p.m., at the Texada mine, a fire occurred in the conveyor way which leads from the underground crushing-chamber to the bottom of the shaft. Dense black smoke hampered fire-fighting, but by constructing seals and by using water-hoses the fire was brought under control by 7 a.m. on August 5th. Gas masks were used. At 2.30 a.m. on August 5th a call was put through to the District Inspector of Mines for help, and this resulted in one mine-rescue team from Britannia and one from Tsable River coal mine being airlifted to the property, to arrive by 7 a.m. The fire was apparently caused by the heat of the belt slipping on the conveyor drive-pulley. About 200 feet of 30-inch-wide belting was burned.

On September 30, 1964, at the H.B. mine, a mechanic developed lung œdema after inhaling excessive amounts of blasting fumes. A second man developed mild œdema following a rescue attempt. The explosive which caused the fumes was of the ammonium nitrate-fuel oil type. Excessive oxides of nitrogen were suspected as causing the lung œdema.

On November 6, 1964, at the Cork Province mine, the muck slip was hoisted into the headframe on a failure of the limit switches.

On December 16, 1964, at the Coast Copper mine, a small service skip fell down the 40-degree inclined shaft when the 75-foot ¾-inch-diameter cable attaching the service skip to the bottom of the main skip broke. The service skip had become stuck in the shaft on descent, and a kink developed in the connecting cable before the hoistman was notified. He was taking up the slack when the service skip broke free and gained sufficient momentum to snap the cable.

On December 19, 1964, at the H.B. mine, four men were partially overcome by blasting fumes in a raise which had not been properly ventilated.

PROSECUTIONS

One prosecution was instituted under the *Metalliferous Mines Regulation Act,* as follows:—

The manager of Giant Explorations Ltd., being the manager and person in charge of operations at the Canam mine, was charged with unlawfully permitting a diesel locomotive to be operated underground contrary to a written order issued by the Inspector of Mines, under the provisions of section 7 (2). The offence took place on November 12, 1964, and the hearing was held at Hope on December 4, 1964. The defendant pleaded guilty and was fined $100 and costs.

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. Blasting certificates of three offenders were suspended in each case for a period of two months. The offenders were drilling in the location of blasted holes and returning too soon after a blast. One blaster also had his certificate suspended because of mental infirmity.

EXPLOSIVES USED IN MINES

The table below shows the quantities of explosives and ammonium nitrate used in mines and quarries (other than coal) in British Columbia in 1960, 1961, 1962, 1963, and 1964:—

	1960	1961	1962	1963	1964
High explosives (lb.)	7,188,000	7,280,000	4,522,619	4,072,000	5,200,000
Hydromex	862,000	2,116,000	2,013,850	1,770,000	2,100,000
Amex II	—	169,000	2,429,550	2,639,000	2,900,000
N.C.N. (C. M. & S. Co., Ltd.)	—	—	[1]	[1]	2,023,000
Ammonium nitrate	1,641,000	2,647,000	5,921,690	8,900,860	10,100,000

[1] Figures for 1962 and 1963 were included in the totals for ammonium nitrate.

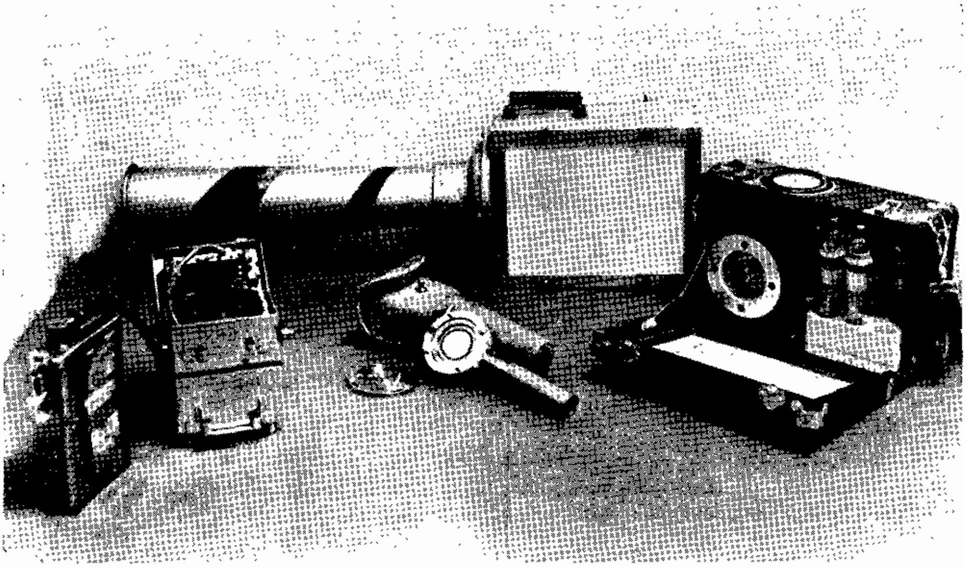
The quantity of all explosives used in 1964 increased over that used in 1963. The do-it-yourself explosive of ammonium nitrate and fuel oil (AN/FO), first introduced in 1957, continued its rise in annual consumption. In 1961 and 1962 respectively, commercial forms of AN/FO, Amex II, and N.C.N. of The Consolidated Mining and Smelting Company of Canada, Limited, were permitted underground and rapidly replaced standard explosives. One serious problem with AN/FO is in the packaging, as the oil in the explosive has a tendency to separate out either by migration or evaporation. Any decrease in the oil content may create excessive amounts of oxides of nitrogen fumes on detonation. Thus the use of AN/FO explosives is contingent on a permit being obtained from the Chief Inspector of Mines, Victoria. For those operators who wish to blend their own ammonium nitrate and fuel oil, written permission must be obtained from the Chief Inspector of Explosives, Ottawa.

DUST CONTROL AND VENTILATION

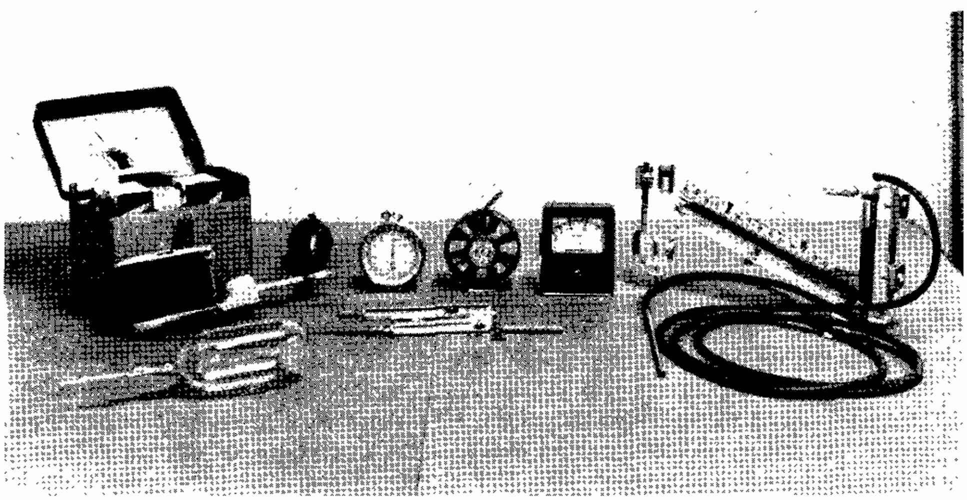
The dust and ventilation conditions at the different operations in the mining industry were surveyed by the Silicosis Control Inspectors of the Department. Excerpts from the report of the Senior Inspector, R. J. Craig, follow:—

A total of 85 inspections of dust were made, as follows: 59 surveys were made at the operations of 42 underground mines, 10 surveys were made at the operations of 8 open-pit mines, 6 surveys were made at the operations of 4 rock quarries, 2 surveys were made at the operations of 1 limestone quarry, 4 surveys were made at the operations of 4 gravel pits, 2 surveys were made at the operations of 1 asbestos mine, and 2 surveys were made at the operations of 1 coal mine.

In the underground and open-pit mines and also at the operations of diamond-drill and construction companies working in underground and open-pit mine, certificates of fitness for workmen who require a medical and X-ray examination before being allowed to work were checked against the payroll list to determine if the regulations pertaining to same were being carried out. No one is allowed to work in a dust-exposure occupation at these operations unless he has had a current medical examination.



Air-sampling equipment. Left to right: Front—thermal precipitator, konimeter, midget impinger; rear—bulk air sampler with filters.



Air-sampling equipment. Left to right: Front—air test vacuum bottle, sling psychrometer; back—gas detector, smoke tube unit, barometer, vane, anemometer, velometer, portable inclined draft gauge.

Three different instruments were used for determining dust concentrations—the konimeter, the midget impinger, and the long running thermal precipitator. The konimeter was used for collecting rock-dust samples at the underground and open-pit mines and plants, at the rock and limestone quarries, and at crushing operations in gravel pits. The midget impinger was used to sample asbestos dust and fibre at the asbestos mine according to standards set by the Quebec asbestos industry. The long running thermal precipitator was used for sampling the coal dust in the coal mines according to standards set by the National Coal Board in Great Britain. Although all of these instruments give a dust count, the counts are related to the instrument used and cannot be related from one instrument to the other. Dust-emission measurements were also made on a coal-drier stock using a Whatman thimble filter and vacuum pump. The instruments were borrowed for this work.

Determinations were made of the dust concentration in the atmosphere of underground mines, at dust-producing operations in the open pits and quarries, in crushing plants, dry-milling plants, and assay grinding-rooms. Measurements of the ventilation and observation of the conditions of exhaust systems and other measures relative to the prevention, suppression, and elimination of dust were made. Recommendations and advice were given for improvements which it was considered would help to lower the dust concentration. A summary of the conditions found follows:—

1. Eighty-five surveys of dust concentration were made at 61 mining operations during 1964. The surveys covered lode mines both underground and open pit, rock quarries and gravel pits, asbestos and coal mines.

2. For silica dust the figure of 300 particles per c.c. as determined with the konimeter is used as a level of dust concentration that can be obtained under good conditions of ventilation and dust control. For asbestos dust, 5 million particles per cubic foot as obtained with the midget impinger is the accepted standard. For coal dust other than anthracite, 850 particles per c.c. between 1 and 5 microns in size as measured with the thermal precipitator is the accepted standard.

3. Fifty-nine per cent of the surveys at drilling operations underground showed averages of less than 500 particles per c.c. One mine has standardized on the use of auxiliary blowers with ventube to reduce the dust concentration in development headings. It is hoped this will become standard practice at all of the mines.

4. At all other underground locations excluding drilling operations, the percentage of surveys with an average of 300 particles per c.c. or less was 81 per cent.

5. In the crushing plants for underground ore, 58 per cent of the surveys showed an average dust concentration of less than 300 particles per c.c. All of the plants depend on exhaust systems to collect the dust.

6. In the open-pit mines the conditions found were as follows: At drilling operations in pit, 80 per cent of surveys less than 500 particles per c.c.; at all other operations in pit, 100 per cent of surveys less than 300 particles per c.c.; at crushing plants, 33 per cent of surveys less than 300 particles per c.c.

7. Eighty-seven per cent of the surveys made in assay grinding-rooms gave averages of less than 300 particles per c.c.

8. The following conditions were found in quarries and plants where structural materials are produced: At drilling operations, 70 per cent of surveys less than 500 particles per c.c.; at crushing and bagging operations, 56 per cent of surveys less than 300 particles per c.c.

9. Surveys of the conditions in the asbestos mill showed 81 per cent of the samples taken to be within the permissible limit of 5 million particles per cubic foot.

10. A survey of the dust conditions in the coal industry showed 86 per cent of the samples to be within the standard set by the National Coal Board.

11. Certificates of fitness were checked at the mines, and more than 96 per cent were found in good order.

12. Aluminum-powder prophylaxis as administered by McIntyre Research Foundation has been dropped by most of the mines in British Columbia. It is being made available in a treatment room at one mine to those men who wish to take the powder.

13. Figure 28 is a graph showing the median of all the averages in various operations in the lode mines obtained each year since 1937.

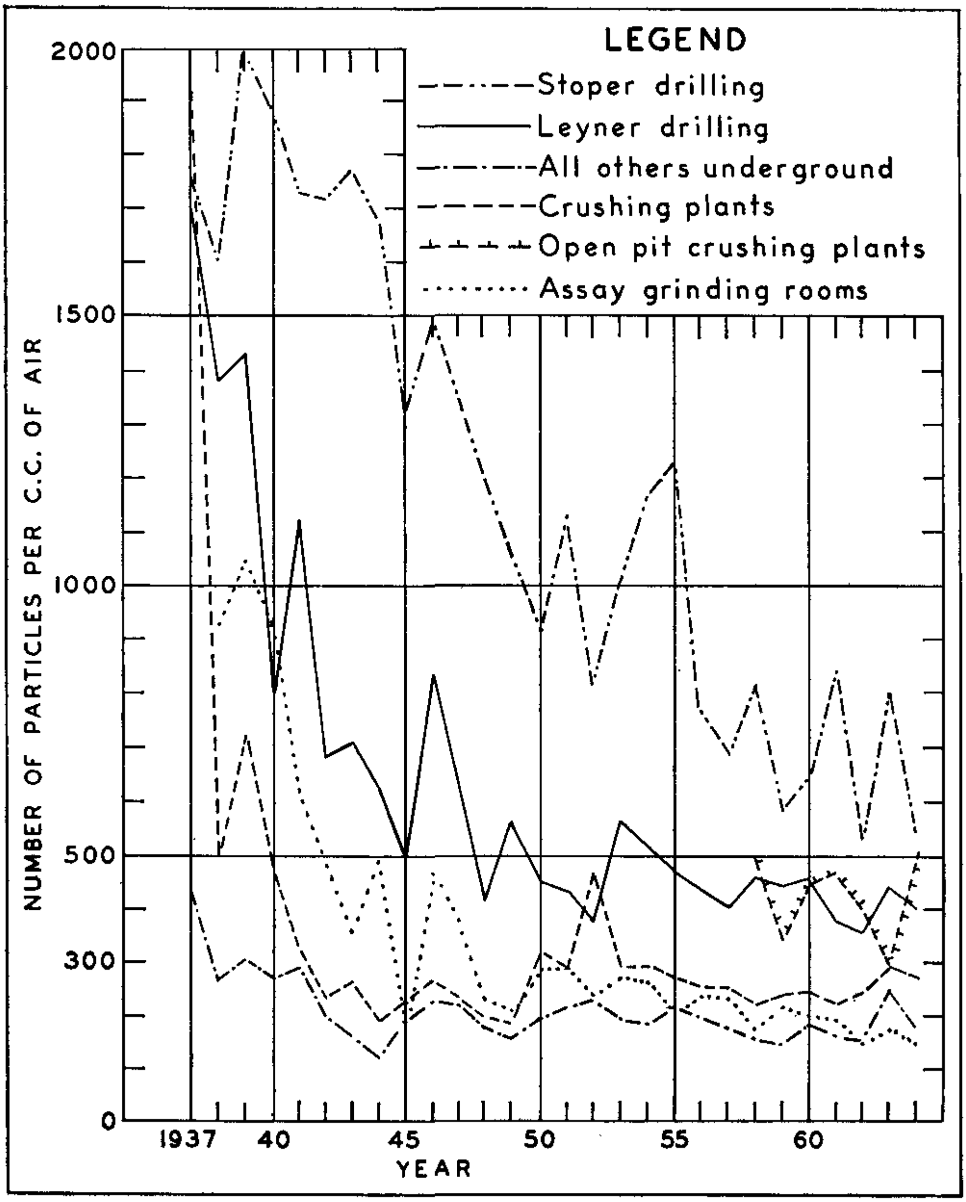


Figure 28. Average dust counts obtained each year since 1937.

SHIFTBOSS CERTIFICATES

The *Metalliferous Mines Regulation Act,* as amended in March, 1960, requires that every person employed underground be under the daily supervision of an official who is the holder of a shiftboss certificate issued under this Act. An applicant for a shiftboss certificate is required to pass an examination on the *Metalliferous Mines Regulation Act* and general safe working practices. He must have three years' practical experience or one year plus a degree in mining engineering. He must also be the holder of a mine-rescue certificate and a first-aid certificate. A fee of $5 is charged for the examination.

The Board may grant provisional certificates under such conditions as the Board considers advisable. During 1964, 77 provisional certificates were issued, each good for two years from the date of issue. Examinations for permanent certificates were held in Nelson, Hope, Kimberley, Jordan River, Vancouver, Wells, Texada Mine, and Beaverdell. Twenty-two men received certificates, as follows:—

Cert. No.	Name	Date	Cert. No.	Name	Date
239	Andrew Burgess	20-1-64	250	John Bradley Burleson	20-5-64
240	Mervin J. Schmidt	5-2-64	251	Edward William Croft	20-5-64
241	John Alexander Glennie	25-2-64	252	Kolbien Birges Grothen	20-5-64
242	William Dexter McArthur	25-2-64	253	Nicholas Kostiuk	20-5-64
243	Dugal Roy McMillan	25-2-64	254	Pierre F. X. Mousset-Jones	20-5-64
244	Stinie Vander Maaten	25-2-64	255	Arthur Lawrence Phenuff	20-5-64
245	Jerry Max Whiting	25-2-64	256	George Walter Gilbert	26-5-64
246	Cyril Alec George	25-2-64	257	Arvid Bertil Lundeberg	30-6-64
247	John D. Ormod	9-4-64	258	Allan Charles Bruce	10-7-64
248	Joseph Chlopan	9-4-64	259	Anton Hlohovsky	14-9-64
249	Guilio Pierobon	14-4-64	260	Arnold Richard Zelmer	16-9-64

MINE RESCUE, SAFETY, AND FIRST AID

The promotion of mine rescue and first aid continued on a high level throughout 1964. Four mine-rescue stations were maintained, with an instructor qualified in mine rescue and first aid available at each station. Each station is equipped with sufficient self-contained oxygen breathing apparatus to maintain two mine-rescue teams of six men each should any emergency in nearby mines arise. There are also sets of mine-rescue equipment maintained at various mines, either on loan from the Department or owned by the mine. In 1964 Department-owned equipment totalled 55 McCaa two-hour apparatus and 38 Chemox ¾-hour apparatus, while that owned by mining companies totalled 54 McCaa's and 59 Chemox's. Each station also has auxiliary equipment, such as all-service masks, self-rescuers, gas-detectors, inhalators, and a complete set of first-aid equipment. The district instructor makes a periodic check of mine-rescue and first-aid equipment at mines in his district.

The station at Nanaimo was re-established after the closure of the Cumberland station in 1963. It had been in existence from 1912 to 1951, but in 1963 the building was not found suitable and a mobile unit was purchased to operate from the Courthouse. Mine-rescue and first-aid classes were held at Texada, Coast Copper, Britannia, and Jedway Iron Ore mines. Help and advice were given to new mines in the district in the purchase of rescue equipment. The main emergency call in 1964 was to give assistance at the underground fire at the Texada mine (*see* Dangerous Occurrences). This was a commendable effort in that mine-rescue teams could be assembled from Tsable River and Britannia mines to arrive on site on such short notice.

The Kamloops station is a mobile unit which has operated from Kamloops since 1961. Service is given over a wide area in central British Columbia from the International Boundary to the Yukon border. Assistance in mine-rescue and first-aid training as well as inspection of equipment was given at Highland Bell, Pacific Silica, Bethlehem Copper, Craigmont, Bralorne, Cariboo Gold Quartz, Boss Mountain, Giant Mascot, Canam Copper, and Cassiar Asbestos mines. Special assistance was also given at the Peace River project as an aftermath of a methane explosion which occurred in one of the underground tunnels. The instructor travelled 9,800 miles by mine-rescue vehicle, 4,600 miles by private car, and 1,800 miles by aircraft during 1964.

The Nelson station is also a mobile unit which services the West Kootenay area. Mine-rescue classes were held at the Bluebell, Canadian Exploration, and H.B. mines, and at Kaslo and Slocan. First-aid classes were also held at the above mines as well as at the Reeves MacDonald and Phoenix Copper mines. There was one emergency call for assistance, to recover the body of Ernest Retzlaff from the Wellington mine (*see* Fatal Accidents). Commendations are due the mine-rescue team from the Bluebell mine, which carried out the recovery operation in a safe and efficient manner.

The mine-rescue station at Fernie 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 and Mineral King mines. First-aid classes had a total of 53 persons. In addition, 10 men took the industrial first-aid course. There were no emergency calls during 1964 for the mine-rescue apparatus.

A certificate of competency in mine-rescue work is granted to each man who takes the training course and passes the examination set by the Department. For those who take a refresher course, a sticker is given for attachment to the certificate. All mine-rescue men are also entitled to a hat emblem. In 1964, in addition to the regular teams in training, 158 men took the course and were granted certificates, as follows:—

Certificate No.	Name	Where Trained	Certificate No.	Name	Where Trained
3553	Frank Rice	Bralorne.	3581	Ernest William Perry	Merritt.
3554	John F. Beyer	Bralorne.	3582	Larry Twerdun	Merritt.
3555	Andrew J. Schmidt	Bralorne.	3583	Gordon Franklin Broad	Merritt.
3556	Guy Lokhorst	Bralorne.	3584	James Adrien Bertrand	Merritt.
3557	Dale A. Harwood	Bralorne.	3585	James Swain	Merritt.
3558	Merl J. Cloutier	Bralorne.	3586	Edmund Nowacky	Merritt.
3559	John T Graham	Bralorne.	3587	Alexander Wilson	Merritt.
3560	Dean C. Bell	Bralorne.	3588	John M. Mulvey	Merritt.
3561	Peter J. Luttmer	Bralorne.	3589	Edmund J. Cops	Merritt.
3562	James MacDonald	Kimberley.	3590	Ambrose A. Cashaback	Merritt.
3563	Pierre F. X. Mousset-Jones	Kimberley.	3591	George Maurice Babet	Beaverdell.
3564	Elmer Eugene Garinger	Kimberley.	3592	Nick Peter Hoodikoff	Beaverdell.
3565	Allan Pearson	Kimberley.	3593	Louis Szabo	Beaverdell.
3566	John Bradley Burleson	Kimberley.	3594	Dennis Ignace Wittner	Beaverdell.
3567	George Henry Adams	Kimberley.	3595	Robert Bernard Kuyten	Beaverdell.
3568	Douglas Richard Karsten	Kimberley.	3596	Wayne Murton	Beaverdell.
3569	William Bell McGregor	Kimberley.	3597	Clark Bellingham	Port McNeill.
3570	Marcel Louis Poisson	Kimberley.	3598	Myrle Elsworth Logan	Port McNeill.
3571	William Sampson Roskilly	Kimberley.	3599	Richard Lofstrom	Port McNeill.
3572	Gordon Neil MacKenzie	Kimberley.	3600	James Hair McClung	Port McNeill.
3573	Edward William Craft	Kimberley.	3601	Bernhardt George Nordkoff	Port McNeill.
3574	Kolbein Birger Grothen	Kimberley.	3602	Herbert Heinz	Port McNeill.
3575	Donald Keith McBain	Kimberley.	3603	Joseph Roland Foisy	Port McNeill.
3576	Robert Louis Gabel	Merritt.	3604	Anthony McNulty	Port McNeill.
3577	Leonard T. Ricker	Merritt.	3605	William Dwernichuk	Port McNeill.
3578	Gary Kreller	Bralorne.	3606	Dennis Quarin	Michel.
3579	Mike P. Lipkewich	Merritt.	3607	Fred Harold Venzi	Michel.
3580	LeRoy Wagner	Merritt.			

Certificate No.	Name	Where Trained
3608	Ronald Rector	Riondel.
3609	Ermanno M. Lorenzi	Riondel.
3610	Isaac M. Hooper	Riondel.
3611	Henry Carlyle Howell	Riondel.
3612	James A. E. Lovestrom	Riondel.
3613	Richard E. Linville	Riondel.
3614	James R. Innes	Riondel.
3615	Ralph L. Schelle	Riondel.
3616	George Osborne	Riondel.
3617	Reid H. Pollard	Riondel.
3618	George J. St. Germaine	Riondel.
3619	David Charles Miller	Riondel.
3620	Manfred Kluckert	Riondel.
3621	Earl G. Green	Riondel.
3622	Roland Allen	Riondel.
3623	Lyle W. Hahermehl	Ashcroft.
3624	Joseph Hunyadi	Ashcroft.
3625	Arpad Fustos	Ashcroft.
3626	Paul Koochin	H.B. mine.
3627	Douglas R. McPhee	H.B. mine.
3628	Walter H. Borth	H.B. mine.
3629	Clifford L. Bartlett	H.B. mine.
3630	Eli Imaiff	H.B. mine.
3631	William Chernenkoff	H.B. mine.
3632	Clarence Thickett	Slocan.
3633	Charles Brith Smith	Ashcroft.
3634	William Henry Pierre	Ashcroft.
3635	Fredrick Raleigh	Texada mine.
3636	Gerald Mellquist	Texada mine.
3637	Donald Legault	Texada mine.
3638	Helmut Jaeckel	Texada mine.
3639	Richard Leon Regan	Texada mine.
3640	James Rozak	Blubber Bay.
3641	Edward Wright	Texada mine.
3642	William Swaren	Texada mine.
3643	Dinko Devcic	Texada mine.
3644	William Jones	Texada mine.
3645	Harold Alexander Armour	Texada mine.
3646	Keith G. Hughes	Texada mine.
3647	William H. Miller	Texada mine.
3648	Joseph Beer	Anaconda.
3649	William Morton Adamson	Anaconda.
3650	Peter MacDonald	Mine safety appliance.
3651	James Ainsley	Anaconda.
3652	Keith Gardner	Anaconda.
3653	George William Preston	Portage Mountain.
3654	Herbert K. Svenson	Portage Mountain.
3655	Raymond J. DeCosse	Portage Mountain.
3656	Kenneth James MacLean	Portage Mountain.
3657	Adolph Edward Stevens	Portage Mountain.
3658	William Douglas Cowin	Portage Mountain.
3659	Kenneth L. Kaldal	Portage Mountain.
3660	Frank MacMillan	Portage Mountain.
3661	John F. Webster	Portage Mountain.
3662	Nick Kochan	Portage Mountain.
3663	Dennis Venn	Portage Mountain.
3664	William H. Barker	Portage Mountain.
3665	Joseph Z. Kuzniakowski	Portage Mountain.
3666	Donald E. Urie	Portage Mountain.
3667	Tom Cloke	Jedway Iron Ore.
3668	Terry Cloghesy	Jedway Iron Ore.
3669	Bruno Lewinski	Jedway Iron Ore.
3670	Tapio E. Keinanen	Jedway Iron Ore.
3671	Gerald McPhillamey	Jedway Iron Ore.
3672	Paul Davison	Jedway Iron Ore.
3673	Wilfred W. Larmour	Jedway Iron Ore.
3674	W. Glenn Martin	Jedway Iron Ore.
3675	Larry McGinnis	Jedway Iron Ore.
3676	Svend Madson	Jedway Iron Ore.
3677	Arnie Gronningsater	Jedway Iron Ore.
3678	Harry B. Johnston	Jedway Iron Ore.
3679	Hugh Grenier	Jedway Iron Ore.
3680	Cornelius van Staalduinen	Canadian Exploration.
3681	James C. O'Rourke	Canadian Exploration.
3682	John D. Bishop	Canadian Exploration.
3683	Douglas Coley	Canadian Exploration.
3684	Owen Edward Bradley	Canadian Exploration.
3685	Edward A. Lawrence	Canadian Exploration.
3686	William Boydell Montgomery	Canadian Exploration.
3687	Tom S. Smith	Canadian Exploration.
3688	Ronald Stard	Canadian Exploration.
3689	William van Staalduinen	Canadian Exploration.
3690	Lorne Ernest Williams	Cariboo Gold Quartz.
3691	Allan P. Brooks	Cariboo Gold Quartz.
3692	William A. McInnes	Cariboo Gold Quartz.
3693	Lothar Heinz Fandrey	Cariboo Gold Quartz.
3694	Robert G. Pelletier	Cariboo Gold Quartz.
3695	George B. Nickerson	Cariboo Gold Quartz.
3696	Anthony Smandych	Cominco.
3697	Joseph Martin Mucha	Cominco.
3698	Reginald Charles Derbyshire	Cominco.
3699	John Edward McGregor	Cominco.
3700	Vincent James Ostir	Cominco.
3701	Vernon Edward Hills	Cominco.
3702	Oscar Andrew Johnson	Cominco.
3703	Charles Lind	Kaslo.
3704	Harry Lauchlin MacPherson	Kaslo.
3705	Robert C. Brown	Kaslo.
3706	Arthur Ross MacLanders	Kaslo.
3707	John Andrew Coates	Bralorne Pioneer.
3708	Walter Leszczyszyn	Bralorne Pioneer.
3709	Adolph Raymond Siatecki	Bralorne Pioneer.
3710	Bruce Mayo	Bralorne Pioneer.
3711	William Douglas Lang	Bralorne Pioneer.

The mine safety association in different centres of the Province, sponsored by the Department of Mines and Petroleum Resources 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 Bridge River Valley Mine Safety Association held its 22nd annual competition at Bralorne on May 23, 1964. This was mainly a first-aid meet with events for juniors and seniors. The senior event was designed for spectator appeal in that a large number of casualties were involved in which the injuries were well simulated. The event was won by a team captained by W. Thiessen. In the mine-rescue competition, two teams competed. The winning team was captained by M. Mitchell.

The Vancouver Island Mine Safety Association held its 50th annual competition in Cumberland on May 30, 1964. Three teams competed in the mine-rescue event—one each from Tsable River, Britannia, and Coast Copper mines. The winning team was from the Tsable River mine and was captained by W. High.

The West Kootenay Mine Safety Association held its 18th annual competition at Nelson on June 6, 1964. Five teams took part in the mine-rescue event—two from the Bluebell mine and one each from the Canadian Exploration, H.B., and Phoenix Copper mines. A Bluebell team captained by B. Ramage took first place.

The Central British Columbia Mine Safety Association held its 16th annual competition at Kamloops on June 13, 1964. Five teams took part in the mine-rescue event—one each from Craigmont, Bethlehem, Bralorne, Highland Bell, and Giant Mascot mines. The Craigmont team captained by G. Sutherland took first place.

The East Kootenay Mine Safety Association held its 43rd annual competition at Kimberley on June 20, 1964. Five teams took part in the mine-rescue event—two from the Sullivan mine and one each from Fernie, Michel, and Toby Creek. A Sullivan team captained by C. Kinrade took first place.

At all four preceding meets, competitions were held in first-aid as well as mine-rescue work. In these competitions, events were held for women and juniors. There were entries in these competitions from industries and organizations not necessarily connected with mining.

The ninth Provincial mine-rescue competition was held at Kamloops on June 27, 1964. The winning teams from Cumberland, Nelson, Kamloops, and Kimberley competed for a trophy and silver trays. The event was won by the Sullivan team of The Consolidated Mining and Smelting Company of Canada, Limited, captained by C. Kinrade. The team also won a silver cup which has been donated by the International Union of Mine, Mill and Smelter Workers for annual competition for mine-rescue teams from metalliferous mines. In conjunction with this competition, the Workmen's Compensation Board sponsored the eighth Provincial men's first-aid competition, and teams competed which had won local events at Victoria, Cumberland, Kitimat, Kamloops, Vancouver, Kimberley, and Nelson. The winning team was the Sullivan mine team from Kimberley captained by R. Chatterson.

JOHN T. RYAN TROPHY

The John T. Ryan safety trophies were set up in 1941 to promote safety in coal and metal mines. Administration of the awards is by the Canadian Institute of Mining and Metallurgy. In 1963 the first major changes in the competition rules were made in that it was required of metalliferous mines that sufficient calendar years be submitted by each entering mine to complete 1,000,000 man-hours. In 1964 the Regional Trophy for metalliferous mines was won by the H.B. mine of The Consolidated Mining and Smelting Company of Canada, Limited, with an accident frequency of 4.1. This is the fourth year in a row for this mine to win the award. The fine showing in 1964 placed the mine second among the mines in Canada in the competition for the Dominion Trophy.

In coal-mining the Michel Colliery of The Crow's Nest Pass Coal Company Limited won the Dominion Ryan Trophy as well as the Regional Trophy. This is noteworthy, as it is the third time in the history of the competition that the Dominion Trophy has come to British Columbia and the second time to the Michel Colliery.

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. 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 involved more than three days' loss of time.

In 1964 the award was won by the H.B. mine of The Consolidated Mining and Smelting Company of Canada, Limited, with an accident frequency of 4.1.

SAFETY COMPETITION, OPEN-PIT MINES AND QUARRIES

In 1961 the Department of Mines and Petroleum Resources instituted a safety competition for the open-pit and quarry industry and put up awards and a trophy for annual competition. The trophy is awarded to the operation having worked a minimum of 75,000 man-hours in the year and having the lowest number of compensable injuries per million man-hours of exposure. For those operations which amass over 15,000 man-hours ending in the competition year, certificates of achievement are given when no compensable accidents occur during this period.

In 1964 the trophy was won by the Mary Hill sand and gravel quarry of Ocean Cement Limited, with an injury frequency of 8.5 per million man-hours. Six quarries received certificates of achievement, as follows: Cobble Hill quarry of the B.C. Cement division of Ocean Cement Limited, Abbotsford Gravel Sales Ltd., Blackham's Construction Ltd., Clayburn-Harbison Ltd., Highland Sand and Gravel quarry of Ocean Cement Limited, and Imperial Limestone Co. Ltd.

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 1964 was 1,121,487 tons, an increase of 155,678 tons or 16.1 per cent over 1963. A total of 160,488 tons came from strip mines at Michel Colliery and Coleman Collieries.

The Vancouver Island District production was 64,390 tons, a decrease of 11,305 tons or 14.9 per cent from 1963.

There were no operating mines in the Nicola-Princeton District during 1964.

The Northern District production was 6,811 tons, an increase of 60 tons or 0.8 per cent over 1963.

The East Kootenay District production was 1,050,286 tons, an increase of 166,983 tons or 18.9 per cent over 1963.

Output and per Capita Production, 1964

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	62,943	251	88	2.85	715	63	3.98	999
Midan mine	704	185	2	1.90	352	2	1.90	352
Loudon No. 6 mine	225	123	1	1.83	225	1	1.83	225
Lewis No. 2 mine (Timberlands)	314	95	2	1.65	157	2	1.65	157
Undun No. 4 mine	204	116	1	1.76	204	1	1.76	204
Bulkley Valley Collieries	6,761	150	11	4.09	614	8	5.63	845
Gething No. 3 mine	50	11	1	4.54	50	1	4.54	50
Michel Colliery (underground)	889,798	230	583	6.63	1,526	368	10.51	2,418
Michel Colliery (strip)	89,437	230	14	27.77	6,388	----	----	----
Coleman Collieries (strip)	71,051	----	10	----	----	----	----	----

District Output and Per Capita Production, Underground Mines, 1964

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	64,390	94	685	69	933
Northern	6,811	12	567	9	757
East Kootenay	889,798	583	1,526	368	2,418
Whole Province	960,999	689	1,395	446	2,155

Output per Man-shift, Underground Mines, 1955–64

Year	Man-shifts[1]	Tonnage	Average per Man-shift (Tons)
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
1960	210,254	766,581	3.66
1961	213,962	877,085	4.10
1962	160,418	805,051	5.02
1963	170,287	866,481	5.09
1964	158,638	960,999	6.05

[1] Includes both surface and underground workers.

Collieries of British Columbia, 1964—Production and Distribution, by Collieries and by Districts (Short Tons)

Name	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.	Elsewhere	Total Sales	
Vancouver Island District														
Comox Mining Company Ltd.—Tsable River Colliery	62,943	......	62,943	......	......	6,587	12,595	6,008	......	56,935	......	......	56,935	56,935
Midan mine	704	......	704	......	......	......	......	......	......	704	......	......	704	704
Loudon No. 6 mine	225	......	225	......	......	......	......	......	......	225	......	......	225	225
Lewis No. 2 mine (Timberlands)	314	......	314	......	......	......	......	......	......	314	......	......	314	314
Undun No. 4 mine	204	......	204	......	......	......	......	......	......	204	......	......	204	204
Totals, Vancouver Island District	64,390	......	64,390	......	......	6,587	12,595	6,008	......	58,382	......	......	58,382	58,382
Northern District														
Bulkley Valley Collieries	6,761	......	6,761	......	......	125	51	......	74	6,835	......	......	6,835	6,835
Gething No. 3 mine	50	......	50	......	......	......	......	......	......	50	......	......	50	50
Totals, Northern District	6,811	......	6,811	......	......	125	51	......	74	6,885	......	......	6,885	6,885
East Kootenay District														
The Crow's Nest Pass Coal Co. Ltd.—Michel Colliery (underground and strip)	979,235	145,001	834,234	17,452	189,342	3,474	52,195	48,721	......	183,173	2,055	393,491	578,719	785,513
Coleman Collieries — Tent Mountain mine (strip)	71,051	10,505[2]	60,546	......	......	......	......	......	......	60,546	......	......	60,546	60,546
Totals, East Kootenay District	1,050,286	155,506	894,780	17,452	189,342	3,474	52,195	48,721	......	243,719	2,055	393,491	639,265	846,059
Coal														
Grand totals for Province	1,121,487	155,506	965,981	17,452	189,342	10,186	64,841	54,729	74	308,986	2,055	393,491	704,532	911,326
Coke														
The Crow's Nest Pass Coal Co. Ltd.—Michel Colliery	144,207	......	144,207	......	......	14,871	9,319	......	5,552	76,218	73,541	......	149,759	......

[1] Includes coal used in making coke and coal used under stationary and locomotive boilers, etc.
[2] Estimated.

Collieries of British Columbia, 1964—Men Employed, Distribution by Collieries and by Districts

Mine	Supervision and Clerical			Miners			Helpers			Labourers			Mechanics and Skilled Labour			Total Men Employed		
	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.	U.	A.	T.
Vancouver Island District																		
Comox Mining Company Ltd.—Tsable River Colliery	7	4	11	51	—	51	—	—	—	—	18	18	5	3	8	63	25	88
Midan mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Loudon No. 6 mine	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	1	—	1
Lewis No. 2 mine (Timberlands)	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Undun No. 4 mine	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	1	—	1
Totals, Vancouver Island District	9	4	13	55	—	55	—	—	—	—	18	18	5	3	8	69	25	94
Northern District																		
Bulkley Valley Collieries	1	1	2	3	—	3	3	—	3	1	1	2	—	1	1	8	3	11
Gething No. 3 mine	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	1	—	1
Totals, Northern District	1	1	2	4	—	4	3	—	3	1	1	2	—	1	1	9	3	12
East Kootenay District																		
The Crow's Nest Pass Coal Co. Ltd.—																		
Michel Colliery (underground)	28	31	59	171	—	171	78	—	78	76	154	230	15	30	45	368	215	583
Michel Colliery (strip)	—	1	1	—	—	—	—	—	—	—	13	13	—	—	—	—	14	14
Coleman Collieries Ltd.—Tent Mountain (strip)	—	1	1	—	—	—	—	—	—	—	9	9	—	—	—	—	10	10
Totals, East Kootenay District	28	33	61	171	—	171	78	—	78	76	176	252	15	30	45	368	239	607
Grand totals for Province	38	38	76	230	—	230	81	—	81	77	195	272	20	34	54	446	267	713

Note.—U.=underground; A.=above ground; T.=total.

Coal-preparation Plants

In addition to the fine-coal cleaning plant built in 1962, a new 40-ton-per-hour flotation plant was put into operation in April, 1964, at Michel Colliery, The Crow's Nest Pass Coal Company Limited. Further details of this plant are given under Michel Colliery notes, East Kootenay District, by Inspector D. R. Morgan.

A Drummond wet scrubber was installed at the Michel Colliery fine cleaning plant in August, 1964, to reduce the dust pollution arising from the exhaust gases from the fine-coal drier.

A battery of six corrugated-steel silo bins was also erected in 1964 at Michel Colliery, adjacent to the coal-preparation plant, to provide surge and blending facilities at the plant.

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.

LABOUR AND EMPLOYMENT

In 1964, 713 persons were employed in and about the coal mines of the Province, a decrease of 35 from 1963. Because of the five-day week in force throughout the Province and the legal holidays, the maximum number of working-days at the larger mines was 242. In the Vancouver Island District the Tsable River mine worked 251 days. In the East Kootenay District the Michel Colliery worked 230 days.

COMPETITION FROM COAL PRODUCED OUTSIDE OF BRITISH COLUMBIA

In 1964 the shipment of Alberta coal, briquettes, and char to British Columbia totalled 261,990, 4,648, and 5,552 tons respectively.

The following table shows the amount of Alberta coal brought into British Columbia during the past 10 years:—

Year	Short Tons	Year	Short Tons
1955	932,764	1960	379,668
1956	860,329	1961	321,909
1957	672,527	1962	283,651
1958	532,911	1963	262,433
1959	437,118	1964	261,990

Of the 704,532 tons of British Columbia coal marketed, 164,073 tons was sold for domestic and industrial use in Alberta, Saskatchewan, Manitoba, and Ontario; 2,055 tons was exported to the United States; and 393,491 tons was exported to Japan.

The amount sold for domestic and industrial use in the Province was 144,913 tons.

ACCIDENTS IN AND AROUND COAL MINES

In 1964 there were two fatal accidents, as compared with one in 1963. The number of fatal accidents per 1,000 persons (underground and strip-mine personnel) employed was 2.80, compared with 1.33 in 1963, 0.00 in 1962, 6.37 in 1961, 0.00 in 1960, 1.89 in 1959, 0.00 in 1958, 1.45 in 1957, 4.39 in 1956, and 3.38 in 1955.

The number of fatal accidents per 1,000,000 gross tons of coal (underground and strip mine coal) produced was 1.71, compared with 1.03 in 1963.

The following tables classify the accidents in coal mines in 1964:—

Accidents Classified as to Occupation

Occupation	Number of Accidents	Percentage of Accidents
Underground—		
Miners	38	28.37
Drillers and facemen	24	17.91
Haulage and conveyor men	24	17.91
Trackmen and mechanics	7	5.22
Supervisors	7	5.22
Timbermen	5	3.73
Coal-cutters	2	1.49
Miscellaneous	7	5.22
Surface—		
Shops	7	5.22
Surface	4	3.00
Preparation and coke-ovens	7	5.22
Miscellaneous	2	1.49
Totals	134	100.00

Accidents Classified as to Cause

Cause	Number of Accidents	Percentage of Accidents
Fall of ground	26	19.40
Fall of material and flying material	7	5.22
Lifting and handling equipment and material	34	25.37
Machinery and tools	24	17.91
Slipped and tripped	34	25.37
Falling off staging and platforms	4	3.00
Miscellaneous	5	3.73
Totals	134	100.00

Accidents Classified as to Injury

Injury	Number of Accidents	Percentage of Accidents
Head and neck	10	7.47
Eyes	2	1.49
Trunk	28	20.90
Back	18	13.44
Arms	4	3.00
Hands and fingers	16	11.91
Legs	48	35.82
Feet	6	4.48
Toes	2	1.49
Totals	134	100.00

COMPENSABLE[1] ACCIDENTS, INCLUDING FATAL ACCIDENTS RELATED TO TONS MINED AND MEN EMPLOYED IN AND ABOUT COAL MINES

Year	Number of Accidents	Number of Persons Employed	Frequency per 1,000 Persons	Tons Mined (Gross)	Tons Mined per Accident
1955	372	1,478	252	1,484,066	3,989
1956	385	1,366	282	1,589,398	4,129
1957	340	1,380	246	1,221,766	3,593
1958	214	1,086	197	882,962	4,126
1959	189	1,056	179	757,628	4,009
1960	235	1,182	198	844,500	3,593
1961	219	942	232	1,018,832	4,652
1962	134	776	173	912,837	6,812
1963	135	748	180	965,809	7,154
1964	134	713	188	1,121,487	8,369

1 Compensable accident means an injury causing a loss of more than four days' work.

In 1963* there was one fatal accident, which occurred underground, at the mines in the Province.

Gino Berdusco, aged 48, married, and employed as a car-dumper, Michel Colliery, was fatally injured when he was crushed between a mine car and the rotary dump on the surface at about 12.40 p.m. on February 6, 1963.

The dumping crew had lowered a trip of 70 mine cars from the portal on a slight downgrade toward the rotary dump, but due to the wet condition of the rails the sprags failed to stop the trip in time and the two front cars of the trip passed through the rotary dump. Berdusco and two other men attempted to uncouple the two cars by means of a tugger hoist and rope. One car was released, and Berdusco was in the act of attaching the rope to the coupling of the second car when apparently due to a misunderstanding two motormen at the other end of the trip started to pull the trip back with their motors in tandem. Berdusco was crushed between the car and the end of the rotary dump.

In 1964 there were two fatal accidents at the mines in the Province, one of which occurred underground and one on the surface.

Thomas J. Bates, aged 43, married, and employed as a miner at the Tsable River mine, Comox Mining Company Limited, was fatally injured when struck by coal sluffing off a pillar on January 30, 1964, at about 3.30 a.m.

The deceased and two other miners were engaged in mining out a small pillar of coal on the right side of a pan conveyor in a pillar extraction area when a considerable amount of coal sluffed off the pillar and struck Bates and pushed him against the conveyor, fatally injuring him.

Brian Bernardo, aged 21, single, and employed as a surface labourer at Michel Colliery, was asphyxiated when he was buried by slack coal in No. 2 section of No. 5 bin, Michel tipple, at about 12.30 p.m. on September 10, 1964.

At 11 a.m. the deceased and Isaac Pettoello were instructed to empty the No. 2 section of No. 5 bin so that the conveyor at the bottom of the bin could be repaired.

Bernardo and Petoello put on their safety belts and tied the ropes to beams at the top of the bin. Bernardo went down into the bin and tried to loosen the coal with a bar on the right side of the bin, but as the slack coal was wet it would not run. Bernardo then threw a shovel to the bottom of the bin and lowered himself by the aid of the safety rope and tie-rods to the bottom. When Bernardo reached the bottom the slack coal which he had tried to move previously and on which he was standing suddenly slid to the bottom of the bin completely burying him. When the body was recovered, artificial respiration failed to revive the deceased.

* Omitted in 1963 Report.

EXPLOSIVES

The following table shows the quantity of explosives used in underground coal mines in 1964, together with the number of shots fired, tons of coal produced per pound of explosives used, and the average number of pounds of explosive per shot fired (these quantities include all the explosives used for breaking coal and rock in coal mines):—

Vancouver Island District

Colliery	Quantity of Explosives Used (Lb.)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosives per Shot Fired
Tsable River Colliery (Comox Mining Company Limited)	30,000	62,943	65,000	2.10	0.46
Midan mine	300	704	300	2.01	1.00
Loudon No. 6 mine	250	225	370	0.90	0.67
Lewis No. 2 mine (Timberlands)	300	314	300	1.05	1.00
Undun No. 4 mine	150	204	300	1.36	0.50
Totals for district	31,000	64,390	66,270	2.07	0.46

Northern District

Bulkley Valley Collieries	6,000	6,761	4,750	1.12	1.26
Gething No. 3 mine	25	50	50	2.00	0.50
Totals for district	6,025	6,811	4,800	1.13	1.25

East Kootenay District

Michel Colliery (underground)	95,646	889,798	65,833	9.30	0.45

Province

Totals for Province	132,671	960,999	136,903	7.24	0.97

Quantity of Different Explosives Used

	Lb.
Monobel of different grades	132,051
Permissible rock powder	620
Total	132,671

MACHINE-MINED COAL

In 1964 mining-machines produced approximately 594,062 tons or 61.81 per cent of the total output from underground mining. A total of 160,488 tons of strip-mined coal was removed by mechanical means.

SAFETY LAMPS

There were 800 safety lamps in use in the mines of the Province. Of this number, 746 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 M-S, carrying the Approval 6D-34 of the United States Bureau of Mines, and Mines and Technical Surveys, Canada, Certificate 39-2 Coal Mines.

The Wheat electric lamp and having Approval No. 20, as issued by the United States Bureau of Mines.

The Wheat electric lamp and having Approval No. 6D-30, 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 14,381 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 accumulaions 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

Since August, 1950, diesel locomotives have been permitted in coal mines in British Columbia.

MILLISECOND DELAY DETONATORS

In February, 1951, an amendment to the *Coal Mines Regulation Act* was passed to allow, with permission of the Chief Inspector, more than one shot to be fired at one time in any coal mine or district of a mine. For further details *see* 1954 Annual Report.

DANGEROUS OCCURRENCES

On January 31, 1964, an electric flash occurred in the No. 1 counter level at the Balmer mine, Michel Colliery, when supplies were being hoisted to the face of the level by use of a tugger hoist. Subsequent investigation disclosed that the rope had been rubbing against an electric trailing cable and had worn through the rubber insulation, causing a short circuit. No one was injured.

On February 13, 1964, an accumulation of inflammable gas was released at the face of the No. 2 entry, No. 1 mine, Michel Colliery, when a continuous miner holed through into a large cave which extended 60 feet along a fault plane from an old working in an underlying seam. The miner was immediately stopped and the electric power isolated. No one was injured.

On March 12, 1964, an electric flash occurred at the face of the No. 1 incline, Balmer mine, Michel Colliery, when a workman was lifting a flexible trailing cable for suspension on a number of hangers at the face. The short circuit ruptured a portion of the rubber insulation. It is suspected that one of the conductors in the cable had been damaged previous to the incident and that the flexing action of the cable being lifted had severed the conductor, thus causing the short circuit. No one was injured.

On June 20, 1964, in "A" South mine, Michel Colliery, a shuttle-car operator ran a shuttle car into the rib, dislodging several timber set legs. The resulting fall of the roof supports injured the operator. The accident was caused by allowing the control-lever deck to become packed with coal so that the " tram " lever would not function properly.

BUMPS AND OUTBURSTS

There were no bumps or outbursts reported from any of the coal mines in the Province during 1964.

PROSECUTIONS

There were no prosecutions reported from any of the coal mines in the Province during 1964.

SUPERVISION OF COAL MINES

During 1964 nine companies operated mines, employing 446 men underground. In the supervision of underground employees there were 2 managers, 6 overmen, and 33 firebosses, or approximately 1 official for every 13 men.

BOARD OF EXAMINERS FOR COAL-MINE OFFICIALS

First-, Second-, and Third-class Certificates and Mine Surveyors' Certificates

The Board of Examiners, formed on July 10, 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. Examinations were held at the Fernie and Telkwa centres on May 20th and November 21st respectively.

The total number of candidates at these examinations were as follows: Mine surveyor's certificate, two (one passed, one failed); third-class certificate, two (one passed, one failed).

The following were the successful candidates: Mine surveyor, Dino De Paoli; third-class certificate, Ernest Ellis.

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 1964, 15 candidates were successful in obtaining coal-miners' certificates. In addition to the certificates granted above, substitute certificates were issued to those who had lost their original certificates.

The Board of Examiners desires to thank the different coal-mining companies for 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 64,390 tons, a decrease of 11,305 tons or 14.9 per cent from the 1963 output. Only one large mine, the Tsable River mine, is now in production on the Island. Operations in the once important Nanaimo coalfield are now restricted to four very small mines, providing employment for no more than six men. These mines operate in outcrops, 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 over 85 per cent since 1951. This condition has resulted from loss of markets due to competition from other fuels, high cost of production, and from the depletion of economic reserves in the Nanaimo and Comox coalfields.

The annual mine-rescue and first-aid meet organized by the Vancouver Island Mine Safety Association was held at Cumberland on Saturday, May 30th. Three teams, one from the Tsable River mine, one from Coast Copper mine, and one from Britannia mine, participated in the mine-rescue competition, and a very high standard of performance was maintained. The winning team was the Tsable River mine team, captained by W. High.

Nanaimo (49° 123° S.W.)

Midan Mine The present operation was opened up by a slope started to the left of the old Chambers No. 5 mine slope to recover a fair-sized pillar of coal left from previous working of the old Extension Colliery. The pillar was skipped on the low side to form a haulage road. Total production in 1964 was 704 tons over a working period of 185 days with a crew of two men. Working conditions were found to be satisfactory in the course of inspections. No accidents were reported.

Lewis Mine

Glyn Lewis, operator and fireboss. The 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 by 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 forms 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 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 1964 was 314 tons over a working period of 95 days with a crew of two men. Working conditions were found to be satisfactory, and no accidents were reported.

Undun No. 3 Mine

J. Unsworth and A. Dunn, operators; A. Dunn, fireboss. This mine was brought into production in September, 1960, and is located near the No. 3 slope, old Extension Colliery. A long outcrop pillar of fairly thick coal was encountered, which was skipped on the inside for several hundred feet to form a level haulage road. This pillar, mined on the retreat, was depleted of reserves in March, 1964, and the mine was abandoned. Working conditions were found to be satisfactory, and no accidents were reported.

Undun No. 4 Mine

J. Unsworth, operator and fireboss. This new mine was started near the portal of the Undun No. 3 mine and is driven in the opposite direction, to the south, in an endeavour to contact an outcrop pillar of coal suspected to have been left in the earlier working of this area. The pillar was encountered, and a skip is being taken off the inside to form a haulage road.

North Wellington (49° 124° S.E.)

Loudon No. 6 Mine

R. B. Carruthers, operator and fireboss. 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 mine workings. The top 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 1964 amounted to 225 tons over a working period of 123 days with a crew of one man. Working conditions were found to be satisfactory during the course of inspections, and no accidents were reported.

Carruthers and Wakelem No. 3 Mine.—This mine, fully reported in previous Annual Reports, did not operate during 1964.

Comox (49° 124° N.W.)*

Comox Mining Company Limited.—S. J. Lawrence, president; G. Dutfield, vice-president; P. F. Grundy, secretary. Head office address, P.O. Box 8, Union Bay, B.C.

* By A. R. C. James.

Tsable River Mine.—S. J. Lawrence, manager; James Cochrane, overman; A. Somerville, M. Frobisher, A. Cullen, L. Cooper, G. Nicholas, and W. High, firebosses.

In 1964 production was mainly from previously unworked areas of coal in the vicinity of Nos. 3 and 4 left levels. The abandoned section of the mine was allowed to fill with water on the main slope to 150 feet below No. 4 right level. The water-level is controlled by an electrically driven turbine pump installed in 1964 on the main slope.

Production in 1964 was 62,943 tons in a working period of 251 days with a crew averaging 88 men. In the present working area of the mine the seam contains several rock bands of varying thickness and relative position; this has considerably increased the problem of mining an adequate tonnage of clean coal. Joy loaders and a coal-cutter are used to some extent, but most of the coal is hand-loaded onto shaker conveyors. Electric multiple blasting with millisecond delay detonators is used throughout the mine.

First-aid arrangements were maintained at a satisfactory standard. A suitably equipped first-aid room was provided on the surface, and an ambulance was held in readiness for emergencies. A mine-rescue team of six men was maintained. Sufficient mine-rescue equipment was stationed at the mine to meet any emergency.

Conditions were usually found satisfactory in the course of inspections.

EAST KOOTENAY INSPECTION DISTRICT

By D. R. Morgan

The production of coal from the East Kootenay Inspection District during 1964 was 1,050,286 tons, an increase of 166,983 tons or 18.9 per cent more than was produced in 1963. There were two companies in operation, but most of the production was obtained by The Crow's Nest Pass Coal Company Limited, whose operations were confined to the Michel Colliery. The colliery produced 979,235 tons, an increase of 96,432 tons, or 10.9 per cent more than in 1963. The remainder of the production was obtained by Coleman Collieries Limited operating a large strip mine on the interprovincial boundary on Tent Mountain, near Corbin. These workings are on both sides of the British Columbia-Alberta border and are operated from the Alberta side. The production of coal from the British Columbia side during 1964 was 71,051 tons, an increase of 70,551 tons above the amount that was produced by the same operation in 1963. A third company, The Pacific Coal Limited, conducted an exploration programme on a coal property in the Morrissey Creek area, southeast of Fernie, but did not produce any coal.

The accident record at Michel Colliery showed a slight increase in both frequency and severity rates during 1964. One workman was fatally injured, and 10 other accidents classified as serious were reported and investigated. The fatal accident occurred when a workman was buried by a quantity of slack coal in a surge bin at the by-product plant. The other accidents occurred underground in the mines, five being caused by machinery and five by falls of roof and coal. This was an increase of seven above the total number of serious accidents reported in 1963. Minor accidents resulting in the loss of one or more working-days totalled 122, of which 99 occurred underground and 23 on the surface, an increase of 16 accidents. Three dangerous occurrences were reported and investigated at Michel Colliery. They are reported more fully in another part of the report under the heading of "Dangerous Occurrences." No accidents or dangerous occurrences were reported from the British Columbia side of the stripping operation on Tent Mountain, or the exploration work at Morrissey.

The East Kootenay Mine Safety Association held its 43rd annual mine-rescue and first-aid competitions at Chapman Camp on June 21st, and the various contests were well attended. Five six-man teams from Fernie, Michel, Kimberley, and the Mineral King mine entered the mine-rescue competition, and the Department of Mines and Petroleum Resources shield was won by the Sullivan Mine No. 2 team, captained by C. S. Kinrade. The Men's Open competition in the first-aid events was won by the Sullivan Mine team, captained by Ralph Chatterson, for the third year in succession. The two teams represented the East Kootenay District in the Provincial competitions held at Kamloops on June 28th, and both won their respective competitions. This was quite an achievement, and is the first time the Provincial mine-rescue and first-aid competitions have been won by two teams coming from the same mine and district.

The Crow's Nest Pass Coal Company Limited

Thomas F. Gleed, president, 2000 Washington Building, Seattle, Wash.; J. E. Morris, vice-president and resident manager, Fernie; W. R. Prentice, vice-president and secretary, Fernie; J. F. Cleeve, vice-president and treasurer, Fernie. This company has conducted large-scale coal-mining operations in the Crowsnest Pass area of the East Kootenay District since 1897. Present operations are confined to the Michel Colliery. The coal is sold on the industrial market and a large quantity is exported to Japan. A large amount of fines is also utilized in the making of coke, and the coke is sold in various parts of Western Canada and the United States. The operations are directed from a head office in Fernie.

MICHEL COLLIERY.—(49° 114° N.W.) Vans H. Hulbert, manager; Irving Morgan, senior overman; Paul Kusnir, safety supervisor; Harry Corrigan, afternoon-shift overman.

The colliery is operated at Michel, 24 miles east of Fernie, and is situated on the Crowsnest branch of the Canadian Pacific Railway. It is a large colliery and has been in operation since 1899. The present workings include four underground mines, two stripping operations, and a modern by-product plant which is located on the colliery-site. A number of prospect tunnels are also being driven in the outcrops of two of the seams as part of a current exploration programme. The mines are on both sides of the valley and, with the exception of one, are named according to the seam that is worked and the direction of the development. Two of the mines are being worked from a pair of long rock tunnels which have been driven across the synclinal structure of the coal measures on the south side of the valley, and the other two, Balmer and "A" North mines, are being developed from the outcrops of the respective seams on each side of the valley. The mines are worked by a modified room-and-pillar system, and the pillars are generally extracted on the retreat. All the mines are fully mechanized, and most of the production at present is mined by continuous miners, of which there were six in operation at the end of the year. The equipment is chiefly operated by electricity. It is of the flameproof type and has been approved for use in coal mines. Transportation on most of the main levels is by compressed-air, diesel, and battery locomotives. The production from all the mines is cleaned and treated at a modern preparation plant located near the entrances to the main rock tunnels.

Upper "A" South Mine.—James Anderson, overman; William Verkerk, Robert Doratty, John Krall, Arnold Webster, Michael Tymchuk, and Ben Volpatti, firebosses.

This mine is in the "A" seam and is being worked to develop a large area of coal left between the abandoned "A" South mine and the outcrop of the seam. The workings are on the western limb of the Michel syncline and are entered by two inclines which were driven in an underlying seam and connected to the "A" seam at a higher elevation by two rock tunnels. The present workings were entered in 1958, and since that time three inclines have been driven to the outcrop of the seam, and development levels driven on each side of the inclines to form a number of extraction panels above each pair of inclines. The panels are worked by the room-and-pillar method, and the pillars are extracted by the caving system. The seam is 26 feet thick, is of good quality, and pitches at an angle of 35 degrees in a westerly direction. A description of the workings has been given in past Annual Reports.

The mine averaged a daily production of 800 tons during 1964 with a crew of 130 men. Most of the activities were directed to the development and extraction of pillars in a large panel of workings above the No. 2 North level. Other activities were directed to the extraction of pillars in a small section of workings off the No. 1 South level. The workings in the No. 2 North level section were developed by continuous miners. The development raises were driven across the pitch to facilitate the operation of the " miners," and the rooms were driven on level course along the strike of the seam. All roadways were driven in contact with the footwall, and the top coal was supported by timber sets. Systematic timbering was enforced. The development work was completed in September, 1964, and since that time activities have been confined to the extraction of pillars, and the continuous miners have been transferred to other mines. During the extraction of pillars the timber supports are withdrawn and the coal is allowed to fall or is blasted into the roadways. The coal is then loaded by duckbill conveyors which extend into the caved areas, and is transferred by conveyors and chutes to various loading points on the main levels. The coal at these points is loaded into 10-ton-capacity bottom-dumping cars and later dumped into large bins on the various levels, and transferred by retarding conveyors on one of the main inclines to a central loading point on the main rock tunnel. Compressed-air locomotives are used for hauling the cars. Total development during 1964 was 10,210 feet.

The mine is ventilated by a 100-horsepower electrically driven aerodyne fan which delivers 70,000 cubic feet of air per minute to the mine workings at a 2½-inch water-gauge. The conditions in general were found to be satisfactory during the course of inspections, but some difficulty was experienced for a short period with the condition of the timber supports on the No. 2 haulage incline and the use of the man-trip had to be stopped while repairs were carried out.

"A" West Mine.—Henry Eberts, overman. This mine, which was operated in the "A" seam on the western limb of the Michel syncline, was abandoned in January, 1964, following the depletion of the coal reserves. The supplies and equipment have since been withdrawn, and the workings sealed. The mine had been in operation since 1940. It was one of the major operations at the colliery, and it is estimated that it produced more than 4,000,000 tons of coal during its life. The mine was developed from the right side of the rock tunnels, and a description of the workings has been given in past Annual Reports.

"A" North Mine.—John Whittaker, overman; Sidney Hughes, Thomas Taylor, and Roger Girou, firebosses.

This mine, in the "A" seam, is on the northern side of the Michel Valley, and is approximately half a mile east of the colliery preparation plant. The mine was opened in 1951 and is being developed by means of two pairs of levels which have been driven from different elevations on the outcrop and follow the strike of the seam. The seam is very irregular and faulty. It is 12 feet thick where normal, dips at an angle of 15 to 20 degrees in a southerly direction, and is overlain by a moderately strong shale roof. The workings are panelled, and most of the operations are conducted by continuous miners. A description of the workings has been given in past Annual Reports.

The mine averaged a daily production of 700 tons during 1964 with a crew of 48 men. Most of the activities were directed to the development and extraction of pillars in a large area of workings known as the No. 1 Incline district above the No. 1 level. The development of the roadways and extraction of the pillars was carried out by a Joy continuous miner, and a very rapid rate of extraction was made. The development rooms were driven on level course, and the pillars were extracted by angling extraction roadways into the pillars while retreating from the rooms. Systematic timbering was rigidly enforced, and adequate pillars were left to support the roof. A great deal of difficulty was experienced at times owing to faults and other geological difficulties, but in general a high percentage of extraction was made. Large auxiliary fans are used with the " miner " for ventilation purposes, and the coal is loaded onto shuttle cars and fast-moving belt conveyors. It is transferred to a central loading point on the No. 1 level, and loaded into 10-ton-capacity bottom-dumping cars which are taken from the mine by diesel and battery locomotives and dumped into a large storage bin on the surface near the portal. It is later trucked to the preparation plant. Total development during 1964 was 19,370 feet.

The mine is ventilated by a 100-horsepower electrically driven axivane fan which delivers 80,000 cubic feet of air to the mine workings at a 2½-inch water-gauge. The fan is located near the entrance to the No. 2 level, and the upper and lower parts of the mine are ventilated as two separate splits. Normally the ventilation is exhausted in the mine, but the fan is reversed in the winter to prevent ice forming in the watercourses in the lower part of the mine. The conditions in general were found to be satisfactory during the course of inspections.

No. 1 Mine.—Henry Eberts, overman; Thomas Krall, Stanley Menduk, and Harvey Travis, firebosses.

This mine is operated in the No. 1 seam, and the workings are on the eastern limb of the Michel syncline. It is an old mine that was abandoned in 1938 but was reopened in 1963 to recover a large number of pillars that were left from the former working. The size of the operation will be considerably restricted by the presence of flooded workings in an overlying seam, but it is estimated there is sufficient area available to recover over 1,000,000 tons of coal without endangering the workings. Entry has been made from the right side of the rock tunnels, and most of the workings are to the dip. The seam is 12 to 15 feet thick, dips at an angle of 15 to 20 degrees in a southerly direction, and is overlain by a moderately hard shale roof. The method of working is by the room-and-pillar system, and most of the production is mined by a continuous miner. A description of the workings has been given in past Annual Reports.

The mine averaged a daily production of 1,000 tons during 1964 with a crew of 48 men. Most of the activities were directed to the development and extraction of pillars in an area of workings below the No. 1 and No. 2 entries in the lower part of the mine. All the work was done by a Joy continuous miner, and a very rapid rate of extraction was made. Four development slopes were driven across the pitch of the seam to facilitate the operation of the " miner," and the pillars were extracted on level course on each side of the slopes. Systematic supports were rigidly enforced, and long lengths of the roadways were supported by roof bolts. Bolts were also used to support the coal ribs in several instances. Further development of the slopes was stopped during the latter part of 1964 owing to an excessive amount of water coming into the workings, and the activities since that time have been confined to the extraction of pillars. The coal is transported via shuttle cars and fast-moving belt. It is transferred to a large coal-bin on the main rock tunnel, loaded into trips of cars, and taken from the mine by compressed-air locomotives. The total development work completed in 1964 was 10,230 feet.

The mine is ventilated by a 100-horsepower electrically driven axivane fan which delivers 70,000 cubic feet of air per minute to the mine workings at a 5.2-inch water-gauge. This quantity was found to be satisfactory to meet the normal requirements of the mine. Other conditions were also found to be satisfactory during the course of inspections, with the exception of one instance where a large cave occurred in a pillar-extraction room, causing excessive damage to the continuous miner.

Balmer (No. 10) Mine.—William Davey, overman; Frank McVeigh, Robert Taylor, Kenneth Kniert, James Walsh, Henry Parsons, Joseph Serek, Harry Sanders, Albert Littler, and Roger Pasiaud, firebosses.

This mine, in No. 10 seam, is being worked to develop a large area of virgin coal on the south side of the Michel Valley. The portals are 1 mile west of the preparation plant, and the workings are being developed from three levels which have been driven from the outcrop of the seam, near creek-level. The coal is 40 feet thick, of good quality, and is overlain by a moderately hard shale roof. The seam pitches at an angle of 30 degrees in an easterly direction, and the three levels are driven in close contact with the roof. The mine was opened in 1960, and a description of the workings has been given in past Annual Reports.

The mine averaged a daily production of 900 tons during 1964 with a crew of 80 men. There were four continuous miners in operation for the greater part of the year, and most of the activities were directed to the development and extraction of pillars in an area of workings located on each side of the No. 1 Incline. Other activities were directed to the driving of the two upper levels, and a new return airway was driven to the surface outcrop for the installation of a larger fan for ventilating the mine. Most of the roadways were driven in contact with the hangingwall, and systematic timbering was rigidly enforced. The pillars in the No. 1 Incline district were developed and extracted in a similar manner to that described in the "A" North mine. The production from all the mine is transported via shuttle car and fast-moving belts to various bins and loading points on the main No. 1 level, from where it is loaded into 10-ton-capacity bottom-dumping cars and taken to the surface by diesel and battery locomotives. The coal is dumped into a large bin on the surface and later trucked to the preparation plant. Total development completed in the mine during 1964 was 12,280 feet.

The mine is presently ventilated by a 100-horsepower electrically driven axivane fan which produces 45,000 cubic feet of air per minute to the mine workings at a 4.75-inch water-gauge. The fan was installed in October, 1964, following the completion of the No. 1 return airway to the surface outcrop, and replaces a smaller fan that was used to ventilate the mine from the portal of the No. 0 level. A marked improvement has been obtained, and the present quantity of air is sufficient for the requirements of the mine. Other conditions were found to be satisfactory during the course of inspections, with the exception of two instances were flexible trailing cables were damaged. These instances are reported more fully in another part of the report under the heading of " Dangerous Occurrences."

Prospect Tunnels.—Michael Mihalnuk, fireboss. These tunnels are being driven as part of an exploration programme conducted by the company to prospect a number of seams outcropping on the mountainsides in the vicinity of the colliery. Most of the operation in 1964 was directed to prospecting the Upper and Lower No. 3 seam and the No. 10 seam. Five prospect tunnels were driven in the No. 10 seam on Sparwood Ridge for a total distance of 1,022 feet; four tunnels in the Upper No. 3 seam on Natal Ridge for a total distance of 325 feet; and one tunnel in each of the Upper and Lower No. 3 seams on the mountainside above McGillvray for a total distance of 302 feet. Several large samples of coal were taken from each of the prospect tunnels and shipped for testing. The work was under the direction of J. J. Crabb, chief geologist.

During 1964, 95,026 pounds of Monobel No. 4, 620 pounds of CXL-ite, and 65,833 electric detonators were used at the colliery for coal and rock blasting. No misfired shots were reported.

One hundred and ninety-seven tons of limestone dust was used for the application of inert dust on the roadways of the various mines to minimize the coal-dust hazard and for tamping shots. Monthly dust samples were taken at all the mines and analysed. The samples were found to be above the minimum requirements needed for incombustible content.

Monthly examinations of the workings were made at all the mines by the miners' inspection committees, and regular safety meetings were held each month at the colliery office. The various report books kept at the mines in compliance with the *Coal Mines Regulation Act* were examined periodically and found to be in order.

Baldy Mountain Strip Mine.—Vans H. Hulbert, manager; George Lancaster, foreman. This operation is on Baldy Mountain, 4 miles northwest of Michel. It is at an elevation of 5,000 feet and can be reached by means of a private road leading from the preparation plant. The coal is 40 to 60 feet thick, of fairly good quality, and dips at an angle of 25 to 30 degrees in an easterly direction. The seam is believed to be the No. 10 seam. It can be traced for several miles, and the company has conducted several large-scale operations along the outcrop since 1948. Present activities are confined to No. 4B pit. The pit was opened in 1960, and is being worked on a contract basis.

The operation produced 28,657 net tons of coal in 1964 with a crew of one shovel operator for loading and three truck-drivers for transporting the coal to the preparation plant. The operation was considerably restricted owing to the state of the coal market, and activities were intermittent and confined to a single-shift basis. The removal of the overburden was completed in No. 4B pit in 1961. It is estimated there was approximately 75,000 tons of coal exposed in the pit at the end of 1964.

"A" South Strip Mine.—Vans H. Hulbert, manager; George Lancaster, foreman. This operation is on Sparwood Ridge, 2 miles southwest of Michel. It is at an elevation of 5,500 feet and can be reached by means of a private road leading from the No. 3 highway, 1 mile east of the preparation plant. The mine was opened in 1961. It is being worked to mine a large area of "A" seam coal outcropping above the underground workings of the Upper "A" South and "A" West mines. The coal is 30 feet thick, of good quality, and rises at an angle of 35 degrees in a westerly direction. Most of the overburden was removed in 1961. The work is being carried out on a contract basis.

The operation produced 51,080 net tons of coal during 1964 with a crew of six men. Most of the activities were directed to loading of coal, and a minor amount of rock work was done. The coal is mined in 15-foot lifts along the strike of the seam. It is loaded by power-shovel and trucked to the preparation plant by means of a new surface road that was completed in the spring of 1964. Prior to this the coal was dumped into a raise from the Upper "A" South mine and transported via the underground workings. The operations were continued during the winter months.

Preparation Plant.—The preparation plant is near the entrances to the main rock tunnels. It has been in operation since 1938, and a description has been given in past Annual Reports. A number of major installations were added in 1964 to improve the cleaning of the fines and facilitate the handling of the coal. The installations include the following.

A new 40-tons-an-hour flotation plant was put into operation in April, 1964. The plant is an addition to the fine-coal cleaning plant that was built in 1962. It is being used to clean the −28 mesh material. The installation includes two banks of Denver No. 30, 100-cubic-foot flotation cells, each bank being made up of six cells in series; one 16- by 6-foot Allis-Chalmers sizing screen; and an 8- by 8-foot Denver conditioning scale. It also includes the necessary tanks and pumps for supplying the necessary reagents—namely, kerosene and methyl isobutyl carbinol—to the flotation cells. The total cost of the project was $175,000.

A Drummond wet scrubber was installed at the fine-coal cleaning section in August, 1964, to reduce the dust pollution arising from the exhaust gases from the drier. The cost of the scrubber and installation was approximately $55,000.

A battery of six corrugated-steel silo bins was erected adjacent to the preparation plant during the summer of 1964 to provide surge and blending facilities for the increasing tonnage of coal being hauled by truck from the various mines. The bins have been surrounded by fill to provide a ramp and dumping space for the trucks, and the bottom of each bin is provided with a variable-speed Syntron feeder for feeding the coal onto a 350-tons-per-hour gallery housed conveyor. The conveyor in turn delivers the coal onto the main feed belt to the preparation plant. Total capacity of the bins is 1,200 tons. The project is estimated to have cost $275,000. It went into operation in October.

By-Product Plant.—George Lancaster, superintendent. This plant is on the colliery-site and is adjacent to the preparation plant. It has been in operation for many years, and a description has been given in past Annual Reports. The operations were confined to the Curran-Knowle ovens in 1964, and the plant produced 131,693 tons of coke, 12,514 tons of breeze (coke fines), and 933,541 gallons of tar.

The 1,800-ton surge bin at the plant was partitioned into four sections during 1964 to facilitate the blending and sizing of the coal for making coke. Short blending conveyors were installed at the bottom of each of the sections for controlling the coal, and a pulverizer and mixer were installed in the main circuit to the ovens to obtain the desired size and blend. The cost of the project was approximately $150,000.

Coleman Collieries Limited

(49° 114° N.W.) Martin Aschacher, mine superintendent. The coal-mining activities carried out by this company in the East Kootenay District are confined to a large stripping operation on Tent Mountain, near Corbin. Most of the operations are on the Alberta side, but large quantities of coal have been produced from the British Columbia side during the past 13 years, where the seams and the workings extend into the Province. The property is at an elevation of 7,000 feet. It can be reached by means of a private road leading from the No. 3 highway at Crowsnest Lake. The roadway is 10 miles long and is on the Alberta side. A description of the property has been given in past Annual Reports.

Most of the activities during 1964 were directed to the No. 4 pit, which has been in operation since 1954. The coal in this area is in the form of a synclinal basin and is 100 feet thick in parts. It is removed in 15-foot lifts, loaded by power-shovel, and trucked to the company's preparation plant at Coleman. The total production from the British Columbia side during 1964 was 71,051 tons. The operation was considerably restricted owing to the state of the coal market and was idle for several short periods. A minor amount of rock work was done during these periods.

Pacific Coal Limited

(49° 114° S.W.) Registered office, 540, 1070 Douglas Street, Victoria. This company was incorporated in 1964, and started an exploration programme on Crown land in the Morrissey Creek area southeast of Fernie. The work started in July and was continued during the winter months. Ten diamond-drill holes were completed, totalling 5,500 feet, and a large number of cuts were made by bulldozer to trace the outcrops of a number of seams. There were six men employed. The work was done by contract.

NICOLA-PRINCETON INSPECTION DISTRICT

By David Smith

There was no coal production in 1964 in the Nicola-Princeton District. The Coldwater mine at Merritt operated by S. Gerrard has been closed. Further exploration was carried out by Imperial Metals and Power Ltd. on the Coldwater leases and in the Coalmont area, and a sample of coal of 320 pounds was sent to the Lurgi Corporation, Frankfurt, Germany, for testing. This test was made in conjunction with magnetite ore from the Lodestone Mountain deposits near Princeton, seeking a method of producing sponge iron locally.

NORTHERN INSPECTION DISTRICT

By David Smith

The coal mines of the Northern District produced a total of 6,811 tons of coal in 1964. The output is sold enitrely on the domestic market, which fact limits all operations to seasonal work.

No accidents and no dangerous occurrences were reported from the mines in this district in 1964. There were no prosecutions.

Peace River (56° 122° S.E.)

King Gething Mines

This property is on Lot 1039, 12 miles by road west of Hudson Hope, and is owned and operated by Q. F. (King) Gething. In 1964, due to failing markets, the mine was closed. A crew of three men had been employed. Conditions in the mine were found to be satisfactory in the course of inspections, and no methane was detected. No accidents were reported.

Peace River Coal Mines Ltd.

This property is on Larry Creek, on the west slope of Portage Mountain, at the upper end of the Peace River canyon, about 18 miles by road from Hudson Hope. In 1964, because of the proximity of this mine to the Portage Mountain Dam, an underground stabilization programme was carried out. The mine passageways and rooms were completely filled with washed sand. The caved areas were filled from surface hydraulically with washed sand. The work was carried out by the dam contractors, and a crew of eight was employed under the direction of W. Barker, superintendent.

Pine Pass (55° 122° N.W.)

Hasler Creek Coal

A sample of coal of 1,200 pounds was obtained from this mine and sent to Ottawa for analysis. A crew of two men under the direction of Q. F. Gething obtained the sample for Stradone Enterprises Ltd., 850 West Hastings Street, Vancouver 1.

TELKWA (54° 127° N.E.)

Bulkley Valley Collieries Limited

Company office, Telkwa. J. D. Carnahan, general manager; L. Gething, superintendent; P. Baker and E. Ellis, firebosses. This property is on Goat Creek, a tributary of Telkwa River, about 7 miles southeast of Telkwa. Total production in 1964 was 6,761 tons. The mine closed in March, a skeleton crew was maintained to carry out routine work, and operations were resumed in September. Pillars are now being extracted in the northwest part of the mine as a decision was made to retreat; a new entry and separate mine has been started to the south of the present portal. This mine will be connected to the present haulageway by an entry housing a belt conveyor to facilitate movement of coal to the tipple. New equipment has been added in an effort to step up mechanization: two shortwall cutters, a track-type loader, and a duckbill head was placed on the conveyor. A general over-all improvement has been made in all buildings and services. An average crew of 14 men was employed.

Conditions in the mine were found to be satisfactory in the course of inspections, and no methane was detected. No accidents were reported.

BOWRON RIVER (53° 121° N.W.)

Northern Coal Mines Ltd.

Registered office, 285—17th Street, West Vancouver. A. J. Garraway, manager. This company holds Coal Licence No. 148 covering Lot 9592 and parts of Lots 9591 and 9593, which lie in the vicinity of the Bowron River, about 30 miles due east of Prince George. In 1962 and 1963 underground development work consisted of driving a 9- by 12-foot slope south 72 degrees east for 250 feet on a gradient of 20 degrees and then levelled off for a landing for a distance of 90 feet. From this landing two crosscuts were turned off northeast and southwest respectively. The northeast crosscut was driven 380 feet from the slope landing and did not cut any major coal seams. The southwest crosscut was driven 180 feet, entering a faulted zone 140 feet from the slope landing.

In 1964 the southwest crosscut was advanced to 250 feet from the slope landing. From this crosscut a drift was continued in the coal for 70 feet in a northwest direction. The drift was then swung to the right and continued for 70 feet. An entry was started at this point in the No. 3 seam and advanced 80 feet. At 40 feet in the entry a crosscut south 45 degrees west was started and advanced 80 feet. Sixteen surface diamond-drill holes totalling 4,000 feet were drilled.

A crew of seven men was employed. Permitted explosives and short-period delay detonators were used for blasting rock and coal, and a mucking-machine was used for loading. General working conditions were found to be satisfactory in the course of inspections, and no methane was found.

Inspection of Electrical Equipment and Installations at Mines, Quarries, and Well Drilling Rigs

By L. Wardman, Senior Electrical Inspector

ELECTRIC POWER

In 1964 electric power was used by 39 mining companies in operations at 42 lode mines, 1 placer mine, and 3 collieries. Thirty-one metallurgical concentrators were operated during the year. Electric power was also used at 22 structural-material and industrial-mineral mines and quarries. Forty-three drilling rigs were operated in the Province during the year.

Lode-metal Mines

Two concentrators were sold, dismantled, moved to new properties, and rebuilt. Both of them were in operation before the end of the year. Two new concentrators were under construction and will be in operation in 1965. Two concentrators were renovated and were in operation in the latter part of the year. Three properties were not operated during 1964.

Power Plants

The kilovolt-ampere capacity of mining-company-owned power plants that were operated in 1964 was as follows:—

Prime Mover	Generator Kva. Capacity
Diesel engines	21,945
Hydro	13,350
Total	35,295

The electric power generated by these plants amounted to 68,039,430 kilowatt-hours. The power purchased from public utilities and from the generating division of The Consolidated Mining and Smelting Company of Canada, Limited, amounted to 305,239,993 kilowatt-hours. The total amount of power consumed at lode mines was 373,279,423 kilowatt-hours.

A general breakdown of the connected load at the operating mines was as follows:—

Equipment	Horsepower
Hoists (incline and shaft)	7,192
Hoists (scraper)	8,145
Fans (mine ventilating)	5,952
Pumps (mine)	6,450
Rectifiers and M.G. sets	7,863
Air compressors	21,142
Crushing	13,661
Sink float	1,950
Grinding	22,969
Concentrating	17,579
Conveyors	3,361

Equipment	Horsepower
Pumps (mill)	11,627
Shovels and rotary drills	2,050
Workshops	2,651
Miscellaneous	9,274
Total	141,866

In addition to electrically powered equipment, there was in use approximately 10,171 horsepower of prime movers driving direct-connected or belt-connected equipment as follows:—

Prime Mover	Horsepower
Diesel engines	8,596
Hydro	1,400
Gasoline	175
Total	10,171

On the haulage systems there were in use 121 battery locomotives, 92 trolley locomotives, and 24 diesel locomotives.

Structural-Material and Industrial-Mineral Mines and Quarries

Electric power was used at 22 structural-material and industrial-mineral mines and quarries. Power is purchased from public utilities for all except three of these operations. At the three operations, company-owned plants of 5,216 kilovolt-amperes produced 14,612,800 kilowatt-hours of power, and this added to the 11,847,300 kilowatt-hours of power which was purchased makes a total of 26,460,100 kilowatt-hours consumed during the year.

A general breakdown of the connected load was as follows:—

Equipment	Horsepower
Hoists and overhead tram	292
Hoists (scraper)	405
Fans	83
Pumps	914
Rectifiers and M.G. sets	37
Air compressors	739
Electric drills and shovels	210
Crushing, rock reject, and drying	5,830
Conveyors	3,229
Screens	679
Milling	3,398
Workshops	338
Miscellaneous	2,020
Total	18,174

At these properties there was also direct-driven equipment totalling 2,915 horsepower.

One battery locomotive was in use for underground haulage.

Coal Mines

Three collieries, the same number as in 1963, used electric power. The distribution of the connected load was as follows:—

	Horsepower	
Surface—		
Compressors	3,945	
Ventilation	580	
Hoisting	906	
Haulage	35	
Coal-crushing	25	
Coal washing and screening	2,899	
Pumping	65	
Coke production	1,373	
Miscellaneous	835	
Total		10,663
Underground—		
Ventilation	235	
Hoisting	150	
Haulage	340	
Coal-loaders	236	
Conveying	1,161	
Pumping	240	
Compressors	100	
Borecuts	225	
Continuous miners	825	
Coal-cutters	200	
Miscellaneous	6	
Total		3,718
Total for surface and underground		14,381

Four battery locomotives and two diesel locomotives were in use for surface and underground haulage.

A total of 31,160,152 kilowatt-hours of electric power was used for mining and coal-processing.

ELECTRICAL INSTALLATIONS

LODE MINES

Cassiar (59° 129° S.W.)

Hanna Gold Mines Ltd.—Electrical power is produced for camp lighting only. Two diesel-driven a.c. generators are on the property. One unit is 12.5 kva. and the other is 10 kva. A 15-horsepower diesel locomotive is used on the main haulage.

Unuk River (56° 130° S.E.)

Granduc Mines Ltd. In the new temporary power-house, built in 1963 near the Leduc portal, two diesel-driven a.c. generators of 300 and 400 kva. respectively were installed. Also installed were two air compressors driven by two electric motors of 125 and 450 horsepower respectively. Workshop and miscellaneous equipment provided a connected load of 140 horsepower.

SALMON RIVER (56° 130° S.E.)

Silbak Premier Mines Limited

The installation of equipment in the concentrator building was completed during the summer, and milling of ore was commenced. A 200-kva. diesel-driven generator was installed, which raised the total generating capacity to 300 kva. The connected load of the concentrator is as follows:—

	Horsepower
Crushing plant	60
Grinding equipment	110
Concentrating	70
Workshop and miscellaneous	30
Total	270

HARRIET HARBOUR (52° 131° S.E.)

Jedway Iron Ore Limited. — Three motors on the conveyors were replaced with larger ones, increasing the conveyor load by 20 horsepower.

TAKOMKANE MOUNTAIN (52° 120° S.W.)

Noranda Mines, Limited (Boss Mountain Division)

A temporary power plant was installed to provide power and lighting during construction of the concentrator. British Columbia Hydro and Power Authority is building a powerline from 100 Mile House on the Cariboo Highway to the property. It is estimated that power will be available by the end of January, 1965, and that all equipment will be installed in the concentrator and ready for testing.

Power will be supplied at 69 kv. by the British Columbia Hydro and Power Authority to a main substation at the mine. A 3,000/4,000 kva. 2.43/4.22-kv. transformer bank connected delta-wye steps the line voltage down to 2.4 kv. for distribution to the camp office building, shops, crusher, flotation, and step-up transformer supplying the mine.

A 50-kva. 2,400–120/230-volt single-phase transformer supplies the office building and assay office. A 225-kva. 2,400–550-volt transformer bank supplies the shops. A 100-kva. 2,400–550-volt transformer bank supplies the crushing and grinding areas. Two 750-kva. 2,400–550-volt transformer banks supply the flotation area. Two 333-kva. transformers connected open delta step up the voltage from 2,400 to 6,900 volts to supply the underground distribution centre, where a 450-kva. 3-phase transformer steps down the voltage from 6,900 to 575 volts.

Three 400-horsepower 2,400-volt synchronous motors drive three air compressors.

Three 150-horsepower 550-volt motors drive a jaw crusher, a standard crusher, and a short head crusher.

A 900-horsepower 2,400-volt synchronous motor drives the grinding mill.

The flotation section consists of 44 rougher cells driven by 22 15-horsepower motors, 12 cleaner cells driven by six 7½-horsepower motors, and 16 recleaner cells driven by eight 5-horsepower motors.

Other equipment consists of settling-tanks, pumps, and filters.

TYAUGHTON CREEK (51° 122° S.W.)

Dot (Silverquick Development Co. (B.C.) Ltd.)

A reduction plant and a power plant were built early in the year. The power plant consists of a 25-kw. 230-volt 3-phase diesel-driven alternator. The equipment in the reduction plant consists of a crusher driven by a 25-horsepower motor, a conveyor driven by a 2-horsepower motor, two shakers driven by two 1-horsepower motors, an exhaust fan driven by a 2-horsepower motor, a turbo-blower driven by a 3-horsepower motor, and a portable discharge conveyor driven by a 3-horsepower motor.

BRIDGE RIVER (50° 122° N.W.)

Bralorne Pioneer Mines Limited.—A new electric control and metering panel was installed in the power-house. The heating plant was destroyed by fire in February but was rebuilt and rewired. A new contactor panel was installed for the Crown hoist.

HIGHLAND VALLEY (50° 120° S.W.)

Bethlehem Copper Corporation Ltd.

The capacity of the concentrator was increased by adding the following equipment: A tertiary crusher driven by a 300-horsepower motor; a rod mill driven by a 900-horsepower motor; two pumps driven by two 40-horsepower motors; one reclaim pump driven by a 200-horsepower motor; six conveyors driven by six motors of 125, 60, 50, 7.5, 5, and 5 horsepower respectively; two blowers requiring 350 horsepower; a thickener driven by a 5-horsepower motor; and a diaphragm pump driven by a 3-horsepower motor.

MERRITT (50° 120° S.W.)

Craigmont Mines Limited

A 200-horsepower 440-volt 3-phase wound-rotor motor was installed to drive the mine ventilation fan at the 3500 level portal. A mine air-heater capable of providing 4.2 million B.t.u. on natural gas or fuel oil was installed at the 3000 level portal. A 5-horsepower 550-volt motor driving a fan provides air circulation within the unit.

A new power circuit to supply the underground load was run to the 3000 level using suspension insulators on the existing pole structures. The conductors are 266.8 M.C.M. A.S.C.R.

In the concentrator there were installed a 300-horsepower 550-volt 3-phase motor on a regrind mill, a spare generator set driven by a 20-horsepower 550-volt motor to supply excitation to any synchronous motor, and a concentrate overflow pump driven by a 10-horsepower motor.

At the jaw crusher a dust-collecting fan driven by a 7½-horsepower motor and a battery-operated emergency lighting system were installed.

An extension was built to the mine dry and wired for lighting.

A 550-volt 3-phase power-line 1,500 feet long was built to the project yard area to provide power and lighting.

In the mine, locomotive-battery charging stations were installed on the 2560, the 2700, the 2852, and the 3008 levels, and lighting was installed at all shaft level stations. A pump for mine water supply driven by a 40-horsepower motor was installed on the 2400 level near the service shaft.

A 112½-kva. 3-phase 4,160–575-volt substation was installed on the 2852 level to supply scraper-hoist motors.

To prevent, if possible, further incidents of lightning damage to trolley equipment, lightning-arrestors were installed on the trolley conductor.

An electronic speed control was installed on the cable belt conveyor to prevent overspeeding.

Other electrical work consisted of temporary installations and the relocation of existing equipment.

Phoenix (49° 118° S.W.)

Phoenix (The Granby Mining Company Limited).—Three flotation pumps and dust-collecting equipment were installed in the mill. A power-line was built to the Rawhide claims, and a water pump and motor was installed at the dam.

Aspen Creek (49° 117° S.E.)

H.B. (The Consolidated Mining and Smelting Company of Canada, Limited).—An excavation for a new transformer station on the 2800 level was made, and three 100-kva. 2,300–575-volt Pyronal-filled transformers and distribution switch-gear from the 3200 level transformer station were installed. This moves the supply centre nearer to the present load centre of the mine.

Iron Mountain (49° 117° S.E.)

Canadian Exploration Limited

The shaft hoist was removed from the 3800 level and sold. The tungsten crushing plant and two mills have been removed from the tungsten concentrator. Six 200-kva. transformers have been removed from the tungsten concentrator substation, and three 100-kva. transformers have been removed from an unused substation at the lead-zinc concentrator.

Nelway (49° 117° S.E.)

Reeves MacDonald Mines Limited

The power of the No. 3 hoist was doubled by the addition of a 200-horsepower wound-rotor motor similar to the one that came with the hoist. The hoist control was modified by the addition of extra equipment to give simultaneous control of both motors. To supply power to the hoist, a 2,300-volt cable 4,000 feet long was installed from the surface to the No. 3 hoist room.

A transformer station was built on the 660 level, and six 25-kva. transformers were installed. This station is supplied from the 1100 level by means of a 2,300-volt armoured cable.

Riondel (49° 116° N.W.)

Bluebell (The Consolidated Mining and Smelting Company of Canada, Limited).—A 6,900-volt line was built to the Comfort mine to supply ventilating fans. A 20-horsepower Sirocco fan was installed at this mine. Indicating lights and alarms were installed for the eight fans at the Kootenay Chief mine.

The hot-water boiler and heaters were removed from the machine-shop, and a 30-kw. 600-volt electric heater was installed. A similar heater was installed in the warehouse.

Keen Creek (49° 117° N.E.)

Cork Province (London Pride Silver Mines Ltd.)

The electrical equipment was overhauled and returned to service after being shut down for almost 10 years. Most of the equipment was serviceable after being dried out. Moisture had penetrated the splice boxes on the armoured cable leading to the underground hoist room, making it necessary to remove them and resplice the cable. A phone communication system between the hoist room and shaft stations was installed.

Springer Creek (49° 117° N.E.)

Meteor (Cultus Exploration Ltd.) A 50-ton mill and power plant were completed and put into service. The power plant consists of a 175-kw. 3-phase diesel-driven generator and a 25-kw. single-phase diesel-driven generator as a stand-by for lighting. The crushing equipment consists of a feeder and a shaker, each driven by a 1-horsepower motor, and a jaw crusher driven by a 50-horsepower motor.

The milling and concentrating equipment consists of a mill driven by a 15-horsepower motor, a Wilfley table driven by a 2-horsepower motor, a concentrate pump driven by a 2-horsepower motor, a bucket elevator driven by a 1½-horsepower motor, a screen driven by a 1-horsepower motor, and a water pump driven by a 15-horsepower motor. A small battery locomotive is used on the main haulage in the mine.

Kimberley (49° 115° N.W.)

Sullivan (The Consolidated Mining and Smelting Company of Canada, Limited) The Bucyrus-Erie 6-yard shovel was returned to operation in the open pit after being idle for several years. The transformers supplying the mine office building were moved from the hillside to a new location behind the mine dry and some pole structures for the overhead lines were replaced. Two mine ventilating fans were relocated. In the sink-float section of the concentrator two water pumps driven by two 25-horsepower motors were installed. Seven pumps driven by six 2-horsepower and one 1-horsepower motors were installed to handle reagents. Fourteen 15-horsepower motors were installed to drive M.S. flotation machines. A pump driven by a 7.5-horsepower motor was installed in the flotation section. Also in the flotation section, two 40-horsepower motors were replaced with 75-horsepower motors and a 25-horsepower motor was replaced with a 40-horsepower motor. The 75-horsepower motor driving the float conveyor was replaced with a 100-horsepower motor. The 15-horsepower motor on the zinc drier was replaced with a 25-horsepower motor.

Rebuilt 550-volt switchboards were installed in the testing department, paint-shop, No. 3 pump pit, and on the tertiary floor.

Seven obsolescent oil switches controlling motors of 25 to 75 horsepower were replaced with magnetic switches. Circuit-breakers were installed to replace fused switches for two ball-mill motors of 200 and 250 horsepower.

Other electrical work consisted of installing mercury and fluorescent lighting in various areas.

Howe Sound (49° 123° N.E.)

Britannia (The Anaconda Company (Canada) Ltd.) An 80,000-c.f.m. fan driven by a 200-horsepower 440-volt motor and a bank of three 200-kva. 6,900–440-volt transformers were installed at the 2700 level. One additional 6,900–440-volt transformer was installed at the 5100 level. Just prior to the end of the year the mine was closed down and all equipment with the exception of the main hoists and transformers was removed from underground.

Texada Island (49° 124° N.W.)

Texada Mines Ltd.—The underground cables were extended to new headings. On the surface a 1,000-kva. transformer bank for the new loading-dock and 2,000 feet of 12-kv. line were built to supply this station.

Benson River (50° 127° S.E.)

Empire Development Company Limited.—To facilitate operation of the new underground mining operation, the construction of a new crushing-plant conveyor system and aerial tram was commenced in 1964.

Old Sport (Coast Copper Company Limited)

A shaft hoist driven by a 225-horsepower motor was installed for the No. 2 winze. Two pumps driven by 25-horsepower motors were installed in the mine. At the concentrator a new magnetite plant was installed. It consists of magnetic separators, thickener, filter, and pumps. The connected load of this plant is 216 horsepower.

Zeballos (50° 126° S.W.)

Zeballos Iron Mines Limited

The 300-kva. diesel-electric power unit at the loading-dock was moved to the power-house at the mill, and a 4,160-volt power-line was built from the mill to the dock, a distance of approximately 4½ miles. Two 100-kva. and one 200-kva. 440-volt diesel-driven electric power units were removed from the power-house at the mill, and a 1,250-kva. 4,160-volt diesel-driven electric power unit was installed. Three 2,300–440-volt transformers connected wye-delta were installed adjacent to the power-house to tie together the 4,160-volt system and the 440-volt system.

A 4,160-volt power-line was built between the mill and the compressor-house at the mine, and three 200-kva. 2,300–440-volt transformers connected wye-delta were installed adjacent to the compressor-house to supply four air compressors driven by four 150-horsepower 440-volt motors.

Tsolum River (49° 125° N.E.)

Mt. Washington Milling Co.

The 1,000-ton mill built at the Motherlode mine near Greenwood in 1956 was dismantled and moved to the Mt. Washington Copper Co.'s property about 15 miles northwest of Courtenay and rebuilt. In general the layout was the same as the original at Greenwood. The connected load is as follows:—

	Horsepower
Crushing plant	432
Grinding equipment	780
Concentrating equipment	416
Pumping equipment	72
Miscellaneous	9
Total	1,709

Kennedy Lake (49° 125° S.E.)

Brynnor Mines Limited.—A shaft hoist driven by an 800-horsepower motor was installed but was not in service at the end of the year. A new power-line was built from the British Columbia Hydro and Power Authority substation to supply the hoist and mine electrical equipment.

STRUCTURAL-MATERIAL AND INDUSTRIAL-MINERAL MINES AND QUARRIES

McDame (59° 129° S.W.)

Cassiar Asbestos Corporation Limited

A new 1,215-kva. 2,400-volt General Electric alternator driven by a Mirrlees diesel was installed in the power-house, increasing the generating capacity to 4,591 kva. The mill building was extended, and crushing, conveying, screening, and collecting equipment was added. At the No. 1 tram terminal a drying plant was built consisting of screen, conveyors, crusher, kiln, and fans. At the mine a 4½-yard electric shovel supplied with power from a portable diesel-driven a.c. generator was put into service to strip overburden.

The new equipment in the mill added 520 horsepower to the connected load. The drier at the mine added 323 horsepower to the connected load. Other alterations added 69 horsepower to the connected load.

Texada Island (49° 124° N.W.)

Ideal Cement Company Ltd. (Rock Products Division).—Two new screens and three new conveyors were installed, which added 30 horsepower to the connected load. Three new 50-kva. transformers were also installed. Four conveyors were relocated.

COAL MINES

Telkwa (54° 127° N.E.)

Bulkley Valley Collieries Limited.—A 30-horsepower Joy loader and two Anderson Boyes short wall cutters were put into service underground. The coal-cutters are powered by 75-horsepower motors.

Comox (49° 124° N.W.)

Comox Mining Company Limited.—Early in the year a high flow of water into the mine made it necessary to build a pump room on the main slope just below the diagonal and install a pump driven by a 75-horsepower motor.

East Kootenay (49° 114° S.W.)

Michel Colliery (The Crow's Nest Pass Coal Company Limited)

With the exception of a ventilation fan, all electrical equipment was removed from "A" West mine. In the Balmer mine a Joy continuous miner, Lee Norse continuous miner, shuttle car, and two Borecut machines were installed. A froth flotation plant was installed in the washing building. There are 12 flotation cells driven by six 20-horsepower motors, a conditioner tank driven by a 5-horsepower motor, a slurry screen driven by a 10-horsepower motor, and a reagent pump driven by a 1-horsepower motor.

The following occurrences took place:—

On Friday, January 31st, in the Balmer mine, open sparking occurred when the haulage cable of a tugger hoist was allowed to rub on and wear through the insulation of three motor feeder cables. The cables were damaged at a point about 6 inches from the plug at the motor starter.

On Thursday, March 12th, in the Balmer mine, open sparking occurred when a tugger cable was being replaced in the hanger. It is thought that the cable had been damaged when supplies were moved past the tugger. Examination of the cable revealed that one conductor was severed and that arcing had taken place between the conductor and shield.

On Saturday, June 20th, a shuttle-car operator was injured when he ran a shuttle car into the rib legs, knocking them out of place and thus allowing the roof supports to fall on him. This accident was caused by allowing the control-lever deck to become packed with coal so that the " tram " lever would not function properly.

Lode-metal Deposits Referred to in the 1964 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 1964:—

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	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Antimony	Page
Northern British Columbia																			
Amy 3	Atlin	59° 130° N.W.		3		3	3												9
Ann, Su	Liard	57° 131° S.W.			3														15
BIK, BUD	Liard	57° 130° S.W., 57° 131° N.W.			3														13
Bam	Liard	57° 130° S.W.			3														18
Bing	Liard	58° 132° S.E.			3														11
COS	Liard	57° 131° S.W.			3														13
CW, PH, NH	Liard	57° 131° S.E.			3														13
Galore Creek	Liard	57° 131° S.E.			3														15
Goat, Kim	Liard	57° 131° S.E.			3														17
Hanna Gold	Liard	59° 129° S.W.	3																10
Hidden Valley	Liard	59° 128° S.E.				3	3												10
Joy	Liard	58° 129° S.E.			3														11
Laverdiere	Atlin	59° 134° S.E.			3														8
McDame, Belle, Bar	Liard	59° 129° S.E.		3		3	3												11
MESS, MEST, JET, DELL	Liard	57° 131° S.E.			3														17
Molly	Atlin	59° 134° S.E.												3					8
Penny	Liard	57° 131° S.E.			3														15
Potlach-Banker	Atlin	58° 133° N.W.		3		3	3												8
SNO	Liard	57° 130° S.W.			3														17
Sil	Atlin	58° 133° N.W.		3		3	3												9
Silver Diamond	Atlin	59° 133° N.E.										3							8
Thorn, Club, Kay	Liard	58° 132° N.W.	3	3	3														11
Storie	Liard	59° 129° S.W.												3					10
Zohini	Atlin	58° 133° N.W.		3		3	3												9
Central British Columbia																			
AX and BX	Omineca	54° 125° S.E.												3					62
Astlais	Omineca	54° 126° N.W.			3														52
Aurum	Cariboo	53° 121° S.W.	1	2															65, A52
Bat	Omineca	54° 124° S.W.												3					64
Bell	Omineca	54° 125° S.E.												3					61
Berg	Omineca	53° 127° N.E.			3									3					56
Boss Mountain	Cariboo	52° 120° S.W.												3					65
CAFB	Omineca	53° 127° S.E.			3									3					57
Cob	Omineca	53° 127° S.E.												3					57
Cronin	Omineca	54° 126° N.W.	2	1		1	1		2										51, A52

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 the shipment. Production for 1964 is listed in Table XIV.

Non-shipping Mines.—(3) Metal present, indicated by assay or mineralogical determination.

Lode-metal Deposits Referred to in the 1964 Annual Report—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Antimony	Page
Central British Columbia—Cont'd																			
DA, AX	Omineca	55° 126° S.E.			3														53
Debenture	Omineca	54° 126° N.W.		3		3	3												52
Deer, Elk, Nu, Dis, Dat	Omineca	54° 125° S.E.												3					61
Endako	Omineca	54° 125° S.E.												3					58
French Peak	Omineca	54° 127° N.E.		1		2	2												A52
Glacier Gulch	Omineca	54° 127° N.E.												3					51
Jumbo	Omineca	53° 127° S.W.												3					56
KO	Omineca	54° 124° S.W.												3					63
Len	Omineca	53° 127° N.E.			3									3					53
Leo and Mo	Omineca	54° 125° S.E., 54° 124° S.W.												3					62
Lucky Ship, Sam, Ram, Road	Omineca	54° 127° S.E.												3					53
Lustdust	Omineca	55° 125° N.E.		3		3	3												53
M.J.M.	Omineca	54° 124° S.W.												3					64
MS	Omineca	54° 125° S.E.												3					62
Molly, Moly, Red, Canyon, Tom, Len	Omineca	55° 127° N.E.												3					48
Molly, Pogo, Sandy, Linda, Ruff, Enco, Scott	Omineca	53° 124° N.W.												3					62
Newman	Omineca	54° 126° N.E.			3														52
Rio Nos. 1-4	Omineca	55° 126° S.W.		3		3													50
Rob, Fran	Omineca	54° 125° S.E.												3					61
Silver Creek, Silver Lake, Trade Dollar	Omineca	54° 127° N.E.		1		1	2												51, A52
Tip, Tan	Omineca	53° 124° N.W.												3					64
VO	Omineca	54° 125° S.E.												3					62
Whit	Omineca	53° 127° N.E.			3									3					55
Coast and Islands																			
A.M.	N. Westminster	49° 121° S.E.			3														136
Ace and Galena	Skeena	55° 129° N.W.		3		3													45
Alice	Skeena	55° 129° S.E.												3					30
Anaconda	Vancouver	49° 122° N.W.			3									3					145
Azure	Vancouver	50° 122° S.W.			3														146
Banks, Banker, etc.	Skeena	53° 130° S.E.	3																47
Baron, Star	Nanaimo	50° 125° S.E.		2	1														152, A53
Basin	Skeena	55° 129° N.E.		3	3														45
Big Interior	Alberni	49° 125° S.W.			3														156
Britannia	Vancouver	49° 123° N.E.	2	2	1	2	1		2										144, A53
Brynnor	Alberni	49° 125° S.E.								1									167, A52
Buttle Lake	Alberni	49° 125° N.W.	3	3	3	3	3												156
Catface	Alberni	49° 125° S.W.			3														155
Copper Road	Nanaimo	50° 125° S.E.			3														151
Della	Alberni	49° 125° S.W.			3														157
Domineer	Nanaimo	49° 125° N.E.			3														155
Dunwell	Skeena	55° 129° N.W.	3	3		3	3												22
Empire Development (Merry Widow and Kingfisher)	Nanaimo	50° 127° S.E.								1									152, A53
F. L., Ridge, Cordova	Nanaimo	50° 126° S.W.								1									153, A52
Fandora and Gold Flake	Alberni	49° 125° S.W.	1	2	2	2													166, A52
Flo, Mac	Skeena	52° 131° S.E.			3					3									46
Gem	N. Westminster	49° 121° N.W.												3					143
Goat	Skeena	56° 129° S.E.	3	3															23
Granduc	Skeena	56° 130° S.E.			3														18
Harriet Harbour	Skeena	52° 131° S.E.								1									46, A53
Holberg	Nanaimo	50° 128° N.E.			3														154
Iron Mike	Nanaimo	50° 125° S.W.								3									152
JB, Molly, HM	Skeena	54° 128° N.E.												3					47
Jib	Skeena	51° 131° N.W.			3					3									46
Kay	Skeena	56° 130° N.E.	3	3		3	3												20
Lenora	Victoria	48° 123° N.W.	2	2		1													168, A53

LODE-METAL DEPOSITS REFERRED TO IN THE 1964 ANNUAL REPORT—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Antimony	Page
Coast and Islands—Continued																			
London	Vancouver	50° 122° S.W.			3														146
Lucky Luke	Skeena	54° 128° N.E.	3		3														47
Lynx, Paramount, Price	Alberni	49° 125° N.W.	3	3	3	3	3												157
McVicar	Vancouver	49° 122° N.W.			3	3	3												146
Mal	Victoria	48° 124° N.W.			3														168
Mammoth	N. Westminster	49° 121° S.E.		3	3								3						137
Moose	Skeena	55° 129° N.W.		3															44
Murphy	N. Westminster	49° 121° S.W.		3	3	3													143
Northwest, Bet	Skeena	54° 128° S.E.			3														48
Old Sport	Nanaimo	50° 127° S.E.	2	2	1					1									153, A53
Porter Idaho	Skeena	55° 129° N.W.		3		3	3												22
Pride of Emory	N. Westminster	49° 121° S.W.			1								1						137, A53
Privateer	Nanaimo	50° 126° S.W.			3														154
Redwing	Skeena	55° 129° S.W.		3	3														45
Roundy Creek	Skeena	55° 129° S.E.												3					36
Shan	Skeena	56° 130° N.W.			3		3			3									18
Silbak Premier	Skeena	56° 130° S.E.	1	1															21, A53
Sunloch and Gabro	Victoria	48° 124° S.E.			3														169
Tasu	Skeena	52° 132° N.E.			3					3									45
Ted, Ray	Skeena	56° 130° N.E.				3	3												20
Texada	Nanaimo	49° 124° N.W.	2	2	1					1									146, A53
Tidewater	Skeena	55° 129° S.W.												3					39
Victory	Skeena	55° 129° N.W.		3															43
Vulcan	Alberni	49° 124° S.E.	3																168
Wolf	Skeena	55° 129° N.W.		3															41
Yreka	Nanaimo	50° 127° S.W.			3														154
South Central British Columbia																			
AL, IC	Nicola	50° 121° S.E.			3									3					88
Ace Mining	Lillooet	50° 122° N.W.	3															3	80
Afton	Kamloops	50° 120° N.E.	3		3														98
Ajax	Greenwood	49° 118° S.E.			3	3	3												112
Alamo, Jae	Nicola	50° 120° S.W.			3														91
Albion	Greenwood	49° 118° S.W.	1	1		1	1												113, A53
Annis Mines	Kamloops	50° 119° N.E.			3	3	3												105
BAR	Kamloops	51° 119° S.W.												3					99
Bet, Saul	Kamloops	51° 119° S.E.					3												99
Bethlehem	Kamloops	50° 120° S.W.	2	2	1									2					86, A54
Blue Jay	Nicola	49° 120° N.E.			3														95
Bralorne	Lillooet	50° 122° N.W.	1	2															81, A54
Brenda	Vernon	50° 119° S.W.												3					104
Cabin Group	Greenwood	49° 118° S.W.			3														110
Chataway	Nicola	50° 120° S.W.			3									3					90
Cinderella	Nicola	50° 120° S.W.			3					3									94
Copperado	Nicola	50° 120° S.W.			3														95
Copper Canyon	Kamloops	50° 121° S.E.			3														94
Craigmont	Nicola	50° 120° S.W.			1														92, A54
Curmo, S.S.	Kamloops	50° 121° S.E.			3									3					91
Dave, Lodge	Kamloops	50° 120° N.W.			3									3					85
Dot, Silverquick	Lillooet	51° 122° S.W.															1		81, A54
Fly Hill	Kamloops	50° 119° N.E.											3						105
Franklin Camp	Greenwood	49° 118° N.E.			3														112
Galaxy	Kamloops	50° 120° N.E.			3														97
Gem, Dividend, Lakeview	Osoyoos	49° 119° S.E.			3									3					109
Goodenough	Vernon	50° 119° S.E.			3														104
Highland-Bell	Greenwood	49° 119° S.E.	2	1		2	2		2										109, A54
Homestake	Kamloops	51° 119° S.W.		3															99
Horn Silver	Osoyoos	49° 119° S.W.	3	3															102
Imperial Metals	Similkameen	49° 120° N.W.								3									100
Independence	Nicola	49° 120° N.W.			3									3					100
Index	Lillooet	50° 122° N.E.												3					84
Iva Lenore	Greenwood	49° 118° S.W.			3														111
Jay	Kamloops	50° 121° S.E.			3														72

Lode-metal Deposits Referred to in the 1964 Annual Report—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Antimony	Page
South Central British Columbia—Continued																			
Jericho	Kamloops	50° 120° S.W.			3									3					89
Kan	Nicola	50° 120° S.W.			3														95
Kentucky	Nicola	49° 120° N.W.			3														96
Kimberley	Kamloops	50° 120° N.E.	3		3														98
Kingfisher	Vernon	50° 118° N.W.				3	3												108
Lake Group	Nicola	50° 120° S.W.			3														94
Laura, Earl	Kamloops	50° 120° N.E.			3														98
Lornex	Nicola	50° 120° S.W.			3									3					88
MLM	Nicola	50° 120° S.W.			3									3					91
Makaoo	Kamloops	50° 120° N.E.			3														98
Nickel Plate	Osoyoos	49° 120° S.E.	3																102
Nig, Gar, Tine	Kamloops	50° 121° S.E.			3														92
North Pacific	Kamloops	50° 120° N.W. 50° 121° N.E.			3									3					88
Outrider, Bay	Kamloops	50° 120° S.W.			3									3					85
Par	Nicola	49° 120° N.W.			3														97
Pay	Nicola	49° 120° N.W.			3														96
Phoenix Copper	Greenwood	49° 118° S.W.	1	2	1														110, A54
Polly Ann	Kamloops	51° 120° N.E.												3					99
Porcupine	Nicola	50° 120° S.W.			3														95
Pyramid	Nicola	49° 120° N.W.			3														96
R, EE	Lillooet	50° 123° N.E.												3					84
Rainbow and Patricia	Osoyoos	49° 119° N.W.			3		3												103
Rat	Osoyoos	49° 119° N.W.												3					103
Red Star	Nicola	49° 120° S.E.	2	2	1														100, A54
Rocky, Tom, Nav	Nicola	50° 121° S.E.			3														84
Sheba, Highmont, Minex, B.X.	Nicola	50° 120° S.W.			3									3					89
Silver Wing	Lillooet	50° 122° N.W.		1	2														A54
Skomac	Greenwood	49° 118° S.W.	2	1		1	2												110, A54
Smuggler	Osoyoos	49° 119° S.W.	3												3				108
Susie	Osoyoos	49° 119° S.W.	1	1		2	2												109, A54
Toketic, Bethsaida, B.L.	Nicola	50° 121° S.E.			3									3					85
Trojan	Nicola	50° 120° N.W.			3									3					87
UP and April	Nicola	50° 120° S.W.			3									3					89
Van, Rocco Plata	Greenwood	49° 119° S.E.			3														109
Virginia, No. 14	Similkameen	49° 120° S.E. and S.W.			3					3									101
WDR	Kamloops	50° 120° N.W.			3									3					85
Southeastern British Columbia																			
Anna	Slocan	49° 117° N.E.		1		2	2												129, A55
Antoine	Slocan	50° 117° S.E.		1		2	2												122, A55
Arlington	Slocan	49° 117° N.E.		1		2	2												129, A55
Bayonne	Nelson	49° 116° S.W.	3																118
Beatrice	Revelstoke	50° 117° N.W.		3		3	3												131
Big Ledge	Revelstoke	50° 118° N.E.					3												130
Black Diamond	Slocan	49° 116° N.W.		1		1	1												120, A55
Bluebell	Slocan	49° 116° N.W.		2	2	1	1		2										118, A55
Boomerang and Richmond	Slocan	49° 117° N.E.		3															127
Bright Star Trio	Revelstoke	51° 118° N.W.				3	3												105
Charleston	Slocan	50° 117° S.E.		3		3	3												122
Cork Province	Slocan	49° 117° N.E.	2	1		1	1		2										120, A55
Coxey	Trail Creek	49° 117° S.W.												3					113
Deadman	Slocan	49° 117° N.E.		1		2	2												125, A55
Delphine	Golden	50° 116° S.E.		3		3													135
Elna	Slocan	49° 116° N.W.		2		1	1		2										121, A55
Estella	Fort Steele	49° 115° N.W.		3		3	3												133
Freddy	Slocan	49° 117° N.E.	2	1		2	2												126, A55
Galena Farm	Slocan	49° 117° N.E.		1		2	1		2										126, A55
Gold Belt	Nelson	49° 117° S.E.	1	2		2	2												116, A55
Goodenough	Nelson	49° 117° S.E.	3																115

LODE-METAL DEPOSITS REFERRED TO IN THE 1964 ANNUAL REPORT—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Antimony	Page
***Southeastern British Columbia*—Continued**																			
H.B.	Nelson	49° 117° S.E.		2		1	1		1										116, A55
Hecla, Mammoth, Standard	Slocan	49° 117° N.E.	2	1		1	1		2										125, A55
Hewitt	Slocan	49° 117° N.E.	2	1		2	1		2										126, A56
Hinckley	Slocan	49° 117° N.E.		3		3	3												123
Holmes	Nelson	49° 117° S.W.	2	1		1	1												115, A55
Humbolt	Fort Steele	49° 116° N.W.		1		1	1												132, A54
I.X.L.	Trail Creek	49° 117° S.W.	1	2			1												114, A56
Idaho	Slocan	49° 117° N.E.		1		1	2												123, A56
Jersey	Nelson	49° 117° S.E.		2		1	1		2										117, A55
Jo Jo	Slocan	50° 117° S.E.		3		3	3												122
Jumbo	Slocan	49° 117° N.E.	3	3															126
Kootenay Belle	Nelson	49° 117° S.E.	1	1		2	2												116, A55
Krao	Slocan	49° 116° N.W.		2		1	1												120, A56
London, Panama	Slocan	50° 117° S.E.		3		3	3												122
Meteor	Slocan	49° 117° N.E.	2	1		2	2												129, A56
Midway	Fort Steele	49° 115° N.W.	3	3															132
Mineral King	Golden	50° 116° S.E.		2	2	1	1		2										134, A54
NePe	Slocan	50° 117° S.W.		3															129
New Arlington	Nelson	49° 117° S.E.	1	1		2	2												115, A55
Ottawa	Slocan	49° 117° N.E.	2	1		2	2												127, A56
Paradise	Golden	50° 116° S.E.		3		3	3												135
Ptarmigan	Golden	50° 116° N.E.		3															135
Queen	Nelson	49° 117° S.E.	1	2		2	2												116, A55
Reco	Slocan	49° 117° N.E.		3		3	3												125
Reeves MacDonald	Nelson	49° 117° S.E.		2		1	1		2										117, A55
Richard First	Slocan	49° 116° N.W.		2		1	1												118, A56
Roseberry and A & E	Revelstoke	51° 118° S.E.				3	3												136
St. Elmo	Trail Creek	49° 117° S.W.												3					113
Scranton	Slocan	49° 117° N.E.	3	3		3	3												120
Shady	Slocan	49° 117° N.E.		1		1	2												125, A56
Sharon	Slocan	49° 117° N.E.		2		1	2												120, A56
Silmonac	Slocan	49° 117° N.E.		3		3	3												124
Silversmith, Richmond-Eureka	Slocan	49° 117° S.E.	2	1		1	1		2										124, A56
Slocan Star	Slocan	49° 117° N.E.		1		2	1		2										A56
Spider	Revelstoke	50° 117° N.W.		3		3	3												130
Sullivan	Fort Steele	49° 115° N.W.	2	2	2	1	1			2		2							132, A54
Sunset	Trail Creek	49° 117° S.W.		1		2	2												114, A56
Teddy Glacier	Revelstoke	50° 117° N.W.		3		3	3												131
Triumph	Slocan	49° 116° N.W.		3		3	3												120
Utica	Slocan	49° 117° N.E.	2	1		2	1		2										121, A56
Velvet	Trail Creek	49° 117° S.W.	1	2	1	2	2												113, A56
Victor	Slocan	49° 117° N.E.	2	1		1	1		2										123, A56
Vin	Slocan	50° 117° S.W.				3	3												131
W.D.	Trail Creek	49° 117° S.W.	1	2		2	2												115, A56
Washington	Slocan	50° 117° S.E.		1		2	1		2										123, A56
Western Exploration	Fort Steele	49° 115° N.W.				3	3												133
White Hope	Slocan	49° 117° N.E.		1		2	2												127
Wonderful	Slocan	49° 117° N.E.		3		3	3												124

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