Minister of Mines and Petroleum Resources

PROVINCE OF BRITISH COLUMBIA

ANNUAL REPORT

for the Year Ended December 31st

1960

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1961

BRITISH COLUMBIA
DEPARTMENT OF MINES AND PETROLEUM RESOURCES
VICTORIA, B.C.

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

P. J. MULCAHY, *Deputy Minister.*

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

S. METCALFE, *Chief Analyst and Assayer.*

HARTLEY SARGENT, *Chief, Mineralogical Branch.*

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

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

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

MAY IT PLEASE YOUR HONOUR:

The Annual Report of the Mineral Industry of the Province for the year 1960 is herewith respectfully submitted.

W. K. KIERNAN,
Minister of Mines and Petroleum Resources.

Minister of Mines and Petroleum Resources Office,
March 31st, 1961.

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ANNUAL REPORT OF THE MINISTER OF MINES AND PETROLEUM RESOURCES, 1960

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 the properties described, in geographic groupings, precedes the index.

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

The work of the branches of the Department is outlined briefly in the section on Departmental Work. This section is followed by notes dealing briefly with the work of other British Columbia or Federal Government services of particular interest to the mineral industry of British Columbia. Information concerning mine operations and some of the activities of the Inspection Branch of the Department of Mines 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*

The end of the calendar year 1960 marked the end of the 1951–60 decade and the beginning of a new one. The past decade witnessed material changes in the mineral industry of British Columbia in production, exploration, and methods. Table I, page A 17, shows that the total value of mineral production to date is more than $4,370,000,000, of which almost $1,370,000,000 is credited to the 1951–60 decade. The production of principal metals in the decade amounted to 37 per cent of the accumulated value of the principal-metals group to the end of 1960; comparable percentages for the other groups of products are: other metals, 74; industrial minerals, 74; structural materials, 55; fuels, 17. These percentages reflect in part the history of production and in part changing prices. The accumulated value of coal was already substantial at the end of 1900; production continued at a relatively high level during the early decades of this century, but has declined markedly in the past decade. For the metals, gold, silver, copper, and lead, except placer gold, production before 1900 represents a small part of the value to the end of 1960, and for zinc production did not begin until 1905, and was small until World War I. The value for the principal-metals group, in the last ten years, also reflects the fact that the average prices for silver, copper, lead, and zinc have been materially higher than for any earlier decade. The value for this group for the past decade is $1,182,000,000, and the value from 1858 to the end of 1960 is $3,198,000,000. Production of the metals listed as "miscellaneous" has been mainly in the last few decades, and for iron, nickel, and tungsten has been mainly or entirely in the last decade. The position of the industrial-minerals group is similar; the entire production of asbestos, amounting to 45 per cent of the accumulated value for the group, has been in the last decade; sulphur production, although substantial in the preceding periods, has increased greatly in the last decade. Production of structural materials and the relative importance of the structural-materials group increased substantially in the last decade to meet the needs of the expanding transportation system, and the needs of the building industry. In the period, cement-making capacity increased greatly, and a plant to produce bloated shale for lightweight aggregate and pozzolanic additive came into production. For fuels, the output and value of coal has declined, but the entire production of oil, natural gas, and natural-gas liquid by-products belongs to the last decade, and mainly to the latter half of the decade; consequently, the value for the fuels group has increased substantially.

During the decade 1951–60 the output of gold declined; production of zinc increased. Copper fell to a very low point in 1958 because of mine closures; however, with the reopening of Britannia and the revival of copper-mining in the Boundary camp, much of the loss in copper output has been regained. Increasing production in 1961 and 1962 because of the opening of new copper mines should restore copper output to the level reached in the period 1925–30. Increased mining of iron ore, recovery of by-product iron at Kimberley, high production of industrial minerals and structural materials, and increasing production of petroleum and natural gas hold promise of increasing mineral production in the decade that begins with 1961.

Several aspects of the geographical distribution of mineral production in the decade 1951–60 are worthy of note. They include the increasing importance of the Liard Mining Division because of asbestos production at Cassiar and production

* By Hartley Sargent.

of natural gas and oil east of the Rocky Mountains. Asbestos production began modestly in 1952 and continued to increase throughout the decade, reaching a value of $11,700,000 in 1960 and more than $53,700,000 for the decade. Production of natural gas for use in Fort St. John began in 1954, and reached substantial volume in 1957, when completion of the Westcoast transmission-line gave access to a wide market in British Columbia and western United States. Liquid by-products and sulphur, derived from cleaning natural gas at Taylor, are credited first in 1958. Oil production to date has been for local use. Oil, gas, and liquid by-products had a combined value of more than $9,225,000 in 1960.

Production of silver, lead, zinc, and copper showed considerable changes in geographic distribution. The principal source of silver, lead, and zinc continues to be in southeastern British Columbia in the Fort Steele Mining Division, which, in the decade 1951–60, yielded 61 per cent of the Provincial total value for that group of metals. Important production began in the Nelson Mining Division at the end of the preceding decade, and in the decade 1951–60 that division contributed more than a tenth of the Provincial output of the group. In the same period the Slocan Mining Division contributed 9 per cent of the Provincial output of those metals. The Slocan Mining Division now includes the former Ainsworth Mining Division, and a large part of the output came from mines at Ainsworth and Riondel, in the former Ainsworth Division. The Atlin, Skeena, Omineca, Vancouver, Revelstoke, Golden, and Greenwood Mining Divisions all contributed to silver-lead-zinc production, although in the final years of the decade the Atlin, Skeena, Revelstoke, and Omineca production had ceased or was small. In 1950 copper production came largely from Vancouver and Similkameen Divisions (Britannia and Copper Mountain mines); in 1960* Britannia contributed more than half the copper output; the Copper Mountain mine had been shut down since 1957, but five other mines were in production, two of them (Texada and Giant Nickel mines) producing copper as an important by-product. Thus copper production had become more widely distributed. Gold, the remaining metal in the principal-metals group, had shrunken materially in annual output, and in the number of mines operated primarily to produce it.

Other changes in lode-metal production in the decade 1951–60 relate to iron, nickel, and tungsten. Production of iron ore for transocean shipment began in 1951, and in 1960 more than 1,164,000 tons of iron concentrate was produced on Vancouver and Texada Islands with a value of almost $10,300,000. More than three-fourths of the tungsten output to date was produced in the period 1952–58, mainly in the Nelson Mining Division and the remainder in Omineca; both operations were closed before the end of the decade. Commercial production of nickel began in 1958, and had a value of $2,645,915 in 1960, coming entirely from the Giant Nickel mine in the Hope area.

Some important changes in the industrial-minerals group have been mentioned earlier. Further items of interest include cessation of gypsum production in the Kamloops Mining Division and increased production of gypsum and of barite in the Golden Mining Division.

Exploration for oil and gas has been carried on actively for more than a decade, and has included work in many parts of the Province, but most of the work has been in the northeastern part, and all of the production has come from that area. The work has included geological and geophysical (mainly seismic) surveys, as early steps, slim-hole drilling, and drilling of wells. In the decade, 628 wells, aggregating 3,511,429 feet, were drilled, yielding 104 wells rated as commercial oil wells and 230 as commercial gas wells.

* *See* footnote, page A 12.

In the lode-mining segment of the industry, increasing use has been made of geophysical surveys, and recently geochemical surveys have been used extensively. Airborne magnetometer surveys were undertaken in several parts of the Province in spite of the difficulties imposed by high relief and rugged terrain. Airborne magnetometer surveys made for the Department of Mines and Petroleum Resources included considerable parts of the larger coastal islands—Vancouver, Texada, and Moresby.

Geological mapping is used increasingly in the search for mineral deposits, and, in addition to the large projects of the Provincial and Federal Government departments, many projects are undertaken by companies. Projects undertaken by companies in the Stewart and Princeton-Merritt areas are worthy of note because of the substantial areas involved. Government mapping in the decade has included detailed mapping in various areas by the British Columbia Department of Mines and Petroleum Resources and less detailed work over very much larger areas by the Federal Geological Survey. Aerial geological mapping, air photography, and topographic mapping have made great progress in the post-war period, and the areas lacking first-stage mapping are rapidly being filled in. First-stage geological mapping is of very great use in indicating areas for mineral exploration and for more detailed mapping. The next stage—detailed studies pointing more specifically to areas worthy of intensive exploration—has been in progress for years, but is needed for many areas and must be pursued vigorously if mineral exploration is to be carried on efficiently at an adequate rate.

Exploration for lode deposits was directed toward the discovery of copper, iron, silver-lead-zinc, gold, tungsten, molybdenum, asbestos, and fluorspar. Exploration for copper and iron were notably successful. In the southwestern Interior, in an area long recognized as a potential source of copper, important reserves of ore have been established, and at Merritt and Highland Valley two large mines are nearing production, and in the belt trending northwesterly from Stewart potentialities for important copper mines have been demonstrated, notably near the Leduc glacier, on the Stikine River, and farther to the northwest. Iron exploration and discoveries have been mainly on Vancouver, Texada, and Moresby Islands, and locally on the Mainland coast, where prospects are best for ready shipments to an overseas market. The importance of by-product iron, as oxide minerals and as iron sulphides occurring with ores of other metals, is emphasized by the important magnetite and specular hematite content of the Craigmont copper deposit, and by the preparation for production of pig iron from iron content of iron sulphide from the Sullivan mine, already used as a source of sulphur in the manufacture of fertilizer.

Tables I, II, and III make it apparent that 1960 was a very good year in the mineral-production history of British Columbia. Improved prices for silver, copper, and especially for zinc, increased output of zinc, and substantially increased output of copper* and lead brought the combined value of gold, silver, copper, lead, and zinc to $112,800,000, a level substantially higher than in 1958 or 1959. Other metals contributed $17,700,000 to the 1960 total, the greatest for any year to date; iron and nickel contributed most of this increase. Industrial minerals also made a new record with a value of almost $16,000,000; asbestos contributed more than $11,700,000, and sulphur contributed more than $3,000,000 to the total. Structural materials contributed $18,800,000, well above the average for the decade but somewhat below the values for 1956 to 1959. Fuels reached a new high in 1960, amounting to $14,500,000. The value for coal was the lowest in many years, natural gas surpassed coal for the first time, and the sum of oil, natural gas,

* Copper credited to 1960 includes some carry-over from 1959 of concentrates stockpiled during the period that the Tacoma smelter was affected by a strike.

and natural-gas liquid by-products exceeded $9,200,000. The combined value for all products is just short of $180,000,000 and has been exceeded only in the year 1956.

The number of lode-mineral claims recorded in 1960 was 11,748, 1,707 less than in 1959; the number of certificates of work issued was 13,157, 661 less than in 1959.

Revenue to the Government, from petroleum and natural gas, amounted to $14,116,470, including rentals, fees, and miscellaneous, $6,722,526; tender bonus, $6,186,627; and royalties, $1,207,317. Land held for petroleum and natural gas, under permits, leases, licences, and drilling reservations, amounted to 39,175,125 acres.

The average number employed through 1960 in placer, lode, coal, industrial-mineral, and structural-material mining was 11,541. Major expenditures by those branches of the industry included: salaries and wages, $50,739,204; fuel and electricity, $7,834,728; process supplies (inclusive of explosives, chemicals, drill-steel, lubricants, etc.), $21,496,912; Federal taxes, $11,219,585; Provincial taxes, $2,674,997; municipal and other taxes, $2,096,872; levies for workmen's compensation (including silicosis), unemployment insurance, and other items, $2,460,054. Dividends amounted to $20,595,943. The lode-mining industry spent $29,505,158 in freight and treatment charges on ores and concentrates. Returns from the operators indicate that in addition to the foregoing items the metal-mining and industrial-mineral sections of the industry spent a further $4,039,170 for work done by contract.

Information supplied by the Canadian Petroleum Association indicates that, exclusive of expenditures for land acquisition and rentals ($12,910,000), natural-gas plants ($79,000), and pipe-line construction ($271,000), the petroleum and natural-gas industry spent $43,728,000 in British Columbia. The number directly employed by forty-six operating and development companies at December 31st was 617. The $43,728,000 expenditure is broken down into: exploration, $33,956,000; development drilling, $4,422,000; capital expenditures, field equipment, secondary recovery, pressure-maintenance projects, etc., $2,008,000; operation of wells, flow-lines, etc., $1,034,000; taxes, royalties, and other expenses, $2,308,000.

Statistics

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

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

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

In the current Report, Tables I and II have new forms, Table VIII has been amalgamated with Table VII, and subsequent tables have been renumbered.

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

METHODS OF COMPUTING PRODUCTION

The tables of statistics recording the mineral production of the Province for each year are compiled from certified returns made by the operators, augmented by some data obtained from the Royal Canadian Mint, from the operators of custom smelters, and from the records of the Petroleum and Natural Gas Branch of the Department of Mines and Petroleum Resources. The values are in Canadian funds. Weights are avoirdupois pounds and tons (2,000 lb.) and troy ounces.

METALS

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

PLACER GOLD

The value of placer gold in dollars is obtained from returns received annually from the operators (1958). A fineness of 822½ is taken as the average for crude placer gold (p. A 16).

LODE METALS, GROSS AND NET CONTENTS, AND CALCULATED VALUE

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

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

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.

AVERAGE METAL PRICES

The methods of computing prices have varied because of changing conditions (1958). The prices are now arrived at by methods given in footnotes to the table of average prices on page A 16.

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

Fuel

Coal

All coal produced, including that used in making coke, is shown as primary mine production (1959, tables renumbered in 1960). Washery loss and changes in stocks, year by year, are shown in the table "Collieries of British Columbia, Production and Distribution by Collieries and by Districts" (p. 218).

Natural Gas

Commerial 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 gross well output is shown in Table 7, page 185. The quantity is reported as thousands of cubic feet at standard conditions (14.4 pounds per square inch pressure, 60° F. temperature).

Natural-gas Liquid By-products

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

Petroleum

Production of petroleum began in 1955, and is shown* in Tables I, III, and VIIA. The quantity is "net sales" (*see* Table 9, p. 189), reported in barrels (35 imperial gallons=1 barrel).

CO-OPERATION WITH DOMINION BUREAU OF STATISTICS

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

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

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

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

Year	Gold,[1] Crude, Oz.	Gold, Fine, Oz.	Silver, Fine, Oz.	Copper, Lb.	Lead, Lb.	Zinc, Lb.	Coal, Short Ton
	$	$	Cents	Cents	Cents	Cents	$
1901	17.00	20.67	56.002 N.Y.	16.11 N.Y.	2.577 N.Y.	....	2.679
1902	....	....	49.55 ,,	11.70 ,,	3.66 ,,	....	....
1903	....	....	50.78 ,,	13.24 ,,	3.81 ,,	....	....
1904	....	....	53.36 ,,	12.82 ,,	3.88 ,,	....	....
1905	....	....	51.33 ,,	15.59 ,,	4.24 ,,	....	....
1906	....	....	63.45 ,,	19.28 ,,	4.81 ,,	....	....
1907	....	....	62.06 ,,	20.00 ,,	4.80 ,,	....	3.125
1908	....	....	50.22 ,,	13.20 ,,	3.78 ,,	....	....
1909	....	....	48.93 ,,	12.98 ,,	3.85 ,,	....	....
1910	....	....	50.812 ,,	12.738 ,,	4.00 ,,	4.60 E. St. L.	....
1911	....	....	50.64 ,,	12.38 ,,	3.98 ,,	4.90 ,,	....
1912	....	....	57.79 ,,	16.341 ,,	4.024 ,,	5.90 ,,	....
1913	....	....	56.80 ,,	15.27 ,,	3.93 ,,	4.80 ,,	....
1914	....	....	52.10 ,,	13.60 ,,	3.50 ,,	4.40 ,,	....
1915	....	....	47.20 ,,	17.28 ,,	4.17 ,,	11.25 ,,	....
1916	....	....	62.38 ,,	27.202 ,,	6.172 ,,	10.88 ,,	....
1917	....	....	77.35 ,,	27.18 ,,	7.91 ,,	7.566 ,,	....
1918	....	....	91.93 ,,	24.63 ,,	6.67 ,,	6.94 ,,	4.464
1919	....	....	105.57 ,,	18.70 ,,	5.19 ,,	6.24 ,,	....
1920	....	....	95.80 ,,	17.45 ,,	7.16 ,,	6.52 ,,	....
1921	....	....	59.52 ,,	12.50 ,,	4.09 ,,	3.95 ,,	....
1922	....	....	64.14 ,,	13.38 ,,	5.16 ,,	4.86 ,,	....
1923	....	....	61.63 ,,	14.42 ,,	6.54 ,,	5.62 ,,	....
1924	....	....	63.442 ,,	13.02 ,,	7.287 ,,	5.39 ,,	....
1925	....	....	69.065 ,,	14.042 ,,	7.848 Lond.	7.892 Lond.	....
1926	....	....	62.107 ,,	13.795 ,,	6.751 ,,	7.409 ,,	....
1927	....	....	56.37 ,,	12.92 ,,	5.256 ,,	6.194 ,,	....
1928	....	....	58.176 ,,	14.570 ,,	4.575 ,,	5.493 ,,	....
1929	....	....	52.993 ,,	18.107 ,,	5.050 ,,	5.385 ,,	....
1930	....	....	38.154 ,,	12.982 ,,	3.927 ,,	3.599 ,,	....
1931	....	....	28.700 ,,	8.116 ,,	2.710 ,,	2.554 ,,	4.018
1932	19.30	23.47	31.671 ,,	6.380 Lond.	2.113 ,,	2.405 ,,	3.795
1933	23.02	28.60	37.832 ,,	7.454 ,,	2.391 ,,	3.210 ,,	....
1934	28.37	34.50	47.461 ,,	7.419 ,,	2.436 ,,	3.044 ,,	....
1935	28.94	35.19	64.790 ,,	7.795 ,,	3.133 ,,	3.099 ,,	....
1936	28.81	35.03	45.127 ,,	9.477 ,,	3.913 ,,	3.315 ,,	....
1937	28.77	34.99	44.881 ,,	13.078 ,,	5.110 ,,	4.902 ,,	....
1938	28.93	35.18	43.477 ,,	9.972 ,,	3.344 ,,	3.073 ,,	....
1939	29.72	36.14	40.488 ,,	10.092 ,,	3.169 ,,	3.069 ,,	....
1940	31.66	38.50	38.249 ,,	10.086 ,,	3.362 ,,	3.411 ,,	....
1941	31.66	38.50	38.261 ,,	10.086 ,,	3.362 ,,	3.411 ,,	....
1942	31.66	38.50	41.166 ,,	10.086 ,,	3.362 ,,	3.411 ,,	....
1943	31.66	38.50	45.254 ,,	11.75 ,,	3.754 ,,	4.000 ,,	....
1944	31.66	38.50	43.000 ,,	12.000 ,,	4.500 ,,	4.300 ,,	....
1945	31.66	38.50	47.000 ,,	12.550 ,,	5.000 ,,	6.440 ,,	....
1946	30.22	36.75	83.650 ,,	12.80 ,,	6.750 ,,	7.810 ,,	4.68
1947	28.78	35.00	72.000 ,,	20.39 ,,	13.670 ,,	11.230 ,,	5.12
1948	28.78	35.00	75.000 Mont.	22.35 U.S.	18.040 ,,	13.930 ,,	6.09
1949	29.60	36.00	74.250 U.S.	19.973 ,,	15.800 U.S.	13.247 U.S.	6.51
1950	31.29	38.05	80.635 ,,	23.428 ,,	14.454 ,,	15.075 ,,	6.43
1951	30.30	36.85	94.55 ,,	27.70 ,,	18.4 ,,	19.9 ,,	6.46
1952	28.18	34.27	83.157 ,,	31.079 ,,	16.121 ,,	15.874 ,,	6.94
1953	28.31	34.42	83.774 ,,	30.333 ,,	13.265 ,,	10.675 ,,	6.88
1954	27.52	34.07	82.982 ,,	29.112 ,,	13.680 ,,	10.417 ,,	7.00
1955	28.39	34.52	87.851 ,,	38.276 ,,	14.926 ,,	12.127 ,,	6.74
1956	28.32	34.44	89.373 ,,	39.787 ,,	15.756 ,,	13.278 ,,	6.59
1957	27.59	33.55	87.057 ,,	26.031 ,,	14.051 ,,	11.175 ,,	6.76
1958	27.94	33.98	86.448 ,,	23.419 ,,	11.755 ,,	10.009 ,,	7.45
1959	27.61	33.57	87.469 ,,	27.708 ,,	11.670 ,,	10.978 ,,	7.93
1960	**27.92**	**33.95**	**88.633 ,,**	**28.985 ,,**	**11.589 ,,**	**12.557 ,,**	**6.64**

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

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

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

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

	Total Quantity to Date	Total Value to Date	Total Quantity, 1951–60	Total Value, 1951–60	Quantity, 1960	Value, 1960
Principal Metals		$		$		$
Gold—placer .... crude oz.	5,217,363	96,429,421	95,708	2,737,180	3,847	107,418
,, lode .... fine oz.	15,709,291	454,584,068	2,254,414	77,608,869	205,580	6,979,441
Silver .... oz.	423,787,442	258,168,462	80,335,238	69,892,002	7,446,237	6,599,823
Copper .... lb.	2,978,608,709	493,736,834	363,389,994	113,366,847	33,064,429	9,583,724
Lead .... lb.	13,198,692,739	983,255,240	2,972,009,442	417,479,699	333,608,699	38,661,912
Zinc .... lb.	11,067,331,405	911,825,961	3,989,092,438	501,495,280	405,438,159	50,910,869
Totals........		3,197,999,986		1,182,579,877		112,843,187
Miscellaneous Metals						
Antimony .... lb.	39,429,202	10,004,156	16,188,551	5,980,179	1,651,786	538,482
Bismuth .... lb.	5,126,986	8,572,352	1,642,406	3,506,995	213,009	419,628
Cadmium .... lb.	26,529,727	37,958,819	13,736,707	23,306,206	1,778,866	2,525,990
Chromite .... tons	796	32,295				
Cobalt .... lb.	1,730	420				
Iron concentrates .... tons	6,593,888	45,477,025	6,519,111	45,232,297	1,160,355	10,292,847
Magnesium .... lb.	204,632	88,184				
Manganese .... tons	1,724	32,668				
Mercury .... lb.	4,163,662	10,409,609	75	250		
Molybdenite (MoS_2) .... lb.	52,171	46,198	9,023	9,500	9,023	9,500
Nickel .... lb.	6,531,353	4,473,218	6,249,900	4,385,494	3,779,878	2,645,915
Palladium .... oz.	749	30,462				
Platinum .... oz.	1,400	134,483	32	2,929		
Selenium .... lb.	731	1,389				
Tin .... lb.	12,699,183	9,967,208	6,260,508	4,888,979	621,718	522,243
Tungsten (WO_3) .... lb.	16,019,324	38,663,751	12,567,014	35,204,550		
Other		3,265,215		3,245,646		760,364
Totals........		169,157,452		125,763,025		17,714,969
Industrial Minerals						
Arsenious oxide .... lb.	22,019,420	273,201				
Asbestos .... tons	185,687	53,734,263	185,687	53,734,263	40,748	11,724,077
Barite .... tons	172,138	2,185,570	114,544	1,966,249	23,573	279,716
Bentonite .... tons	791	16,858				
Diatomite .... tons	1,619	36,265	270	6,013	44	1,430
Fluorspar .... tons	35,341	784,964				
Fluxes .... tons	3,607,319	5,776,886	947,156	2,483,013	83,370	294,559
Granules .... tons	143,567	1,901,630	114,177	1,484,205	19,063	257,067
Gypsum and gypsite .... tons	1,993,372	8,395,802	1,143,798	3,057,242	107,900	337,200
Hydro-magnesite .... tons	2,253	27,536				
Iron oxide and ochre .... tons	18,108	155,050				
Magnesium sulphate .... tons	13,894	254,352				
Mica .... lb.	12,572,050	177,793	2,815,300	35,474	122,000	3,186
Natro-alunite .... tons	522	9,398				
Perlite .... tons	1,112	11,120	1,112	11,120		
Phosphate rock .... tons	3,842	16,894				
Sodium carbonate .... tons	10,492	118,983				
Sulphur .... tons	4,280,291	44,565,771	2,136,831	24,323,245	264,697	3,095,541
Talc .... tons	1,805	34,871				
Totals........		118,477,207		87,100,824		15,992,776
Structural Materials						
Clay products........		41,386,488		17,604,539		2,073,708
Cement		99,561,672		56,051,333		6,432,752
Lime and limestone........		28,878,322		14,224,907		1,602,019
Rock[1]		27,410,655		16,252,269		1,075,373
Sand and gravel		93,779,890		63,742,885		7,597,278
Stone		8,551,135		1,628,576		48,859
Not assigned........		7,010,452				
Totals........		306,578,614		169,504,509		18,829,989
Fuels						
Coal[2] .... tons	134,513,110	556,860,787	11,779,163	80,907,684	788,658	5,242,223
Natural gas—						
To pipe-line .... M s.c.f.	210,236,655	14,870,507	210,236,655	14,870,507	80,115,339	7,101,949
Liquid by-products[3]		1,487,008		1,487,008		593,648
Petroleum crude .... bbl.	2,691,636	5,177,439	2,691,636	5,177,439	838,598	1,531,049
Totals		578,395,741		102,442,638		14,468,869
Grand totals		4,370,609,000		1,667,390,873		179,849,790

[1] Rubble, riprap, and crushed stone.
[2] 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.
[3] Includes value of propane, butane, and natural-gasoline shipments.

Table II.—Total Value of Production, 1836–1960

1836–1900	$153,093,007	1954	$153,284,471
1901–10	221,928,930	1955	174,711,086
1911–20	331,995,328	1956	190,067,465
1921–30	532,582,031	1957	172,331,610
1931–40	522,040,932	1958	146,757,699
1941–50	941,577,899	1959	149,560,908
1951	176,330,205	1960	179,849,790
1952	171,309,429		
1953	153,188,210	Total	$4,370,609,000

TABLE III.—QUANTITY AND VALUE OF MINERAL PRODUCTS FOR YEARS 1951 TO 1960

Description	1951		1952		1953		1954		1955	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Principal Metals		$		$		$		$		$
Gold—placer, crude ... oz.	23,691	717,911	17,554	494,756	14,245	403,230	8,684	238,967	7,666	217,614
,, lode, fine ... oz.	261,274	9,627,947	251,393	8,615,238	253,553	8,727,294	258,388	8,803,279	242,477	8,370,306
Silver ... oz.	8,215,884	7,768,118	8,796,720	7,315,088	8,376,953	7,017,709	9,825,153	8,153,108	7,902,145	6,942,113
Copper ... lb.	43,249,658	11,980,155	42,005,512	13,054,893	49,021,013	14,869,544	50,150,087	14,599,693	44,328,031	16,932,549
Lead ... lb.	273,456,604	50,316,015	284,949,396	45,936,692	297,634,712	39,481,244	332,474,456	45,482,505	302,567,640	45,161,245
Zinc ... lb.	337,511,324	67,164,754	372,871,717	59,189,656	382,300,862	40,810,618	334,124,560	34,805,755	429,198,565	52,048,909
Totals		147,574,900		134,606,323		111,309,639		112,083,307		129,672,736
Miscellaneous Metals										
Antimony ... lb.	1,310,836	622,647	2,333,239	1,028,025	1,551,043	570,474	1,302,333	382,104	2,021,721	667,776
Bismuth ... lb.	191,471	451,872	142,246	312,941	71,298	157,569	225,351	493,519	160,767	356,903
Cadmium ... lb.	1,164,933	3,122,021	726,172	1,561,270	787,158	1,550,701	680,734	1,123,211	1,593,591	2,677,233
Indium ... oz.	582	1,368	404	889	6,752	9,588	477	1,278	104,774	232,389
Iron ore concentrates ... tons	113,535	790,000	900,481	5,474,924	991,248	6,763,105	535,746	3,733,891	610,930	3,228,756
Mercury ... lb.									75	250
Platinum ... oz.	22	2,085	2	176			4	408		
Tin ... lb.	346,718	495,807	212,113	250,293	1,092,228	581,746	587,528	280,437	391,228	311,613
Tungsten (WO_3) ... lb.			1,434,640	4,565,024	2,168,977	5,950,323	2,172,163	5,752,172	1,914,000	5,460,967
Totals		5,485,800		13,193,542		15,583,506		11,767,020		12,935,897
Industrial Minerals										
Asbestos ... tons			20	23,000	3,102	988,716	8,599	2,920,751	17,187	4,265,971
Barite ... tons	1,248	16,224	848	13,408	3,560	52,845	5,056	115,337	9,465	238,825
Diatomite ... tons	8	223	12	240					14	280
Fluxes (quartz, limestone) ... tons	144,235	292,100	55,588	141,478	37,358	110,698	39,897	40,804	111,759	208,198
Granules (quartz, limestone, granite) ... tons	5,727	73,767	1,610	21,026	4,620	59,321	4,541	65,507	6,355	73,858
Gypsum and products ... tons	124,729	263,072	91,112	235,453	172,665	387,655	175,480	421,734	149,719	383,934
Mica ... lb.	606,000	7,462	314,000	3,001	604,000	11,338	284,000	5,326	505,300	2,861
Perlite ... tons					1,112	11,120				
Sulphur ... tons	194,874	1,840,992	182,607	1,745,258	151,954	1,590,055	219,999	2,308,422	216,520	2,624,171
Totals		2,493,840		2,182,864		3,211,748		5,877,881		7,798,098
Structural Materials										
Brick—common ... No.	1,353,000	41,820	830,815	28,248	1,382,883	51,381	1,289,911	35,550	4,853,940	232,139
,, face, paving, sewer ... No.	3,127,888	153,575	2,566,540	121,254	4,307,894	226,459	5,651,262	316,676	3,901,866	248,913
,, firebrick, blocks ...		380,742		435,681		426,783		372,528		578,578
Clays ... tons	14,786	60,255	11,483	51,797	5,226	31,990	6,609	36,425	8,033	46,757
Structural tile, hollow blocks ...		171,481		60,273		123,469		122,903		114,460
Drain-tile, sewer-pipe, flue-linings ...		410,206		468,110		627,097		753,297		801,019
Pottery—glazed or unglazed ...		4,695		6,536		30,012		31,081		38,035
Other clay products ...		10,393		11,296		19,267		32,697		55,514
Cement ...		3,311,439		3,603,273		5,071,260		4,935,298		5,474,875
Lime and limestone ... tons	241,723	1,251,327	321,710	1,552,772	338,005	1,357,958	317,976	1,555,002	318,152	1,711,348
Rubble, riprap, crushed rock ... tons	972,178	1,145,072	739,504	982,792	770,415	1,122,516	920,707	1,253,856	890,613	962,272
Sand and gravel ...		3,355,693		3,839,965		4,388,594		4,850,469		4,886,890
Stone ... tons	4,837	309,350	122,308	434,964	2,611	78,252	3,055	99,392	26,079	148,454
Totals		10,606,048		11,596,961		13,555,038		14,395,174		15,299,254
Fuel										
Coal[1] ... tons	1,573,572	10,169,617	1,402,347	9,729,739	1,384,138	9,528,279	1,308,284	9,154,544	1,332,874	8,986,501
Natural gas ... M s.c.f.							60,883	6,545	168,948	18,130
Petroleum, crude ... bbls.									582	480
Totals								9,161,089		9,005,111
Provincial totals		176,330,205		171,309,429		153,188,210		153,284,471		174,711,086

Description	1956 Quantity	1956 Value	1957 Quantity	1957 Value	1958 Quantity	1958 Value	1959 Quantity	1959 Value	1960 Quantity	1960 Value
Principal Metals		$		$		$		$		$
Gold—placer, crude ......oz.	3,865	109,450	2,936	80,990	5,650	157,871	7,570	208,973	3,847	107,418
„ lode, fine ......oz.	191,743	6,603,628	222,506	7,465,076	194,354	6,604,149	173,146	5,812,511	205,580	6,979,441
Silver ......oz.	8,404,600	7,511,443	8,129,971	7,077,708	7,040,416	6,086,299	6,197,159	5,420,593	7,446,237	6,599,823
Copper ......lb.	43,360,575	17,251,872	29,318,494	7,631,897	12,658,649	2,964,529	16,233,546	4,497,991	33,064,429	9,583,724
Lead ......lb.	283,718,073	44,702,619	281,603,346	39,568,086	294,573,159	34,627,075	287,423,357	33,542,306	333,608,699	38,661,912
Zinc ......lb.	443,853,004	58,934,801	449,448,607	50,225,881	432,002,790	43,234,839	402,342,850	44,169,198	405,438,159	50,910,869
Totals	......	135,113,813	......	112,049,638	......	93,674,762	......	93,651,572	......	112,843,187
Miscellaneous Metals										
Antimony ......lb.	2,140,432	768,843	1,360,731	577,344	858,633	284,208	1,657,797	540,276	1,651,786	538,482
Bismuth ......lb.	156,753	346,424	145,634	314,569	154,034	308,068	181,843	345,502	213,009	419,628
Cadmium ......lb.	1,937,927	3,236,338	1,946,397	3,172,627	1,425,108	2,166,164	1,695,821	2,170,651	1,778,866	2,525,990
Indium ......oz.	363,192	795,390	384,360	693,770	75,434	117,677	......	......	......	......
Iron concentrates ......tons	369,955	2,190,847	357,342	2,200,637	630,271	4,193,442	849,248	6,363,848	1,160,355	10,292,847
Mercury ......lb.	......	......	......	......	......	......	......	......	......	......
Molybdenite (MoS_2) ......lb.	......	......	......	......	......	......	......	......	9,023	9,500
Nickel ......lb.	......	......	......	......	1,408,490	996,507	1,061,532	743,072	3,779,878	2,645,915
Platinum ......oz.	......	......	......	......	4	260	......	......	......	......
Tin ......lb.	756,934	637,792	709,102	555,936	795,496	625,260	747,443	627,852	621,718	522,243
Tungsten (WO_3) ......lb.	2,264,775	6,351,376	1,921,483	5,240,479	690,976	1,884,209	......	......	......	......
Others	......	......	......	......	......	......	......	632,933	......	760,364
Totals	......	14,327,010	......	12,755,362	......	10,575,795	......	11,424,134	......	17,714,969
Industrial Minerals										
Asbestos ......tons	20,356	6,620,060	31,714	9,245,800	30,078	8,203,384	33,883	9,742,504	40,748	11,724,077
Barite ......tons	11,436	287,626	20,072	433,200	16,144	341,700	23,142	187,368	23,573	279,716
Diatomite ......tons	40	800	120	2,400	27	540	5	100	44	1,430
Fluxes (quartz, limestone) ......tons	176,311	392,429	137,433	442,204	90,635	311,630[2]	70,570	248,913	83,370	294,559
Granules (quartz, limestone, granite) ......tons	13,220	173,214	17,295	221,864	22,674	284,330	19,072	254,251	19,063	257,067
Gypsum and products ......tons	72,973	391,919	66,499	142,751	70,498	211,494	112,223	282,030	107,900	337,200
Mica ......lb.	200,000	1,100	180,000	1,200	......	......	......	......	122,000	3,186
Sulphur ......tons	212,885	2,523,190	226,550	2,872,332	211,300	2,410,395	255,445	3,312,889	264,697	3,095,541
Totals	......	10,390,338	......	13,361,751	......	11,763,473	......	14,028,055	......	15,992,776
Structural Materials										
Brick—common ......No.	2,248,447	75,767	663,828	24,345	427,550	15,125	385,810	11,954	2,262,653	187,673
„ face, paving, sewer ......No.	6,913,682	485,176	4,660,231	345,081	4,871,562	344,133	5,412,822	428,100	1,775,591	145,091
„ firebrick, blocks	......	600,753	......	658,873	......	405,485	......	538,566	......	621,865
Clays ......tons	7,985	30,263	3,849	29,495	4,105	12,579	6,250	17,001	8,003	22,671
Structural tile, hollow blocks	......	129,257	......	200,216	......	122,877	......	149,383	......	83,842
Drain-tile, sewer-pipe, flue-linings	......	696,385	......	697,611	......	639,173	......	680,702	......	616,858
Pottery—glazed or unglazed	......	38,385	......	47,612	......	68,387	......	46,902	......	48,825
Other clay products	......	69,659	......	38,868	......	32,416	......	80,910	......	346,883
Cement	......	6,339,071	......	7,078,108	......	6,755,619	......	7,049,638	......	6,432,752
Lime and limestone ......tons	396,012	1,220,792	334,303	1,494,578	269,747	997,819	519,580	1,481,292	565,945	1,602,019
Rubble, riprap, crushed rock ......tons	2,028,143	2,210,315	2,364,301	4,272,768	1,866,950	2,098,952	1,169,854	1,128,353	1,148,305	1,075,373
Sand and gravel	......	8,535,348	......	10,503,274	......	8,442,676	......	7,342,698	......	7,597,278
Stone ......tons	35,266	139,150	2,403	236,110	2,141	64,335	13,710	69,710	4,328	48,859
Totals	......	20,570,321	......	25,626,939	......	19,999,576	......	19,025,209	......	18,829,989
Fuels										
Coal[1] ......tons	1,417,209	9,346,518	1,085,657	7,340,339	796,413	5,937,860	690,011	5,472,064	788,658	5,242,223
Natural gas delivered to pipe-line ......M s.c.f.	269,736	20,143	8,547,100	433,830	64,051,785	3,368,327	69,959,566	3,921,583	80,115,339	7,101,949
Natural-gas liquid by-products[3]	......	......	......	......	......	428,297	......	465,063	......	593,648
Petroleum, crude ......bbls.	148,545	299,322	345,320	763,751	512,359	1,009,609	866,109	1,573,228	838,598	1,531,049
Totals	......	9,665,983	......	8,537,920	......	10,744,093	......	11,431,938	......	14,468,869
Provincial totals	......	190,067,465	......	172,331,610	......	146,757,699	......	149,560,908	......	179,849,790

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

TABLE IV.—MINERAL PRODUCTION VALUE, 1895–1960

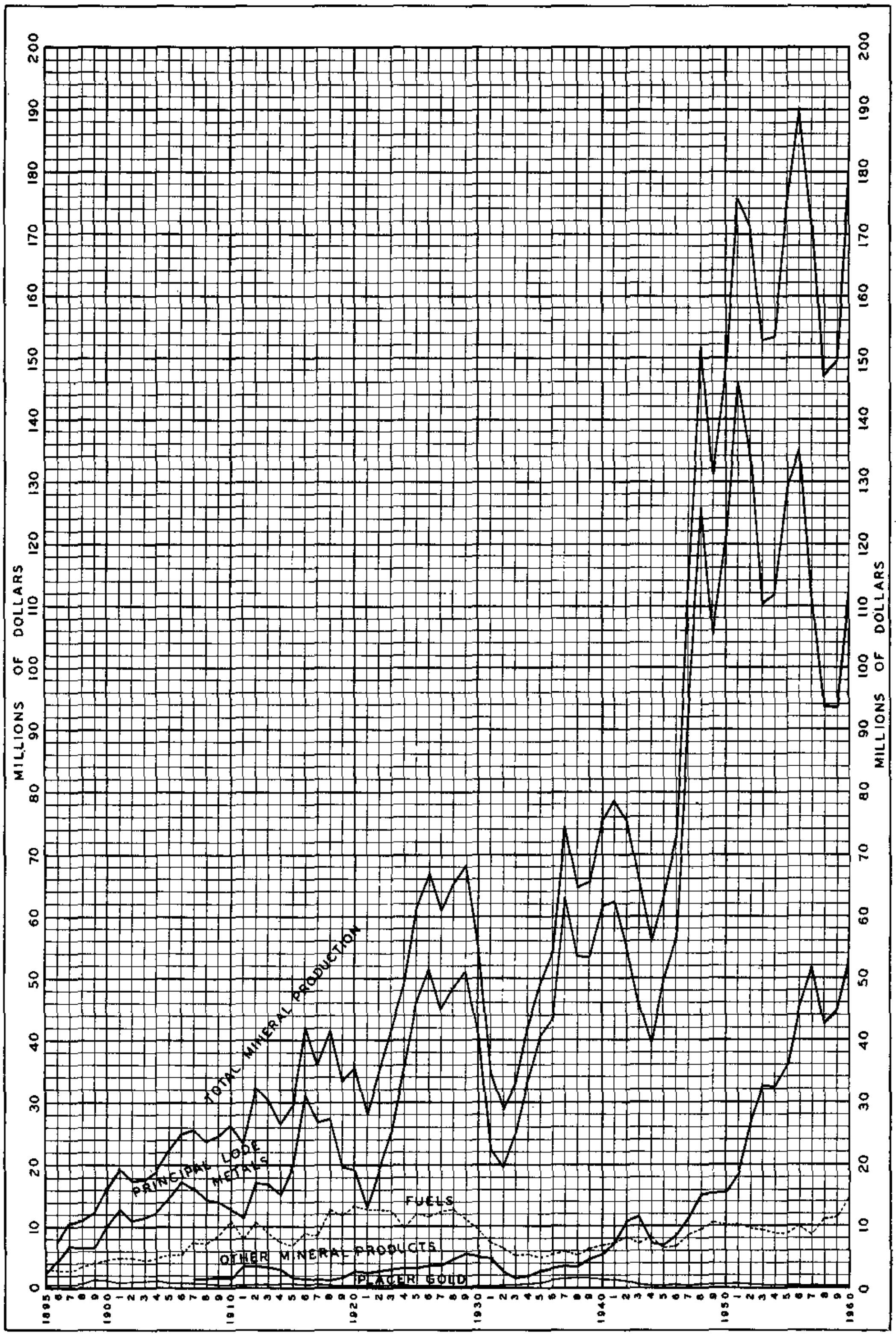


TABLE V.—PRINCIPAL LODE-METALS PRODUCTION, 1913–1960

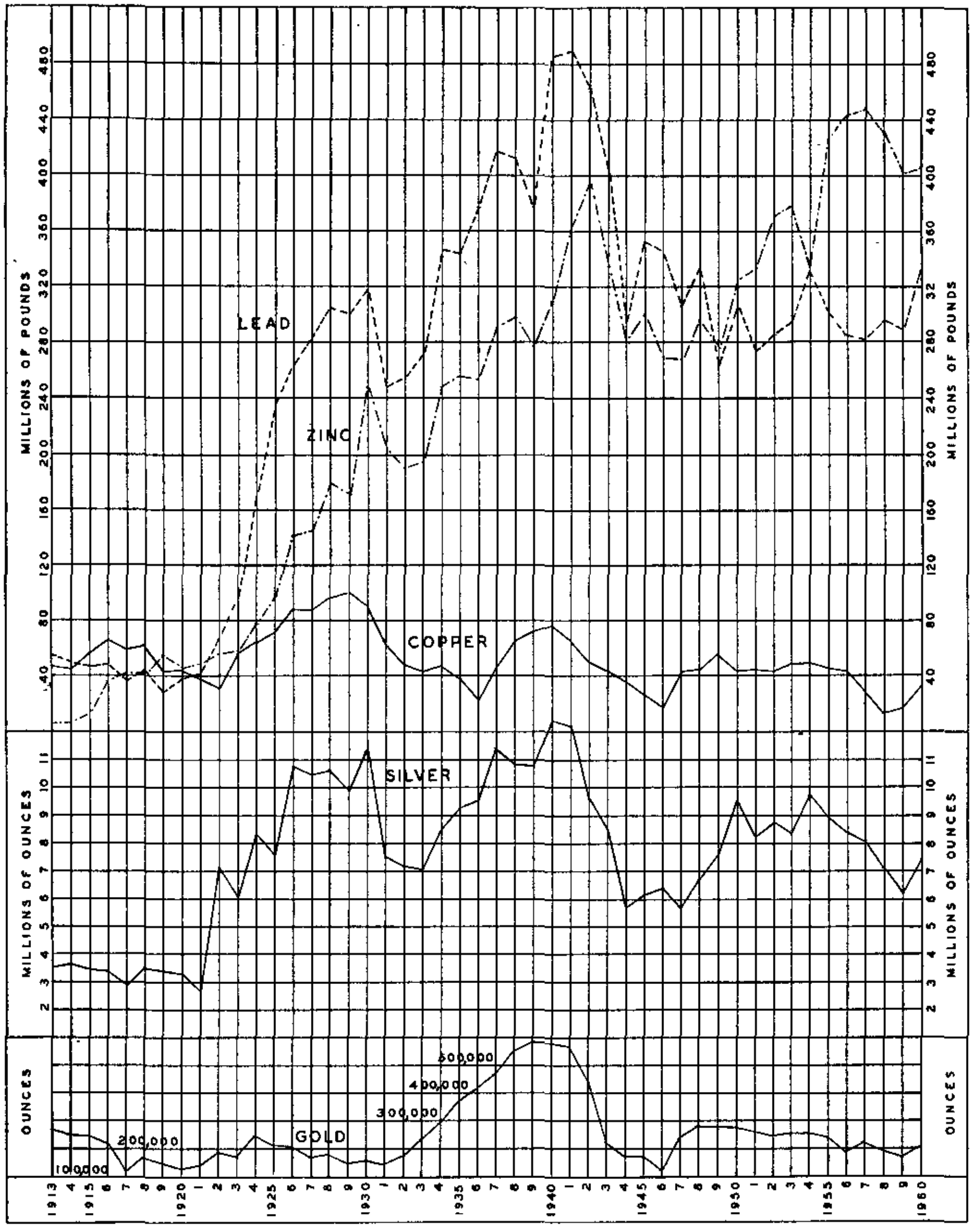


TABLE VI.—PRODUCTION OF PRINCIPAL METALS, 1858–1960

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

	Oz.	$	Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
1924	24,750	420,750	247,716	5,120,535	8,341,768	5,292,184	64,845,393	8,442,870	170,384,481	12,415,917	79,130,970	4,266,741	35,958,997
1925	16,476	280,092	209,719	4,335,269	7,654,844	5,286,818	72,306,432	10,153,269	237,899,199	18,670,329	98,257,099	7,754,450	46,480,227
1926	20,912	355,503	201,427	4,163,859	10,748,556	6,675,606	89,339,768	12,324,421	263,023,937	17,757,535	142,876,947	10,586,610	51,863,534
1927	9,191	156,247	178,001	3,679,601	10,470,185	5,902,043	89,202,871	11,525,011	282,996,423	14,874,292	145,225,443	8,996,135	45,133,329
1928	8,284	143,208	188,087	3,888,097	10,627,167	6,182,461	97,908,316	14,265,242	305,140,792	13,961,412	181,763,147	9,984,613	48,425,033
1929	6,983	118,711	145,387	3,005,411	9,960,172	5,278,194	102,793,669	18,612,850	307,999,153	15,555,189	172,096,841	9,268,792	51,839,147
1930	8,955	152,235	160,853	3,325,126	11,328,263	4,322,185	92,362,240	11,990,466	321,803,725	12,638,198	250,479,310	9,017,005	41,445,215
1931	17,176	291,992	146,133	3,020,837	7,550,331	2,254,979	64,134,746	5,365,690	261,902,236	7,097,812	202,071,702	5,160,911	23,192,221
1932	20,400	395,542	181,651	4,263,349	7,150,655	2,264,729	50,608,036	3,228,892	252,007,574	5,326,432	192,120,091	4,621,641	20,100,585
1933	23,928	562,787	223,589	6,394,645	7,021,754	2,656,526	43,149,460	3,216,701	271,689,217	6,497,719	195,963,751	6,291,416	25,619,794
1934	25,181	714,431	297,216	10,253,952	8,613,977	4,088,280	49,651,733	3,683,662	347,366,967	8,461,859	249,152,403	7,584,199	34,786,383
1935	30,929	895,058	365,343	12,856,419	9,269,944	6,005,996	39,428,208	3,073,428	344,268,444	10,785,930	256,239,446	7,940,860	41,557,691
1936	43,389	1,249,940	404,578	14,172,367	9,547,124	4,308,330	21,671,711	2,053,828	377,971,618	14,790,029	254,581,393	8,439,373	45,013,867
1937	54,153	1,558,245	460,781	16,122,727	11,308,685	5,075,451	46,057,584	6,023,411	419,118,371	21,416,949	291,192,278	14,274,245	64,471,028
1938	57,759	1,671,015	557,522	19,613,624	10,861,578	4,722,288	65,769,906	6,558,575	412,979,182	13,810,024	298,497,295	9,172,822	55,548,348
1939	49,746	1,478,492	587,336	21,226,957	10,821,393	4,381,365	73,254,679	7,392,862	378,743,763	12,002,390	278,409,102	8,544,375	55,026,441
1940	39,067	1,236,928	583,416	22,461,516	12,327,944	4,715,315	77,980,223	7,865,085	466,849,112	15,695,467	312,020,671	10,643,025	62,617,336
1941	43,775	1,385,962	571,026	21,984,501	12,175,700	4,658,545	66,435,583	6,700,693	456,840,454	15,358,976	367,869,579	12,548,031	62,636,708
1942	32,904	1,041,772	444,518	17,113,943	9,677,881	4,080,775	50,097,716	5,052,856	507,199,704	17,052,054	387,236,469	13,208,636	57,550,036
1943	14,600	462,270	224,403	8,639,516	8,526,310	3,858,496	42,307,510	4,971,132	439,155,635	16,485,902	336,150,455	13,446,018	47,863,334
1944	11,433	361,977	186,632	7,185,332	5,705,334	2,453,293	36,300,589	4,356,070	292,922,888	13,181,530	278,063,373	11,956,725	39,494,927
1945	12,589	398,591	175,373	6,751,860	6,157,307	2,893,934	25,852,366	3,244,472	336,976,468	16,848,823	294,791,635	18,984,581	49,122,261
1946	15,729	475,361	117,612	4,322,241	6,365,761	5,324,959	17,500,538	2,240,070	345,862,680	23,345,731	274,269,956	21,420,484	57,128,846
1947	6,969	200,585	243,282	8,514,870	5,707,691	4,109,538	41,783,921	8,519,741	313,733,089	42,887,313	253,006,168	28,412,593	92,644,640
1948	20,332	585,200	286,230	10,018,050	6,718,122	5,038,592	43,025,388	9,616,174	320,037,525	57,734,770	270,310,195	37,654,210	120,646,996
1949	17,886	529,524	288,396	10,382,256	7,636,053	5,669,769	54,856,808	10,956,550	265,378,899	41,929,866	288,188,620	38,176,346	107,644,311
1950	19,134	598,717	283,983	10,805,553	9,507,225	7,666,151	42,212,133	9,889,458	284,024,522	41,052,905	290,344,227	43,769,392	113,782,176
1951	23,691	717,911	261,274	9,627,947	8,215,884	7,768,118	43,249,658	11,980,155	273,456,604	50,316,015	337,511,324	67,164,754	147,574,900
1952	17,554	494,756	251,393	8,615,238	8,796,720	7,315,088	42,005,512	13,054,893	284,949,396	45,936,692	372,871,717	59,189,656	134,606,323
1953	14,245	403,230	253,553	8,727,294	8,376,953	7,017,709	49,021,013	14,869,544	297,634,712	39,481,244	382,300,862	40,810,618	111,309,639
1954	8,684	238,967	258,388	8,803,279	9,825,153	8,153,108	50,150,087	14,599,693	332,474,456	45,482,505	334,124,560	34,805,755	112,083,307
1955	7,666	217,614	242,477	8,370,306	7,902,145	6,942,113	44,238,031	16,932,549	302,567,640	45,161,245	429,198,565	52,048,909	129,672,736
1956	3,865	109,450	191,743	6,603,628	8,404,600	7,511,443	43,360,575	17,251,872	283,718,073	44,702,619	443,853,004	58,934,801	135,113,813
1957	2,936	80,990	222,506	7,465,076	8,129,971	7,077,708	29,318,494	7,631,897	281,603,346	39,568,086	449,448,607	50,225,881	112,049,638
1958	5,650	157,871	194,354	6,604,149	7,040,416	6,086,299	12,658,649	2,964,529	294,573,159	34,627,075	432,002,790	43,234,839	93,674,762
1959	7,570	208,973	173,146	5,812,511	6,197,159	5,420,593	16,233,546	4,497,991	287,423,357	33,542,306	402,342,850	44,169,198	93,651,572
1960	3,847	107,418	205,580	6,979,441	7,446,237	6,599,823	33,064,429	9,583,724	333,608,699	38,661,912	405,438,159	50,910,869	112,843,187
Totals	5,217,363	96,429,421	15,709,291	454,584,068	423,787,442	258,168,462	2,978,608,709	493,736,834	13,198,692,739	983,255,240	11,067,331,405	911,825,961	3,197,999,986

[1] Ounces of crude gold.

[2] Ounces of fine gold.

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

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

TABLE VIIA.—PRODUCTION, 1959 AND 1960, AND

Division	Period	Placer Gold		Principal Lode Metals	Miscellaneous Metals	Industrial Minerals	Structural Materials
		Quantity[1]	Value				
		Oz.	$	$	$	$	$
Alberni	1959	......	......	33,052	......	......	30,104
	1960	......	......	**511**	......	......	**84,361**
	To date	1,613	33,136	11,692,199	......	9,398	1,059,369
Atlin	1959	957	26,418	......	......	......	39,066
	1960	**1,959**	**54,700**	**1,156**	......	......	**22,481**
	To date	732,038	17,278,316	37,483,344	562,122	20,325	275,669
Cariboo	1959	6,322	174,521	598,453	......	100	508,675
	1960	**1,634**	**45,625**	**666,212**	......	**4,616**	**785,135**
	To date	2,602,277	53,925,891	38,905,814	23,730	171,420	4,772,498
Clinton	1959	......	......	......	......	......	......
	1960	......	......	......	......	......	......
	To date	10,093	240,834	847,454	900	162,427	110,928
Fort Steele	1959	24	662	47,991,149	627,878	907,020	225,846
	1960	**6**	**168**	**59,647,970**	**522,243**	**643,145**	**249,941**
	To date	20,475	466,752	1,545,086,232	10,059,215	4,931,647	4,659,368
Golden	1959	......	......	2,631,335	43,398	469,398	87,066
	1960	......	......	**3,098,048**	**43,181**	**616,916**	**81,596**
	To date	469	11,268	41,243,942	467,108	3,942,580	1,477,225
Greenwood	1959	......	......	1,640,272	7,039	......	28,718
	1960	......	......	**3,842,662**	**8,323**	......	**36,885**
	To date	5,056	115,136	121,108,980	88,414	2,323,897	805,444
Kamloops	1959	24	663	......	......	......	385,165
	1960	**5**	**139**	......	**35,968**	......	**495,977**
	To date	27,555	603,591	3,044,836	101,646	6,528,308	7,932,238
Liard	1959	......	......	......	......	10,429,841	186,063
	1960	......	......	......	......	**12,306,577**	**203,145**
	To date	50,082	1,245,186	6,312	79	55,024,913	1,538,417
Lillooet	1959	106	2,926	4,619,810	......	......	101,319
	1960	**30**	**838**	**4,815,524**	......	......	**140,967**
	To date	91,859	1,892,613	122,906,423	48,350	5,129	1,322,902
Nanaimo	1959	......	......	296,858	6,363,848	16,026	1,488,955
	1960	......	......	**624,206**	**10,256,879**	**23,302**	**1,555,579**
	To date	866	19,300	7,218,797	45,373,249	726,338	31,542,996
Nelson	1959	6	166	13,336,208	685,385	......	65,799
	1960	......	......	**12,673,675**	**712,603**	......	**106,553**
	To date	3,581	88,871	165,031,567	40,519,872	64,126	2,749,324
New Westminster	1959	36	994	137,818	743,072	107,248	4,661,005
	1960	**11**	**307**	**392,131**	**2,645,915**	**120,441**	**4,716,804**
	To date	11,592	243,146	818,099	4,473,218	672,934	64,495,835
Nicola	1959	......	......	......	......	......	33,799
	1960	......	......	**1,589**	......	......	**22,529**
	To date	234	4,764	572,717	......	10,050	458,109
Omineca	1959	36	994	34,818	940	......	306,733
	1960	**179**	**4,998**	**33,916**	**941**	......	**299,196**
	To date	52,654	1,394,531	17,345,508	15,632,176	11,460	3,210,182
Osoyoos	1959	18	497	250,044	......	379,830	525
	1960	......	......	**237,680**	......	**407,823**	**684**
	To date	208	4,639	50,931,845	1,020	3,424,729	973,206
Revelstoke	1959	5	138	......	......	......	38,185
	1960	......	......	**278,186**	**12,069**	......	**45,630**
	To date	7,579	164,389	11,053,917	185,244	......	1,254,238
Similkameen	1959	7	193	17,511	......	......	23,050
	1960	**3**	**84**	**23,549**	......	......	**71,260**
	To date	12,146	288,153	120,061,655	128,661	18,558	2,269,652
Skeena	1959	......	......	869,030	......	......	247,896
	1960	......	......	**467,671**	......	......	**181,166**
	To date	4,603	105,569	210,300,368	337,504	1,240,215	6,910,603
Slocan	1959	2	55	6,352,608	136,997	......	40,337
	1960	......	......	**6,910,292**	**151,792**	......	**109,665**
	To date	366	9,397	178,749,656	2,880,905	......	865,557
Trail Creek	1959	1	28	26,017	......	......	93,669
	1960	**2**	**56**	**55,803**	......	......	**66,474**
	To date	851	24,260	82,785,235	35,774	......	1,721,497
Vancouver	1959	......	......	2,317,360	14,383	43,412	4,595,256
	1960	......	......	**6,903,597**	**46,952**	**56,206**	**5,018,309**
	To date	182	5,306	203,730,168	968,758	6,270,274	42,996,492
Vernon	1959	26	718	......	......	......	262,453
	1960	**18**	**503**	**34**	**9,500**	......	**144,814**
	To date	2,695	71,990	188,344	9,500	3,978	2,604,271
Victoria	1959	......	......	1,386,176	......	60	5,575,525
	1960	......	......	**772,520**	......	**60**	**4,390,838**
	To date	628	15,680	8,775,561	35,437	188,186	109,308,343
Not assigned[4]	1959	......	......	10,904,080	2,801,194	1,675,120	......
	1960	......	......	**11,288,837**	**3,268,603**	**1,813,690**	......
	To date	1,577,661	18,176,703	121,681,592	47,224,570	32,726,315	11,264,251
Total	1959	7,570	208,973	93,442,599	11,424,134	14,028,055	19,025,209
	1960	**3,847**	**107,418**	**112,735,769**	**17,714,969**	**15,992,776**	**18,829,989**
	To date	5,217,363	96,429,421	3,101,570,565	169,157,452	118,477,207	306,578,614

[1] Crude gold—equivalent in fine gold: 1959, 6,255 oz.; 1960, 3,164 oz. The year of first recorded production for the major placer-producing mining divisions was: Atlin, 1898; Cariboo, 1858; Lillooet, 1874; Quesnel, 1858.

[2] Total quantity is gross mine output; it includes material discarded in picking and washing. The quantities shown for 1959 and 1960 are those sold and used (*see also* Table VIIIc).

Total to Date, by Mining Divisions—Summary

Fuels							Division Totals
Coal		Petroleum		Natural Gas			
				Direct to Pipe-line		Liquid By-products, Value[3]	
Quantity[2]	Value	Quantity	Value	Quantity	Value		
Tons	$	Bbl.	$	M S.C.F.	$	$	$
......	......	......	......	......	......	......	63,156
......	......	......	......	......	......	......	**84,872**
......	......	......	......	......	......	......	12,794,102
......	......	......	......	......	......	......	65,484
......	......	......	......	......	......	......	**78,337**
......	......	......	......	......	......	......	55,619,776
......	......	......	......	......	......	......	1,281,749
......	......	......	......	......	......	......	**1,501,588**
290	1,100	......	......	......	......	......	97,800,453
......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	......
......	......	......	......	......	......	......	1,362,548
542,422	3,957,498	......	......	......	......	......	53,710,053
674,042	**4,618,360**	......	......	......	......	......	**65,681,827**
54,756,950	225,075,326	......	......	......	......	......	1,790,278,540
......	......	......	......	......	......	......	3,231,197
......	......	......	......	......	......	......	**3,839,741**
......	......	......	......	......	......	......	47,142,123
......	......	......	......	......	......	......	1,676,029
......	......	......	......	......	......	......	**3,887,870**
......	......	......	......	......	......	......	124,441,871
......	......	......	......	......	......	......	385,828
......	......	......	......	......	......	......	**532,084**
14,995	59,765	......	......	......	......	......	18,270,384
3,319	31,040	866,109	1,573,228	69,959,566	3,921,583	465,063	16,606,818
2,293	**21,526**	**838,598**	**1,531,049**	**80,115,339**	**7,101,949**	**593,648**	**21,757,894**
95,449	658,856	2,691,636	5,177,439	210,236,655	14,870,507	1,487,008	80,008,717
......	......	......	......	......	......	......	4,724,055
......	......	......	......	......	......	......	**4,957,329**
......	......	......	......	......	......	......	126,175,417
137,240	1,415,971	......	......	......	......	......	9,581,658
105,499	**530,154**	......	......	......	......	......	**12,990,120**
80,108,431	297,781,788	......	......	......	......	......	382,662,468
......	......	......	......	......	......	......	14,087,558
......	......	......	......	......	......	......	**13,492,831**
......	......	......	......	......	......	......	208,453,760
......	......	......	......	......	......	......	5,650,137
......	......	......	......	......	......	......	**7,875,598**
......	......	......	......	......	......	......	10,703,232
416	3,710	......	......	......	......	......	37,509
213	**2,183**	......	......	......	......	......	**26,301**
2,929,544	11,077,084	......	......	......	......	......	12,122,724
5,453	55,318	......	......	......	......	......	398,803
5,417	**60,448**	......	......	......	......	......	**399,499**
422,698	2,650,909	......	......	......	......	......	40,244,766
......	......	......	......	......	......	......	630,896
......	......	......	......	......	......	......	**646,187**
1,122	5,008	......	......	......	......	......	55,340,447
......	......	......	......	......	......	......	38,323
......	......	......	......	......	......	......	**335,885**
......	......	......	......	......	......	......	12,657,788
1,161	8,527	......	......	......	......	......	49,281
1,194	**9,552**	......	......	......	......	......	**104,445**
4,655,334	19,550,951	......	......	......	......	......	142,317,630
......	......	......	......	......	......	......	1,116,926
......	......	......	......	......	......	......	**648,837**
......	......	......	......	......	......	......	218,894,259
......	......	......	......	......	......	......	6,529,997
......	......	......	......	......	......	......	**7,171,749**
......	......	......	......	......	......	......	182,505,515
......	......	......	......	......	......	......	119,714
......	......	......	......	......	......	......	**122,333**
......	......	......	......	......	......	......	84,566,766
......	......	......	......	......	......	......	6,970,411
......	......	......	......	......	......	......	**12,025,064**
......	......	......	......	......	......	......	253,970,998
......	......	......	......	......	......	......	263,171
......	......	......	......	......	......	......	**154,851**
......	......	......	......	......	......	......	2,878,083
......	......	......	......	......	......	......	6,961,761
......	......	......	......	......	......	......	**5,163,418**
......	......	......	......	......	......	......	118,323,207
......	......	......	......	......	......	......	15,380,394
......	......	......	......	......	......	......	**16,371,130**
......	......	......	......	......	......	......	231,073,431
690,011	5,472,064	866,109	1,573,228	69,959,566	3,921,583	465,063	149,560,908
783,658	**5,242,223**	**838,598**	**1,531,049**	**80,115,339**	**7,101,949**	**593,648**	**179,849,790**
142,984,813[4]	556,860,787	2,691,636	5,177,439	210,236,655	14,870,507	1,487,008	4,370,609,000

[3] Includes propane, butane, and natural gasoline.
[4] 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.

Table VIIb.—Production, 1959 and 1960, and Total to Date, by Mining Divisions—Principal Lode Metals

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	1959	953	31,992	539	471			5,043	589			33,052
	1960	**15**	**509**	**2**	**2**							**511**
	To date	301,104	11,265,624	162,425	77,995	2,290,699	343,518	117,937	5,062			11,692,199
Atlin	1959											
	1960	**34**	**1,154**	**3**	**2**							**1,156**
	To date	344,197	12,126,732	3,375,333	2,893,942	24,777,661	8,160,266	23,765,211	3,437,907	91,067,749	10,864,497	37,483,344
Cariboo	1959	17,746	595,734	3,108	2,719							598,453
	1960	**19,552**	**663,791**	**2,732**	**2,421**							**666,212**
	To date	1,080,935	38,821,488	123,611	79,663	2,352	920	24,560	3,724	505	19	38,905,814
Clinton	1959											
	1960											
	To date	23,390	827,328	31,564	14,214	57,548	5,905	193	7			847,454
Fort Steele	1959	313	10,507	3,383,110	2,959,172			190,663,665	22,250,449	207,424,129	22,771,021	47,991,149
	1960	**362**	**12,290**	**5,177,507**	**4,588,980**			**259,357,600**	**30,056,952**	**199,010,500**	**24,989,748**	**59,847,970**
	To date	4,914	138,064	202,866,897	116,032,331	28,592	6,193	11,265,047,001	810,253,351	8,141,404,500	618,656,293	1,545,086,232
Golden	1959	4	134	228,024	199,450	126,066	34,930	8,377,769	977,686	12,927,081	1,419,135	2,631,335
	1960			**194,659**	**172,532**	**147,739**	**42,822**	**9,054,501**	**1,049,326**	**14,600,369**	**1,833,368**	**3,098,048**
	To date	169	4,844	3,184,356	2,370,121	1,053,498	331,461	213,660,144	20,143,442	229,587,863	18,394,074	41,243,942
Greenwood	1959	4,490	150,729	882,015	771,490	1,859,595	515,257	845,796	98,704	948,191	104,092	1,640,272
	1960	**18,861**	**640,331**	**957,789**	**848,917**	**7,307,427**	**2,118,058**	**877,617**	**101,707**	**1,064,340**	**133,649**	**3,842,662**
	To date	1,159,466	25,264,804	32,960,648	19,926,392	451,561,728	73,443,998	15,742,702	1,244,241	16,719,767	1,229,545	121,108,980
Kamloops	1959											
	1960											
	To date	47,868	1,608,328	304,512	181,984	6,411,583	1,179,668	538,097	45,030	438,023	29,826	3,044,836
Liard	1959											
	1960											
	To date	114	4,120	540	446	56	22	10,102	1,724			6,312
Lillooet	1959	136,897	4,595,633	27,641	24,177							4,619,810
	1960	**141,087**	**4,789,903**	**28,907**	**25,621**							**4,815,524**
	To date	3,513,513	122,368,684	858,468	535,148	400	41	62,513	2,548	15	2	122,906,423
Nanaimo	1959	769	25,815	15,898	13,906	928,024	257,137					296,858
	1960	**1,517**	**51,502**	**31,522**	**27,939**	**1,879,473**	**544,765**					**624,206**
	To date	87,859	2,050,460	637,268	395,003	26,423,729	4,773,334					7,218,797
Nelson	1959	255	8,560	149,790	131,020			31,809,997	3,712,227	86,394,614	9,484,401	13,336,208
	1960	**274**	**9,302**	**122,762**	**108,808**			**20,227,114**	**2,344,120**	**81,320,738**	**10,211,445**	**12,673,675**
	To date	1,329,421	41,572,982	8,038,297	4,847,821	14,798,370	1,682,270	285,629,960	34,361,236	669,697,900	82,567,258	165,031,567

		Oz.	$	Oz.	$	Lb.	$	Lb.	$	Lb.	$	$
New Westminster	1959					497,394	137,818					137,818
	1960					**1,352,874**	**392,131**					**392,131**
	To date	4,449	113,528	14,154	6,616	2,558,905	696,355	28,425	1,119	12,755	481	818,099
Nicola	1959											
	1960			**17**	**15**	**5,430**	**1,574**					**1,589**
	To date	8,525	234,914	267,436	126,603	561,142	110,087	2,235,428	90,516	320,683	10,597	572,717
Omineca	1959	16	537	13,883	12,143			113,532	13,249	80,969	8,889	34,818
	1960	**22**	**747**	**13,977**	**12,388**			**97,985**	**11,355**	**75,062**	**9,426**	**33,916**
	To date	25,075	773,894	9,546,527	7,583,394	6,750,202	1,545,334	27,908,867	3,540,834	31,513,087	3,902,052	17,345,508
Osoyoos	1959	7,430	249,426	706	618							250,044
	1960	**6,435**	**218,468**	**1,811**	**1,605**	**59,650**	**17,290**	**1,802**	**209**	**864**	**108**	**237,680**
	To date	1,644,588	50,120,789	591,285	387,626	2,843,616	417,190	127,896	5,663	8,417	577	50,931,845
Revelstoke	1959											
	1960	**8**	**272**	**2,950**	**2,615**			**92,889**	**10,765**	**2,106,665**	**264,534**	**278,186**
	To date	37,300	1,069,260	4,107,618	2,766,476	153,686	51,037	36,343,774	3,853,894	27,194,200	3,313,250	11,053,917
Similkameen	1959	18	604	477	417	59,514	16,490					17,511
	1960	**538**	**18,265**	**223**	**198**	**17,548**	**5,086**					**23,549**
	To date	184,012	6,327,260	4,219,439	2,582,266	601,187,921	111,134,861	382,544	13,304	72,275	3,964	120,061,655
Skeena	1959	650	21,821	853,615	746,649			853,118	99,559	9,114	1,001	869,030
	1960	**7,548**	**256,255**	**199,498**	**176,821**			**112,695**	**13,060**	**171,494**	**21,535**	**467,671**
	To date	2,401,403	60,509,913	68,567,146	43,833,812	687,106,270	98,025,648	59,859,787	5,420,255	16,979,068	2,510,740	210,300,368
Slocan	1959	107	3,592	523,153	457,597			23,238,045	2,711,880	28,962,829	3,179,539	6,352,608
	1960	**123**	**4,176**	**521,900**	**462,576**			**26,303,094**	**3,048,266**	**27,038,893**	**3,395,274**	**6,910,292**
	To date	15,655	451,008	69,891,694	44,752,415	229,696	43,512	853,598,595	69,327,603	667,016,081	64,175,118	178,749,656
Trail Creek	1959	257	8,627	921	805	58,399	16,181	2,974	347	522	57	26,017
	1960	**395**	**13,410**	**1,020**	**904**	**143,095**	**41,476**	**57**	**7**	**51**	**6**	**55,803**
	To date	2,950,097	62,599,539	3,622,907	2,067,944	121,343,117	18,092,383	135,754	11,004	119,621	14,365	82,785,235
Vancouver	1959	3,174	106,551	27,521	24,072	6,714,761	1,860,526	64,539	7,532	2,902,887	318,679	2,317,360
	1960	**8,590**	**291,631**	**74,091**	**65,669**	**17,911,128**	**5,191,540**	**209,794**	**24,313**	**10,595,235**	**1,330,444**	**6,903,597**
	To date	452,593	14,436,671	4,832,469	2,957,038	947,000,344	157,625,806	18,094,627	1,823,402	207,785,599	26,887,251	203,730,168
Vernon	1959											
	1960	**1**	**34**									**34**
	To date	5,224	176,082	12,823	8,084	654	100	24,913	2,933	10,816	1,146	188,345
Victoria	1959			23,232	20,321	4,929,462	1,365,855					1,386,176
	1960			**14,062**	**12,464**	**2,622,243**	**760,056**					**772,520**
	To date	37,663	812,730	876,220	506,255	36,028,550	7,152,805	210,097	19,848	3,568,709	283,923	8,775,561
Not assigned[1]	1959	67	2,249	63,526	55,566	1,060,331	293,797	31,448,879	3,670,084	62,692,514	6,882,384	10,904,080
	1960	**218**	**7,401**	**100,805**	**89,346**	**1,617,822**	**468,926**	**17,273,551**	**2,001,832**	**69,453,948**	**8,721,332**	**11,288,837**
	To date	49,757	905,022	4,693,805	3,234,873	45,438,390	8,914,120	395,143,612	29,646,593	963,813,772	78,980,983	121,681,591
Totals	1959	173,146	5,812,511	6,197,159	5,420,593	16,233,546	4,497,991	287,423,357	33,542,306	402,342,850	44,169,198	93,442,599
	1960	**205,580**	**6,979,441**	**7,446,237**	**6,599,823**	**33,064,429**	**9,583,724**	**333,608,699**	**38,661,912**	**405,438,159**	**50,910,869**	**112,735,769**
	To date	15,709,291	454,584,068	423,787,442	258,168,462	2,978,608,709	493,736,834	13,198,692,739	983,255,240	11,067,331,405	911,825,961	3,101,570,565

[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, 1959 AND 1960, AND TOTAL

Division	Period	Antimony Quantity	Antimony Value	Bismuth Quantity	Bismuth Value	Cadmium Quantity	Cadmium Value	Chromite Quantity	Chromite Value
		Lb.	$	Lb.	$	Lb.	$	Tons	$
Atlin	1959								
	1960								
	To date					819,212	561,762		
Cariboo	1959								
	1960								
	To date								
Clinton	1959								
	1960								
	To date							126	900
Fort Steele	1959					20	26		
	1960								
	To date					1,837	3,323		
Golden	1959					33,905	48,398		
	1960					**30,409**	**43,181**		
	To date	40,062	14,906			273,243	452,202		
Greenwood	1959					5,490	7,039		
	1960					**5,861**	**8,323**		
	To date					33,727	57,019	670	$1,395
Kamloops	1959								
	1960								
	To date								
Liard	1959								
	1960								
	To date								
Lillooet	1959								
	1960								
	To date	*13,466*	*4,321*						
Nanaimo	1959								
	1960								
	To date								
Nelson	1959					535,457	685,385		
	1960					**501,833**	**712,603**		
	To date					3,878,022	6,601,183		
New Westminster	1959								
	1960								
	To date								
Omineca	1959					734	940		
	1960					**663**	**941**		
	To date	104,489	15,217			261,150	516,576		
Osoyoos	1959								
	1960								
	To date								
Revelstoke	1959								
	1960					**8,499**	**12,069**		
	To date	9,394	3,455			103,612	176,102		
Similkameen	1959								
	1960								
	To date								
Skeena	1959								
	1960								
	To date					141,890	316,764		
Slocan	1959					107,029	136,997		
	1960					**106,896**	**151,792**		
	To date	31,865	8,133			1,594,305	2,864,612		
Trail Creek	1959								
	1960								
	To date					115	210		
Vancouver	1959					11,237	14,883		
	1960					**33,065**	**46,952**		
	To date					473,365	968,758		
Vernon	1959								
	1960								
	To date								
Victoria	1959								
	1960								
	To date					7,000	10,929		
Not assigned[2] [3] [4]	1959	1,657,797	540,276	181,843	345,502	1,001,940	1,282,488		
	1960	**1,651,786**	**538,482**	**213,009**	**419,628**	**1,091,640**	**1,550,129**		
	To date	39,229,926	9,958,124	5,126,986	8,572,852	19,442,159	25,428,879		
Totals	1959	1,657,797	540,276	181,843	345,502	1,695,821	2,170,651		
	1960	**1,651,786**	**538,452**	**213,009**	**419,628**	**1,778,866**	**2,525,990**		
	To date	39,429,202	10,004,156	5,126,986	8,572,352	26,529,727	37,958,819	796	$2,295

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

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

TO DATE, BY MINING DIVISIONS—MISCELLANEOUS METALS

Cobalt		Iron Concentrates		Magnesium		Manganese		Mercury	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Lb.	$	Tons	$	Lb.	$	Tons	$	Lb.	$
				204,632	88,184				
		4,058	**35,968**						
		21,167	95,851					10,987	5,795
								1,783	3,555
		849,248	6,363,848						
		1,156,297	**10,256,879**						
		6,570,971	45,373,249						
1,730	420							4,150,892	10,400,259
						16[1]			
		1,200	6,000						
						541	8,160		
		550	1,925						
						1,167	24,508		
		849,248	6,363,848						
		1,160,355	**10,292,847**						
1,730	420	6,593,888	45,477,025	204,632	88,184	1,724	32,668	4,163,662	10,409,609

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

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

Year of first recorded production: Antimony, 1907; bismuth, 1929; chromite, 1918; indium, 1942; iron concentrates, 1885; magnesium, 1941; manganese, 1918; mercury, 1895.

TABLE VIIc.—PRODUCTION, 1959 AND 1960, AND TOTAL TO DATE,

Division	Period	Molybdenite (MoS_2)		Nickel		Palladium	
		Quantity	Value	Quantity	Value	Quantity	Value
		Lb.	$	Lb.	$	Lb.	$
Atlin	1959						
	1960						
	To date						
Cariboo	1959						
	1960						
	To date						
Clinton	1959						
	1960						
	To date						
Fort Steele	1959						
	1960						
	To date						
Golden	1959						
	1960						
	To date						
Greenwood	1959						
	1960						
	To date						
Kamloops	1959						
	1960						
	To date						
Liard	1959						
	1960						
	To date						
Lillooet	1959						
	1960						
	To date	2,448	2,440				
Nanaimo	1959						
	1960						
	To date						
Nelson	1959						
	1960						
	To date	25,058	18,378				
New Westminster	1959			1,061,532	743,072		
	1960			**3,779,878**	**2,645,915**		
	To date			6,531,353	4,473,218		
Omineca	1959						
	1960						
	To date	1,600	1,840				
Osoyoos	1959						
	1960						
	To date	1,020	1,020				
Revelstoke	1959						
	1960						
	To date						
Similkameen	1959						
	1960						
	To date						
Skeena	1959						
	1960						
	To date	13,022	13,020				
Slocan	1959						
	1960						
	To date						
Trail Creek	1959						
	1960						
	To date					749	30,462
Vancouver	1959						
	1960						
	To date						
Vernon	1959						
	1960	**9,023**	**9,500**				
	To date	9,023	9,500				
Victoria	1959						
	1960						
	To date						
Not assigned	1959						
	1960						
	To date						
Totals	1959			1,061,532	748,072		
	1960	**9,023**	**9,500**	**3,779,878**	**2,645,915**		
	To date	52,171	46,198	6,531,353	4,478,218	749	30,462

Year of first recorded production: Molybdenite, 1914; nickel, 1936; palladium, 1928; platinum, 1887;

BY MINING DIVISIONS—MISCELLANEOUS METALS—*Continued*

Platinum		Selenium		Tin		Tungsten (WO_3)		Other Value	Division Totals
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value		
Lb.	$	Lb.	$	Lb.	$	Lb.	$	$	$
						292	360		562,122
59	2,299					27,698	21,431		23,730
									900
				747,443	627,852				627,878
				621,718	**522,243**				**522,243**
				12,699,183	9,967,208				10,059,215
									43,398
									43,181
									467,108
									7,039
									8,323
									88,414
									35,968
									101,646
2	79								79
3	113					32,353	37,921		48,350
									6,363,848
									10,256,879
									45,373,249
									685,385
									712,603
						13,739,939	33,900,311		40,519,872
									743,072
									2,645,915
									4,473,218
									940
									941
3	154					2,210,892	4,697,710		15,632,176
									1,020
									12,069
						7,784	5,667		185,244
1,280	128,661								128,661
		731	1,389			366	331		337,504
									136,997
									151,792
									2,880,905
53	3,177								35,774
									14,383
									46,952
									968,758
									9,500
									9,500
									35,437
								632,933	2,801,194
								760,364	**3,268,808**
								3,265,215	47,224,570
				747,443	627,852			632,933	11,424,134
				621,718	**522,243**			**760,364**	**17,714,969**
1,400	134,488	731	1,389	12,699,183	9,967,208	16,019,324	38,663,751	3,265,215	169,157,452

selenium, 1931; tin, 1941; tungsten, 1937.

TABLE VIID.—PRODUCTION, 1959 AND 1960, AND TOTAL TO DATE, BY MINING DIVISIONS—INDUSTRIAL MINERALS

Division	Period	Arsenious Oxide		Asbestos		Barite		Bentonite		Diatomite		Fluorspar		Fluxes (Quartz and Limestone)	
		Quantity	Value	Quantity	Value[1]	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
		Lb.	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$
Alberni	1959														
	1960														
	To date														
Atlin	1959														
	1960														
	To date														
Cariboo	1959									5	100				
	1960									**44**	**1,430**				
	To date									1,619	36,265[2]				
Clinton	1959														
	1960														
	To date														
Fort Steele	1959														
	1960														
	To date					8	80								
Golden	1959					23,142	187,368								
	1960					**23,573**	**279,716**								
	To date					172,130	2,185,490								
Greenwood	1959														
	1960														
	To date											35,309	783,578	1,790,502	1,540,319
Kamloops	1959														
	1960														
	To date														
Liard	1959			33,883	9,742,504										
	1960			**40,748**	**11,724,077**										
	To date			185,687	53,734,263										
Lillooet	1959														
	1960														
	To date														
Nanaimo	1959													15,697	16,026
	1960													**18,629**	**23,302**
	To date													674,974	726,338
Nelson	1959														
	1960														
	To date													7,601	8,174

		Lb.	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$
New Westminster	1959														
	1960														
	To date														
Nicola	1959														
	1960														
	To date														
Omineca	1959														
	1960														
	To date	16,997	340												
Osoyoos	1959													54,867	232,827
	1960													**64,735**	**271,197**
	To date	22,002,423	272,861									32	1,386	533,161	2,450,453
Similkameen	1959														
	1960														
	To date							791	16,858						
Skeena	1959														
	1960														
	To date													601,019	1,050,722
Vancouver	1959														
	1960														
	To date														
Vernon	1959														
	1960														
	To date														
Victoria	1959													6	60
	1960													**6**	**60**
	To date													62	880
Totals	1959			33,883	9,742,504	23,142	187,368			5	100			70,570	248,913
	1960			**40,748**	**11,724,077**	**23,573**	**279,716**			**44**	**1,430**			**83,370**	**294,559**
	To date	22,019,420	273,201	185,687	53,734,263	172,138	2,185,570	791	16,858	1,619	36,265	35,341	784,964	3,607,319	5,776,886

[1] Does not include value of containers.
[2] Includes 30 tons of volcanic ash, worth $300.
Year of first recorded production: Arsenious oxide, 1917; asbestos, 1952; barite, 1940; bentonite, 1926; diatomite, 1928; fluorspar, 1918; flux, 1911.

TABLE VIID.—PRODUCTION, 1959 AND 1960, AND TOTAL TO DATE, BY MINING DIVISIONS—INDUSTRIAL MINERALS—*Continued*

Division	Period	Granules (Quartz, Limestone, and Granite)		Gypsum and Gypsite		Hydromagnesite		Iron Oxide and Ochre		Magnesium Sulphate		Mica	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
		Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Lb.	$
Alberni	1959												
	1960												
	To date												
Atlin	1959												
	1960												
	To date					1,450	20,325						
Cariboo	1959												
	1960											**122,000**	**3,186**
	To date	48	168									9,763,800	134,987
Clinton	1959												
	1960												
	To date			873	6,236	803	7,211			1,923	39,085		
Fort Steele	1959			51									
	1960												
	To date			112,878	298,824								
Golden	1959			112,172	282,030								
	1960			**107,900**	**337,200**								
	To date			630,046	1,755,814			27	920				
Greenwood	1959												
	1960												
	To date												
Kamloops	1959												
	1960												
	To date			1,246,918	6,323,178					8,742	193,967	424,700	2,078
Liard	1959												
	1960												
	To date												
Lillooet	1959												
	1960												
	To date												
Nanaimo	1959												
	1960												
	To date												
Nelson	1959												
	1960												
	To date	2	51					7,292	55,901				

		Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Lb.	$
New Westminster	1959	8,621	107,248										
	1960	**8,869**	**120,441**										
	To date	54,871	672,934										
Nicola	1959												
	1960												
	To date			2,407	10,050								
Omineca	1959												
	1960												
	To date												
Osoyoos	1959	10,451	147,003										
	1960	**10,194**	**136,626**										
	To date	49,349	652,791							3,229	21,300	1,588,800	25,938
Similkameen	1959												
	1960												
	To date			250	1,700								
Skeena	1959												
	1960												
	To date											634,250	10,815
Vancouver	1959												
	1960												
	To date	29,692	418,606					10,669	97,389				
Vernon	1959												
	1960												
	To date											160,500	3,978
Victoria	1959												
	1960												
	To date	9,605	157,080					120	840				
Totals	1959	19,072	254,251	112,223	282,030								
	1960	**19,063**	**257,067**	**107,900**[3]	**337,200**							**122,000**	**3,186**
	To date	143,567	1,901,680	1,993,372	8,395,802	2,253	27,536	18,108	155,050	13,894	254,352	12,572,050	177,793

[3] Includes 51 tons of gypsum residue from Trail smelter for testing, and of no commercial value.

Year of first recorded production: Granules, 1930; gypsum and gypsite, 1911; hydromagnesite, 1904; iron oxide and ochre, 1918; magnesium sulphate, 1915; mica, 1932.

TABLE VIID.—PRODUCTION, 1959 AND 1960, AND TOTAL TO DATE, BY MINING DIVISIONS—INDUSTRIAL MINERALS—*Continued*

Division	Period	Natro-alunite		Perlite		Phosphate Rock		Sodium Carbonate		Sulphur		Talc		Division Totals
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
		Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	$
Alberni	1959													
	1960													
	To date	522	9,398											9,398
Atlin	1959													
	1960													
	To date													20,325
Cariboo	1959													100
	1960													**4,616**
	To date													171,420[4]
Clinton	1959													
	1960													
	To date							9,524	109,895					162,427
Fort Steele	1959									39,062	907,020			907,020
	1960									**40,577**	**643,145**			**643,145**
	To date					3,842	16,894			247,875	4,615,849[5]			4,931,647
Golden	1959													469,398
	1960													**616,916**
	To date											5	356	3,042,580
Greenwood	1959													
	1960													
	To date													2,323,897
Kamloops	1959													
	1960													
	To date							968	9,088					6,528,308
Liard	1959									45,217	687,337			10,429,841
	1960									**37,950**	**582,500**			**12,306,577**
	To date									84,635	1,290,650			55,024,918
Lillooet	1959													
	1960													
	To date											206	5,129	5,129
Nanaimo	1959													16,026
	1960													**23,302**
	To date													726,338
Nelson	1959													
	1960													
	To date													64,126

		Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	$
New Westminster	1959													107,248
	1960													**120,441**
	To date													672,934
Nicola	1959													
	1960													
	To date													10,050
Omineca	1959													
	1960													
	To date			1,112	11,120									11,460
Osoyoos	1959													379,830
	1960													**407,823**
	To date													3,424,729
Similkameen	1959													
	1960													
	To date													18,558
Skeena	1959													
	1960													
	To date									41,624	178,678			1,240,215
Vancouver	1959									3,654	43,412			43,412
	1960									**4,801**	**56,206**			**56,206**
	To date									618,556	5,754,279			6,270,274
Vernon	1959													
	1960													
	To date													3,978
Victoria	1959													60
	1960													**60**
	To date											1,504	29,386	188,186
Not assigned	1959									167,512	1,675,120			1,675,120
	1960									**181,369**	**1,813,690**			**1,813,690**
	To date									3,287,601	32,726,315			32,726,315
Totals	1959									255,445	3,312,889			14,028,055
	1960									**264,697**	**3,095,541**			**15,992,776**
	To date	522	9,398	1,112	11,120	3,842	16,894	10,492	118,983	4,280,291	44,565,771	1,805	34,871	118,477,207

[4] Includes 30 tons of volcanic ash, worth $300.
[5] Recovery in 1953 and subsequent years.
Year of first recorded production: Natro-alunite, 1912; perlite, 1953; phosphate rock, 1927; sodium carbonate, 1921; sulphur, 1916; talc, 1916.

TABLE VIIE.—PRODUCTION, 1959 AND 1960, AND TOTAL TO DATE, BY MINING DIVISIONS—STRUCTURAL MATERIALS

Division	Period	Cement	Lime and Limestone	Building-stone	Rubble, Riprap, and Crushed Rock	Sand and Gravel	Brick (Common)	Face, Paving, and Sewer Brick	Fire-bricks, Blocks	Clays	Structural Tile (Hollow Blocks), Roof-tile, Floor-tile	Drain-tile and Sewer-pipe	Pottery (Glazed or Unglazed)	Other Clay Products	Unclassified Material	Division Totals
		$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
Alberni	1959				1,337	28,767										30,104
	1960				**1,608**	**82,753**										**84,361**
	To date				54,812	1,004,557										1,059,369
Atlin	1959				23,087	15,979										39,066
	1960				**6,000**	**16,481**										**22,481**
	To date		1,108		97,478	177,083										275,669
Cariboo	1959				218,036	290,639										508,675
	1960				**253,232**	**531,903**										**785,135**
	To date		7,500		958,843	3,775,078	1,193	184	4,651	15,807				9,242		4,772,498
Clinton	1959															
	1960															
	To date				1,606	109,322										110,928
Fort Steele	1959				45,680	180,166										225,846
	1960				**62,948**	**178,875**								**8,118**		**249,941**
	To date		5,350	71,941	1,033,450	3,532,709	7,800							8,118		4,659,368
Golden	1959				370	85,196								1,500		87,066
	1960				**15,314**	**66,282**										**81,596**
	To date		1,000	24,000	102,190	1,348,535								1,500		1,477,225
Greenwood	1959				22,233	6,485										28,718
	1960				**2,546**	**34,339**										**36,885**
	To date		102,442	30,500	168,319	382,900	114,361			6,922						805,444
Kamloops	1959				321,288	63,877										385,165
	1960				**386,129**	**109,848**										**495,977**
	To date		12,000	18,000	4,324,327	3,505,532	72,379									7,932,238
Liard	1959				850	185,213										186,063
	1960				**3,100**	**200,045**										**203,145**
	To date				30,260	1,508,157										1,538,417
Lillooet	1959				1,952	99,367										101,319
	1960				**10,849**	**130,118**										**140,967**
	To date		100	2,000	302,162	1,018,640										1,322,902
Nanaimo	1959		1,323,682		5,302	159,971										1,488,955
	1960		**1,375,485**	**4,275**	**6,528**	**169,291**										**1,555,579**
	To date		24,912,440	3,188,807	74,570	2,188,187	1,104,295	38,939		35,758						31,542,996
Nelson	1959					65,799										65,799
	1960				**1,846**	**104,707**										**106,553**
	To date		34,543	356,679	285,512	2,050,616	19,110	2,864								2,749,324

		$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
New Westminster	1959		104,793	9,310	326,178	2,450,267	11,006	394,826	498,222	15,951	135,557	599,509	46,902	68,484		4,661,005
	1960		**162,318**		**183,448**	**2,553,613**	**183,936**	**122,800**	**583,103**	**22,671**	**83,842**	**559,809**	**48,825**	**212,439**		**4,716,804**
	To date		1,150,215	9,310	8,254,714	23,378,416	1,611,279	4,500,076	10,926,194	822,056	2,764,977	10,215,507	324,299	538,792		64,495,835
Nicola	1959				20,645	13,154										33,799
	1960				**10,660**	**11,869**										**22,529**
	To date			8,000	108,966	341,743										458,109
Omineca	1959				15,529	291,204										306,733
	1960				**1,745**	**297,451**										**299,196**
	To date		3,077		560,489	2,641,342	5,274									3,210,182
Osoyoos	1959					525										525
	1960					**684**										**684**
	To date		32,070	14,850	145,557	780,729										973,206
Revelstoke	1959				5,732	32,453										38,185
	1960				**2,774**	**42,856**										**45,630**
	To date		1,000	5,575	322,279	925,384										1,254,238
Similkameen	1959				2,000	21,050										23,050
	1960					**71,260**										**71,260**
	To date	10,500	11,571	24,000	511,044	1,699,182				1,363				11,992		2,269,652
Skeena	1959		40,712		38,903	168,281										247,896
	1960		**50,725**		**44,476**	**85,965**										**181,166**
	To date		1,393,681	144,000	1,191,620	4,168,053				4,925				8,324		6,910,603
Slocan	1959					40,337										40,337
	1960				**24,250**	**85,415**										**109,665**
	To date		1,000	115,143	94,264	655,150										865,557
Trail Creek	1959			11,600	10,000	72,069										93,669
	1960			**5,584**		**60,890**										**66,474**
	To date		28,000	67,234	212,042	1,414,221										1,721,497
Vancouver	1959	2,647,240		48,800	49,804	1,794,603		33,274	21,535							4,595,256
	1960	**2,922,279**		**39,000**	**48,988**	**1,970,169**		**22,291**	**15,582**							**5,018,309**
	To date	7,465,237	40,885	3,885,026	7,648,356	22,911,384	132,194	231,201	557,819	12,724			23,362	88,304		42,996,492
Vernon	1959				4,829	257,624										262,453
	1960				**8,204**	**136,610**										**144,814**
	To date		46,499	81,052	191,422	2,124,044	131,467	6,202	1,011	5	18,224	4,325		20		2,604,271
Victoria	1959	4,402,398	12,105		14,598	1,019,672	948		18,809	1,050	13,826	81,198		10,926		5,575,525
	1960	**3,510,473**	**13,491**		**728**	**655,854**	**3,737**		**23,180**			**57,049**		**126,326**		**4,390,838**
	To date	92,085,935	778,343		454,518	12,138,926	1,811,172	23,052	70,822	1,050	705,521	962,744	127,705	148,255		109,308,343
Not assigned	1959															
	1960															
	To date		315,498	505,018	282,455									3,150,828[1]	7,010,452[2]	11,264,251
Totals	1959	7,049,638	1,481,292	69,710	1,128,353	7,342,698	11,954	428,100	538,566	17,001	149,383	680,702	46,902	80,910		19,025,209
	1960	**6,432,752**	**1,602,019**	**48,859**	**1,075,379**	**7,597,278**	**187,673**	**145,091**	**621,865**	**22,671**	**83,842**	**616,858**	**48,825**	**346,883**		**18,829,989**
	To date	99,561,672	28,878,322	8,551,135	27,410,655	93,779,890	5,010,524	4,802,518	11,560,497	900,610	3,489,022	11,182,576	475,366	3,965,375	7,010,452	306,578,614

[1] Includes $3,150,828 of unclassified clay products.
[2] Includes a value of $7,010,452 that cannot be allotted to a particular class of structural material.

TABLE VIIIA.—QUANTITY (GROSS[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	1911	2,573,444	$8,071,747
1860	15,956	56,988	1912	3,388,795	10,786,812
1861	15,427	55,096	1913	2,879,251	9,197,460
1862	20,292	72,472	1914	2,426,399	7,745,847
1863	23,906	85,380	1915	2,209,290	7,114,178
1864	32,068	115,528	1916	2,783,849	8,900,675
1865	36,757	131,276	1917	2,686,561	8,484,343
1866	28,129	100,460	1918	2,888,170	12,833,994
1867	34,988	124,956	1919	2,698,022	11,975,671
1868	49,286	176,020	1920	3,020,387	13,450,169
1869	40,098	143,208	1921	2,877,995	12,836,013
1870	33,424	119,372	1922	2,890,625	12,880,060
1871	55,458[2]	164,612	1923	2,848,146	12,678,548
1872	55,458[2]	164,612	1924	2,226,037	9,911,935
1873	55,459[2]	164,612	1925	2,737,607	12,168,905
1874	91,334	244,641	1926	2,609,640	11,650,180
1875	123,362	330,435	1927	2,748,286	12,269,135
1876	155,895	417,576	1928	2,829,906	12,633,510
1877	172,540	462,156	1929	2,521,402	11,256,260
1878	191,348	522,538	1930	2,113,586	9,435,650
1879	270,257	723,903	1931	1,912,501	7,684,155
1880	299,708	802,785	1932	1,719,172	6,523,644
1881	255,760	685,171	1933	1,416,516	5,375,171
1882	315,997	846,417	1934	1,508,741	5,725,133
1883	238,895	639,897	1935	1,330,524	5,048,864
1884	441,358	1,182,210	1936	1,508,048	5,722,502
1885	409,468	1,096,788	1937	1,618,051	6,139,920
1886	365,832	979,908	1938	1,466,559	5,565,069
1887	462,964	1,240,080	1939	1,655,217	6,280,956
1888	548,017	1,467,903	1940	1,867,966	7,088,265
1889	649,411	1,739,490	1941	2,018,635	7,660,000
1890	759,518	2,034,420	1942	2,170,737	8,237,172
1891	1,152,590	3,087,291	1943	2,040,253	7,742,030
1892	925,495	2,479,005	1944	2,165,676	8,217,966
1893	1,095,690	2,934,882	1945	1,700,914	6,454,360
1894	1,134,509	3,038,859	1946	1,639,277	6,732,470
1895	1,052,412	2,824,687	1947	1,923,573	8,680,440
1896	1,002,268	2,693,961	1948	1,809,018	9,765,395
1897	999,372	2,734,522	1949	1,917,296	10,549,924
1898	1,263,272	3,582,595	1950	1,756,667	10,119,303
1899	1,435,314	4,126,803	1951	1,824,384	10,169,617
1900	1,781,000	4,744,530	1952	1,650,619	9,729,739
1901	1,894,544	5,016,398	1953	1,576,105	9,528,279
1902	1,838,621	4,832,257	1954	1,447,608	9,154,544
1903	1,624,742	4,332,297	1955	1,484,066	8,986,501
1904	1,887,981	4,953,024	1956	1,589,398	9,346,518
1905	2,044,931	5,511,861	1957	1,221,766	7,340,339
1906	2,126,965	5,548,044	1958	882,962	5,937,860
1907	2,485,961	7,637,713	1959	757,628	5,472,064
1908	2,362,514	7,356,866	1960	844,500	5,242,223
1909	2,688,672	8,574,884			
1910	3,515,944	11,108,335	Totals	142,984,813	$556,860,787

[1] Gross mine output, including washery loss and coal used in making coke.

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

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

District and Mining Division	Total to Date			1959		1960	
	Period	Quantity	Value	Quantity	Value	Quantity	Value
Vancouver Island District		Tons	$	Tons	$	Tons	$
Nanaimo Mining Division	1836–1960	80,108,431	297,781,788	149,668	1,415,971	91,404	530,154
Nicola-Princeton District							
Kamloops Mining Division	1893–1945	14,995	59,765	......	......	......	......
Nicola Mining Division	1907–1960	2,929,544	11,077,084	416	3,710	213	2,183
Osoyoos Mining Division	1926–1927	1,122	5,008	......	......	......	......
Similkameen Mining Division	1909–1960	4,655,334	19,550,951	1,161	8,527	1,194	9,552
District totals	1893–1960	7,600,995	30,692,808	1,577	12,237	1,407	11,735
Northern District							
Cariboo Mining Division	1942–1944	290	1,100	......	......	......	......
Liard Mining Division	1923–1960	95,449	658,856	3,319	31,040	2,293	21,526
Omineca Mining Division	1918–1960	422,698	2,650,909	5,524	55,318	5,417	60,448
District totals	1918–1960	518,437	3,310,865	8,843	86,358	7,710	81,974
East Kootenay District							
Fort Steele Mining Division	1898–1960	54,756,950	225,075,326	597,540	3,957,498	743,979	4,618,360
Provincial totals	1836–1960	142,984,813	556,860,787	757,628	5,472,064	844,500	5,242,223

[1] Gross mine output, including washery loss and coal used in making coke.

TABLE VIIIc.—QUANTITY[1] AND VALUE OF COAL SOLD AND USED,[2] 1950–60

Year	District and Mining Division	Total Sales[2]*	Used under Companies' Boilers[2]†	Used in Making Coke[2]‡	Total Sold and Used[2]		District Totals, 1960	
		Tons	Tons	Tons	Tons	$	Tons	$
	Vancouver Island	...	...	...	...	...	**105,499**	**530,154**
1950	Nanaimo	472,690	4,329	...	477,019	4,060,337		
1951	"	391,687	3,425	...	395,112	3,486,615		
1952	"	267,346	2,986	...	270,332	2,749,206		
1953	"	204,931	1,798	...	206,729	2,059,828		
1954	"	181,534	536	...	182,070	2,029,099		
1955	"	173,861	465	...	174,326	1,769,682		
1956	"	172,140	389	...	172,529	1,629,168		
1957	"	163,574	439	...	164,013	1,849,306		
1958	"	153,892	404	...	154,296	1,615,470		
1959	"	136,879	361	...	137,240	1,415,971		
1960	"	**105,231**	**268**	...	**105,499**	**530,154**		
	Nicola-Princeton	...	...	...	...	...	**1,407**	**11,735**
1950	Nicola	1,125	...	...	1,125	9,926		
1951	"	899	...	...	899	8,640		
1952	"	1,139	...	...	1,139	11,493		
1953	"	1,040	...	...	1,040	10,400		
1954	"	1,256	...	...	1,256	12,769		
1955	"	1,259	...	...	1,259	12,904		
1956	"	1,170	...	...	1,170	12,092		
1957	"	1,081	...	...	1,081	11,615		
1958	"	543	...	...	543	5,919		
1959	"	416	...	...	416	3,710		
1960	"	**213**	...	...	**213**	**2,183**		
1950	Similkameen	16,784	...	...	16,784	87,483		
1951	"	3,941	...	...	3,941	28,094		
1952	"	6,306	...	...	6,306	48,760		
1953	"	7,047	...	...	7,047	51,012		
1954	"	29,713	...	...	29,713	138,080		
1955	"	73,475	...	...	73,475	379,511		
1956	"	72,102	...	...	72,102	366,820		
1957	"	17,696	...	...	17,696	92,748		
1958	"	146	...	...	146	1,122		
1959	"	1,161	...	...	1,161	8,527		
1960	"	**1,194**	...	...	**1,194**	**9,552**		
	Northern	...	...	...	...	...	**7,710**	**81,974**
1950	Liard	12,250	...	...	12,250	82,258		
1951	"	3,199	...	...	3,199	26,095		
1952	"	3,854	...	...	3,854	42,606		
1953	"	4,815	20	...	4,835	50,895		
1954	"	4,359	...	...	4,359	33,079		
1955	"	3,650	...	...	3,650	32,850		
1956	"	4,642	...	...	4,642	38,211		
1957	"	2,758	...	...	2,758	28,421		
1958	"	3,194	...	...	3,194	28,738		
1959	"	3,319	...	...	3,319	31,040		
1960	"	**2,293**	...	...	**2,293**	**21,526**		
1950	Omineca	13,037	62	...	13,099	104,790		
1951	"	27,904	...	...	27,904	206,799		
1952	"	37,270	...	...	37,270	285,732		
1953	"	42,079	...	...	42,079	324,986		
1954	"	36,572	...	...	36,572	292,862		
1955	"	30,015	...	...	30,015	227,010		
1956	"	8,553	...	...	8,553	71,234		
1957	"	4,991	...	...	4,991	47,414		
1958	"	4,677	...	...	4,677	44,972		
1959	"	5,453	...	...	5,453	55,318		
1960	"	**5,417**	...	...	**5,417**	**60,448**		
	East Kootenay	...	...	...	...	...	**674,042**	**4,618,360**
1950	Fort Steele	825,315	15,196	213,218	1,053,729	5,774,509		
1951	"	889,669	15,977	236,871	1,142,517	6,413,374		
1952	"	822,071	15,813	245,528	1,083,412	6,591,942		
1953	"	878,865	12,729	230,814	1,122,408	7,031,158		
1954	"	820,081	15,310	218,923	1,054,314	6,648,655		
1955	"	803,125	16,560	230,464	1,050,149	6,564,544		
1956	"	890,100	19,518	248,595	1,158,213	7,228,993		
1957	"	677,534	17,830	199,754	895,118	5,310,835		
1958	"	401,875	7,274	224,408	633,557	4,241,619		
1959	"	358,682	10,813	172,927	542,422	3,957,498		
1960	"	**472,782**	**13,800**	**187,460**	**674,042**	**4,618,360**		
1950	Provincial totals	1,341,201	19,587	213,218	1,574,006	10,119,303		
1951	"	1,317,299	19,402	236,871	1,573,572	10,169,617		
1952	"	1,137,986	18,799	245,528	1,402,313	9,729,739		
1953	"	1,138,777	14,547	230,814	1,384,138	9,528,279		
1954	"	1,073,515	15,846	218,923	1,308,284	9,154,544		
1955	"	1,085,385	17,025	230,464	1,332,874	8,986,501		
1956	"	1,148,707	19,907	248,595	1,417,209	9,346,518		
1957	"	867,634	18,269	199,754	1,085,657	7,340,339		
1958	"	564,327	7,678	224,408	796,413	5,937,860		
1959	"	505,910	11,174	172,927	690,011	5,472,064		
1960	"	**587,130**	**14,068**	**187,460**	**788,658**	**5,242,223**	**788,658**	**5,242,223**

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

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

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

† Coal used in company boilers, including steam locomotives.

‡ Coal used in making coke.

Table IX.—Coke and By-products Production for Years 1895 to 1925 and 1926 to 1960

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
Totals	16,072,397	68,365,066	6,223,241	35,571,124	2,633,191	28,207,996	1,829,283	11,777,717	10,684,812	75,556,837	83,269,939	3,956,525	553,717	163,337,018

[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, 1897–1960

Dividends Paid during 1959 and 1960

	1959	1960
Bralorne Pioneer Mines Ltd.	$603,905	$638,940
Cassiar Asbestos Corporation Ltd.	1,980,000	2,376,000
Consolidated Mining and Smelting Co. of Canada, Ltd.	13,104,262	16,380,344
Crow's Nest Pass Coal Co. Ltd.	372,708	372,708
Highland-Bell Ltd.	78,293	156,986
Reeves MacDonald Mines Ltd.	292,250	467,600
Sheep Creek Mines Ltd.		150,000
Others	12,863	53,365
Totals	$16,444,281	$20,595,943

Dividends Paid Yearly, 1917 to 1960, Inclusive

Year	Amount Paid	Year	Amount Paid
1917	$3,269,494	1940	$14,595,530
1918	2,704,469	1941	16,598,110
1919	2,494,283	1942	13,627,104
1920	1,870,296	1943	11,860,159
1921	736,629	1944	11,367,732
1922	3,174,756	1945	10,487,395
1923	2,983,570	1946	15,566,047
1924	2,977,276	1947	27,940,213
1925	5,853,419	1948	37,672,319
1926	8,011,137	1949	33,651,096
1927	8,816,681	1950	34,399,330
1928	9,572,536	1951	40,921,238
1929	11,263,118	1952	32,603,956
1930	10,543,500	1953	22,323,089
1931	4,650,857	1954	25,368,262
1932	2,786,958	1955	35,071,583
1933	2,471,735	1956	36,262,682
1934	4,745,905	1957	24,247,420
1935	7,386,070	1958	14,996,123
1936	10,513,705	1959	16,444,281
1937	15,085,293	1960	20,595,943
1938	12,068,875		
1939	11,865,698	Total	$642,445,872

TABLE X.—DIVIDENDS PAID BY MINING COMPANIES, 1897–1960—*Continued*

Lode-gold Mines[1]

Company or Mine	Locality	Class	Amount Paid
Arlington	Erie	Gold	$94,872
Athabasca	Nelson	Gold	25,000
Bayonne	Tye Siding	Gold	25,000
Bralorne Mines Ltd.[2]	Bridge River	Gold	17,760,125
Bralorne Pioneer Mines Ltd.[2]	Bridge River	Gold	1,242,845
Belmont-Surf Inlet	Princess Royal Island	Gold	1,437,500
Cariboo Gold Quartz Mining Co. Ltd.	Wells	Gold	1,679,976
Cariboo-McKinney Con. M. & M. Co.	Camp McKinney	Gold	565,588
Canadian Pacific Exploration (Porto Rico)	Nelson	Gold	37,500
Centre Star	Rossland	Gold-copper	472,255
Fairview Amalgamated	Oliver	Gold	5,254
Fern Gold Mining & Milling Co. Ltd.	Nelson	Gold	9,375
Gold Belt Mining Co. Ltd.	Sheep Creek	Gold	668,595[3]
Goodenough (leasers)	Ymir	Gold	13,731
Hedley Mascot Gold Mines Ltd.	Hedley	Gold	1,290,553
Island Mountain Mines Ltd.	Wells	Gold	2,491,236[3]
I.X.L.	Rossland	Gold	134,025
Jewel-Denero	Greenwood	Gold	11,751
Kelowna Exploration Co. Ltd. (Nickel Plate)	Hedley	Gold	2,040,000
Kelowna Mines Hedley Ltd.	Hedley	Gold	780,000[4]
Kootenay Belle Gold Mines Ltd.	Sheep Creek	Gold	357,856
Le Roi Mining Co.	Rossland	Gold-copper	1,475,000
Le Roi No. 2 Ltd.	Rossland	Gold-copper	1,574,640
Lorne (later Bralorne)	Bridge River	Gold	20,450
Motherlode	Sheep Creek	Gold	163,500
Mount Zeballos Gold Mines Ltd.	Zeballos	Gold	165,000
Nickel Plate (Hedley Gold Mining Co. Ltd.)	Hedley	Gold	3,423,191
Pioneer Gold Mines of B.C. Ltd.[2]	Bridge River	Gold	10,048,914
Poorman	Nelson	Gold	25,000
Premier Gold Mining Co. Ltd.	Premier	Gold	18,858,075[5]
Privateer Mine Ltd.	Zeballos	Gold	1,914,183
Queen (prior to Sheep Creek Gold Mines Ltd.)	Sheep Creek	Gold	98,674
Relief Arlington Mines Ltd. (Second Relief)	Erie	Gold	308,000[3]
Reno Gold Mines Ltd.	Sheep Creek	Gold	1,433,640[3]
Sheep Creek Gold Mines Ltd.[7]	Sheep Creek	Gold	3,609,375[6]
Silbak Premier Mines Ltd.	Premier	Gold	2,425,000[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			$79,157,840

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

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

Table X.—Dividends Paid by Mining Companies, 1897–1960—*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	498,280,985[2]
Couverapee	Field	Silver-lead-zinc	5,203
Duthie Mines Ltd.	Smithers	Silver-lead-zinc	50,000
Florence Silver	Ainsworth	Silver-lead-zinc	35,393
Giant Mascot Mines Ltd.	Spillimacheen	Silver-lead-zinc	179,263
Goodenough	Cody	Silver-lead-zinc	45,668
H.B. Mining Co.	Hall Creek	Silver-lead-zinc	8,904
Highland Lass Ltd.	Beaverdell	Silver-lead-zinc	132,464
Highland-Bell Ltd.	Beaverdell	Silver-lead-zinc	1,789,890
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	3,097,850
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	243,750
Silversmith and Slocan Star[4]	Sandon	Silver-lead-zinc	1,267,600
Silver Standard Mines Ltd.	Hazelton	Silver-lead-zinc	1,715,333
Spokane-Trinket	Ainsworth	Silver-lead-zinc	10,365
Standard Silver Lead	Silverton	Silver-lead-zinc	2,734,688
Sunset and Trade Dollar	Retallack	Silver-lead-zinc	88,000
Sunshine Lardeau Mines Ltd.	Beaton	Silver-lead-zinc	164,000
Torbrit Silver Mines Ltd.	Alice Arm	Silver-lead-zinc	390,000
Utica	Kaslo	Silver-lead-zinc	64,000
Violamac Mines (B.C.) Ltd.	New Denver	Silver-lead-zinc	850,000
Wallace Mines Ltd. (Sally)	Beaverdell	Silver-lead-zinc	135,000
Washington	Rambler Station	Silver-lead-zinc	20,000
Western Exploration Co. Ltd.	Silverton	Silver-lead-zinc	30,867
Whitewater	Retallack	Silver-lead-zinc	592,515
Yale Lead and Zinc Mines Ltd.	Ainsworth	Silver-lead-zinc	278,620
Miscellaneous mines			70,239
Total, silver-lead-zinc mines			$529,395,282

[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, 1897–1960—*Continued*

Copper Mines

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

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

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

Coal Mines

Company or Mine	Locality	Class	Amount Paid
Wellington Collieries Ltd.	Nanaimo	Coal	$16,000,000
Bulkley Valley Collieries Ltd.	Telkwa	Coal	24,000
Crow's Nest Pass Coal Co. Ltd.	Fernie	Coal	17,464,614
Canadian Collieries Resources Ltd.	Nanaimo	Coal	828,271
Total, coal mines			$34,316,885

Aggregate of All Classes

Lode-gold mining	$79,157,840
Silver-lead-zinc mining and smelting	529,395,282
Copper-mining	49,970,647
Coal-mining	34,316,885
Miscellaneous, structural, and placer gold	12,044,533
Total	$704,885,187

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	Process Supplies
Lode-mining	33,311,121	$4,051,311	$16,069,452
Placer-mining	4,929	....	410
Fuel—coal, coke and gas plant	3,326,430	324,907	442,922
„ —petroleum and natural gas	2,004,386[1]	194,939[1]	1,943,299[1]
Miscellaneous metals and industrial minerals	6,571,078	1,245,469	2,066,063
Structural materials industry	5,521,260	2,018,102	974,766
Totals	**50,739,204**	**$7,834,728**	**$21,496,912**
Totals, 1959	$49,961,996	$7,677,821	$17,371,638
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	21,849,690	3,066,311	6,845,330
1936	17,887,619	2,724,144	4,484,501
1935	16,753,367	2,619,639	4,552,730
Grand totals, 1935–60	*$964,508,710*	*$168,794,570*	*$350,728,193*

[1] Figures for the petroleum and natural-gas industry are based on returns made on Dominion Bureau of Statistics forms by twenty-eight operators out of fifty-three listings. The sum of the expenditures by those operators for salaries and wages, fuel and electricity, and process supplies amounts to $4,142,624. The Canadian Petroleum Association supplied figures indicating total expenditures by the petroleum and natural-gas industry in *British Columbia in 1960, amounting to $56,988,000. Of this sum, approximately $3,960,000 is indicated as for* salaries and wages; no figures are given for fuel and electricity or process supplies. The total expenditure includes large items for geological and geophysical exploration, drilling, pipe-lines, construction, and capital expenditures, presumably done mainly by contractors and therefore not reflected in the figure $4,142,624 derived from individual returns. It should be noted that the $56,988,000 includes some $13,260,000 for land acquisition and rentals, natural-gas plants, and pipe-line construction. Comparable expenditures by other branches of the mineral industry are not shown in the above tabulation. *See* last paragraph of review, page A 13.

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

TABLE XII.—AVERAGE NUMBER EMPLOYED IN THE MINING INDUSTRY,[1] 1901–60

Year	Placer-mining	Lode-mining			In Concentrators	In Smelters	Coal-mining			Structural Materials		Industrial and Miscellaneous	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	....	2,358	1,680	4,038	....	....	3,894	1,524	5,418	....	....	....	9,451
1925	....	2,298	2,840	5,138	....	....	3,828	1,615	5,443	....	....	....	10,581
1926	209	2,606	1,735	4,341	808	2,461	3,757	1,565	5,822	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	1,871	3,603	1,818	5,421	1,168	3,027	2,286	867	3,153	724	327	938	16,129
1938	1,303	3,849	2,266	6,115	919	3,158	2,088	874	2,962	900	295	369	16,021
1939	1,252	3,905	2,050	5,955	996	3,187	2,167	809	2,976	652	311	561	15,890
1940	1,004	3,923	2,104	6,027	1,048	2,944	2,175	699	2,874	827	334	647	15,705
1941	939	3,901	1,823	5,724	1,025	3,072	2,229	494	2,723	766	413	422	15,084
1942	489	2,920	1,504	4,424	960	3,555	1,892	468	2,360	842	378	262	13,270
1943	212	2,394	1,699	4,093	891	2,835	2,240	611	2,851	673	326	567	12,448
1944	255	1,896	1,825	3,721	849	2,981	2,150	689	2,839	690	351	628	12,314
1945	209	1,933	1,750	3,683	822	2,834	1,927	503	2,430	921	335	586	11,820
1946	347	1,918	1,817	3,735	672	2,813	1,773	532	2,305	827	555	679	11,933
1947	360	3,024	2,238	5,262	960	3,461	1,694	731	2,425	977	585	869	14,899
1948	348	3,143	2,429	5,572	1,126	3,884	1,594	872	2,466	1,591	656	754	16,397
1949	303	3,034	2,724	5,758	1,203	3,763	1,761	545	2,306	2,120	542	626	16,621
1950	327	3,399	2,415	5,814	1,259	3,759	1,745	516	2,261	1,916	616	660	16,612
1951	205	3,785	3,695	7,480	1,307	4,044	1,462	463	1,925	1,783	628	491	17,863
1952	230	4,171	3,923	8,094	1,516	4,120	1,280	401	1,681	1,530	557	529	18,257
1953	132	3,145	2,589	5,734	1,371	3,901	1,154	396	1,550	1,909	559	634	15,790
1954	199	2,644	2,520	5,164	1,129	3,119	1,076	358	1,434	1,861	638	584	14,128
1955	103	2,564	2,553	5,117	1,091	3,304	1,100	378	1,478	1,646	641	722	14,102
1956	105	2,637	2,827	5,464	1,043	3,339	968	398	1,366	1,598	770	854	14,539
1957	67	2,393	2,447	4,840	838	3,328	1,020	360	1,380	1,705	625	474	13,257
1958	75	1,919	1,809	3,728	625	3,081	826	260	1,086	1,483	677	446	11,201
1959	99	1,937	1,761	3,698	618	3,008	765	291	1,056	1,357	484	459	10,779
1960	**86**	**1,780**	**1,890**	**3,741**	**648**	**3,034**	**894**	**288**	**1,182**	**1,704**	**557**	**599**	**11,541**

[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.

TABLE XIII.—LODE-METAL MINES—TONNAGE, NUMBER OF MINES, NET AND GROSS VALUE,[4] 1901–60

Year	Tonnage[1]	Number of Shipping Mines	Number of Mines Shipping over 100 Tons	Gross Value as Reported by Shipper[2]	Freight and Treatment[2]	Net Value to Shipper[3]	Gross Value of Lode Metals Produced[4]
1901	926,162	119	78	....	....	....	$13,287,947
1902	1,009,016	124	75	....	....	....	11,136,162
1903	1,288,466	125	74	....	....	....	11,579,382
1904	1,461,609	142	76	....	....	....	12,309,035
1905	1,706,679	146	79	....	....	....	15,180,164
1906	1,963,872	154	77	....	....	....	17,484,102
1907	1,805,614	147	72	....	....	....	16,222,097
1908	2,083,606	108	59	....	....	....	14,477,411
1909	2,057,713	89	52	....	....	....	14,191,141
1910	2,216,428	83	50	....	....	....	13,228,731
1911	1,770,755	80	45	....	....	....	11,454,063
1912	2,688,532	86	51	....	....	....	17,662,766
1913	2,663,809	110	58	....	....	....	17,190,838
1914	2,175,971	98	56	....	....	....	15,225,061
1915	2,720,669	132	59	....	....	....	19,992,149
1916	3,229,942	169	81	....	....	....	31,483,014
1917	2,797,368	193	87	....	....	....	26,788,474
1918	2,912,516	175	80	....	....	....	27,595,278
1919	2,146,920	144	74	....	....	....	19,756,648
1920	2,215,445	121	60	....	....	....	19,451,725
1921	1,586,428	80	35	....	....	....	12,925,448
1922	1,592,163	98	33	....	....	....	19,228,257
1923	2,447,672	77	28	....	....	....	25,348,399
1924	3,413,912	86	37	....	....	....	35,538,247
1925	3,849,269	102	40	....	....	....	46,200,135
1926	4,775,327	138	55	....	....	$38,558,613	51,508,031
1927	5,416,411	132	52	....	....	27,750,364	44,977,082
1928	6,241,672	110	49	....	....	29,070,075	48,281,825
1929	6,977,903	106	48	....	....	34,713,887	51,720,436
1930	6,804,276	68	32	....	....	21,977,688	41,292,980
1931	5,549,622	44	22	....	....	10,513,931	22,900,229
1932	4,354,904	75	29	....	....	7,075,393	19,705,043
1933	4,063,775	109	47	....	....	13,976,358	25,057,007
1934	5,141,744	145	69	....	....	20,243,278	34,071,955
1935	4,927,204	177	72	....	....	25,407,914	40,662,633
1936	4,381,173	168	70	....	....	30,051,207	43,813,898
1937	6,145,244	185	118	$48,617,920	$4,663,843	43,954,077	62,950,536
1938	7,377,117	211	92	40,222,237	4,943,754	35,278,483	53,878,093
1939	7,212,171	217	99	45,133,788	4,416,919	40,716,869	53,554,092
1940	7,949,736	216	92	50,004,909	6,334,611	43,670,298	61,735,604
1941	8,007,987	200	96	52,354,870	5,673,048	46,681,822	62,607,882
1942	6,894,844	126	76	50,494,041	5,294,637	45,199,404	59,694,192
1943	5,786,864	48	32	37,234,070	3,940,367	33,293,703	52,651,868
1944	4,879,851	51	31	29,327,114	2,877,706	26,449,408	39,369,738
1945	4,377,722	36	27	34,154,917	2,771,292	31,383,625	48,724,001
1946	3,705,594	50	32	48,920,971	2,904,130	46,016,841	56,653,485
1947	5,011,271	75	33	81,033,093	4,722,010	76,311,087	93,124,847
1948	5,762,321	97	51	118,713,859	18,585,183	100,128,727	121,696,891
1949	6,125,460	118	54	99,426,678	19,613,185	79,814,604	107,775,413
1950	6,802,482	112	58	108,864,792	22,113,431	86,751,361	113,464,619
1951	6,972,400	119	64	142,590,427	25,096,743	117,493,684	147,646,989
1952	9,174,617	95	58	140,070,389	30,444,575	106,601,451	144,151,515
1953	9,660,281	80	48	94,555,069	27,815,152	66,739,892	123,619,837
1954	8,513,865	63	40	106,223,833	29,135,673	77,088,160	120,829,789
1955	9,126,902	53	34	119,039,285	30,696,044	88,343,241	138,145,095
1956	8,827,037	70	40	125,043,590	31,933,681	93,110,262	143,546,586
1957	7,282,436	59	40	95,644,930	30,273,900	65,370,185	119,409,764
1958	6,402,198	57	28	83,023,111	28,068,396	54,955,069	100,591,049
1959	6,990,985	60	44	92,287,277	27,079,911	65,208,728	100,549,519
1960	**8,242,703**	**67**	**31**	**114,852,061**	**29,505,158**	**85,346,923**	**125,674,531**

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

[2] Data not collected before 1937.

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

[4] Gross value calculated by valuing gold, silver, copper, lead, zinc, mercury (1938–44, 1955), and nickel (1936–37, 1958–60) at yearly average prices, and iron (1901–03, 1907, 1918–23, 1928, 1948–60) and tungsten (1939–45, 1947–58) at values given by operators.

TABLE XIV.—LODE-METAL PRODUCTION IN 1960

Property or Operator	Location of Mine	Owner or Agent	Ore Shipped or Treated	Product Shipped	Gross Metal Contents					
					Gold	Silver	Copper	Lead	Zinc	Cad-mium
NORTHERN BRITISH COLUMBIA			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Atlin Mining Division										
Cornucopia (Benroy)	McDame Creek	J. J. Copeland and J. J. Couture, Whitehorse, Y.T.	25	Bullion	34	3	—	—	—	—
Liard Mining Division										
Nil			—		—	—	—	—	—	—
CENTRAL BRITISH COLUMBIA										
Cariboo Mining Division										
Cariboo Gold Quartz and Aurum	Wells	The Cariboo Gold Quartz Mining Co. Ltd., Vancouver	39,113	Bullion	19,555	2,732	—	—	—	—
Clinton Mining Division										
Nil			—		—	—	—	—	—	—
Omineca Mining Division										
Cronin Babine	Smithers	Lessees from New Cronin Babine Mines Ltd., Vancouver	1,015	Lead concentrates, 79 tons; zinc concentrates, 66 tons	16	9,054	—	91,720	76,002	948
Silver Standard	Hazelton	J. Gallo, lessee from Silver Standard Mines Ltd., Vancouver	37	Crude ore	6	5,208	737	11,422	12,306	—
COAST AND ISLANDS										
Alberni Mining Division										
Tofino	Tranquil Inlet	Tofino Mines Ltd., Vancouver	53	Bullion	15	2	—	—	—	—
Nanaimo Mining Division										
Merry Widow No. 5 and Kingfisher	Benson Lake	Empire Development Co. Ltd., Vancouver	1,046,989	Iron concentrates, 453,563 tons	—	—	—	—	—	—
Nimpkish	Beaver Cove	Nimpkish Iron Mines Ltd., Vancouver	479,250	Iron concentrates, 283,083 tons	—	—	—	—	—	—

TABLE XIV.—LODE-METAL PRODUCTION IN 1960—*Continued*

Property or Operator	Location of Mine	Owner or Agent	Ore Shipped or Treated	Product Shipped	Gross Metal Contents: Gold	Silver	Copper	Lead	Zinc	Cadmium
			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
COAST AND ISLANDS—*Continued*										
Nanaimo Mining Division—Continued										
Prescott, Paxton, Yellow Kid, Yellow Jacket	Texada Island	Texada Mines Ltd., Vancouver	867,736	Iron concentrates, 419,651 tons; copper concentrates, 7,927 tons	1,517	33,181	1,958,743	....	....	....
New Westminster Mining Division										
Pride of Emory	Choate	Giant Nickel Mines Ltd., Hope	250,261	Bulk nickel and copper concentrates, 19,995 tons	....	....	1,578,312	....	....	....
Skeena Mining Division										
Silbak Premier	Premier	Silbak Premier Mines Ltd., Vancouver; Bermah Mines Ltd., lessees, Vancouver; F. W. Robinson, c/o Silbak Premier Mines Ltd., Vancouver	1,282	Crude ore	7,548	203,570	16,258	118,326	201,318	....
Vancouver Mining Division										
Britannia	Britannia Beach	Howe Sound Co. (Britannia Division), Britannia Beach	409,751	Copper concentrates and precipitates, 29,224 tons; zinc concentrates, 10,121 tons; tailings, 58,767 tons	8,590	77,991	18,203,368	419,598	12,215,595	47,236
Victoria Mining Division										
Blue Grouse	Cowichan Lake	Cowichan Copper Co. Ltd., Lake Cowichan	66,419[1]	Copper concentrates, 4,901 tons	....	14,802	2,534,673	....	....	....
Nadira	Nitinat	Nadira Mines Ltd., Vancouver	5,142	Crude ore; milled at Cowichan Copper and produced 261 tons of concentrates	....	....	136,530	....	....	....
SOUTH CENTRAL BRITISH COLUMBIA										
Greenwood Mining Division										
Bounty Fraction	Beaverdell	Sheritt Lee Mines Ltd., Vancouver	12	Crude ore	1	1,221	....	1,085	2,218	....
Brooklyn-Stemwinder	Greenwood	Continental Consolidated Mines Ltd., Vancouver	905	Crude ore	30	196	19,028	....	....	....
Cariboo-Amelia	Rock Creek	McKinney Gold Mines Ltd., Vancouver	4,370	Siliceous ore	5,204	6,830	....	65,545	65,479	....

			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Highland-Bell	Beaverdell	Highland-Bell Ltd., Vancouver	18,204	Lead concentrates, 1,903 tons; zinc concentrates, 872 tons; jig concentrates, 231 tons	570	903,614	—	856,522	1,183,460	8,372
Mother Lode	Greenwood	Consolidated Woodgreen Mines Ltd., Vancouver	201,497	Copper concentrates	5,273	17,850	2,326,276	—	—	—
Phoenix	Greenwood	Phoenix Copper Co. Ltd., Grand Forks	346,638	Copper concentrates, 10,728 tons (includes 2,344 tons from 1959 stockpile and shipped in 1960)	7,782	48,768	5,118,943	—	—	—
Providence	Greenwood	S. J. Kleman, Greenwood	5	Crude ore	2	541	—	224	168	—
Silver Scandie	Beaverdell	Silver Scandie Mines Ltd., Beaverdell	6	Crude ore	—	350	—	451	840	—
Kamloops Mining Division										
Gift	Kamloops	Burns & Dutton Concrete and Construction Co. Ltd., Richmond	4,055	Crude iron ore	—	—	—	—	—	—
Lillooet Mining Division										
Bralorne	Bridge River	Bralorne Pioneer Mines Ltd. (Bralorne Division), Vancouver	153,482	Bullion; gold concentrates, 3,409 tons	114,116	23,908	—	—	—	—
Pioneer	Bridge River	Bralorne Pioneer Mines Ltd. (Pioneer Division), Vancouver	50,163	Bullion	26,971	5,397	—	—	—	—
Nicola Mining Division										
Aberdeen	Merritt	Torwest Resources Ltd., Vancouver	37	Crude ore	—	18	5,800	—	—	—
Osoyoos Mining Division										
Fairview	Oliver	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	24,573	Silica flux	—	—	—	—	—	—
French	Hedley	French Mines Ltd., Vancouver	13,553	Bullion	6,373	319	—	—	—	—
Golconda	Keremeos	Keremeos Mines Ltd., Olalla	1,500[1]	Molybdenite (MoS_2) concentrates; copper concentrates, 141 tons	2	460	61,060	1,406	—	—
Susie	Oliver	W. J. Cudworth, Penticton, lessee from American Smelting & Refining Co., Wallace, Ida.	508	Siliceous ore	60	1,077	—	1,527	1,017	—
Similkameen Mining Division										
Copper Mountain	Copper Mountain	H.G. Mining Co. Ltd. and The Granby Mining Co. Ltd., Vancouver	41	Crude ore; clean-up material, 26 tons	538	235	18,218	—	—	—
Vernon Mining Division										
Rex 86	Kelowna	R. Bruch and J. B. van Gundy, Kelowna	—	Tailings	1	1	—	4	4	—

[1] Estimated.

TABLE XIV.—LODE-METAL PRODUCTION IN 1960—*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										
Fort Steele Mining Division										
Sullivan	Kimberley	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	2,522,554	Lead concentrates, 184,916 tons; zinc concentrates, 233,017 tons; tin concentrates, 482 tons	362	5,283,170	784,200	273,008,000	234,130,000	......
Golden Mining Division										
Mineral King	Toby Creek	Sheep Creek Mines Ltd., Nelson	195,702	Lead concentrates, 7,155 tons; zinc concentrates, 14,873 tons	......	198,636	173,810	9,531,057	16,980,049	43,441
Nelson Mining Division										
Euphrates	Apex	L. Soukeroff and B. Logan, Nelson	11	Crude ore	6	68	......	344	206	......
Gold Belt	Salmo	A. Endersby, Fruitvale	143	Crude ore	57	51	......	603	645	......
Goodenough	Ymir	E. R. Nilson, Ymir	11	Crude ore	4	11	......	257	364	......
H.B.	Salmo	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	464,408	Lead concentrates, 5,595 tons; zinc concentrates, 34,347 tons	......	72,158	......	7,917,580	38,718,480	328,523
Hummingbird	Taghum	Carter-Logan-Holmes, c/o W. L. Carter, Nelson	22	Mill clean-up	......	55	......	788	2,146	......
Jersey	Salmo	Canadian Exploration Ltd., Vancouver	364,424	Lead concentrates, 5,769 tons; zinc concentrates, 25,103 tons	......	27,054	......	9,664,738	29,499,477	228,530
Kenville (White Lease)	Nelson	D. H. Norcross, Nelson	12	Crude ore	19	16	......	70	47	......
Kootenay Belle	Salmo	M. M. Arishenkoff, Shoreacres	4,377	Siliceous ore; tailings, 12 tons	151	513	......	10,577	10,054	......
New Arlington	Erie	G. D. Fox, Trail	52	Crude ore	37	105	......	1,776	2,194	......
Reeves MacDonald	Remac	Reeves MacDonald Mines Ltd., Vancouver	411,282	Lead concentrates, 2,547 tons; zinc concentrates, 22,653 tons	......	25,231	......	3,694,962	24,793,300	159,851
Revelstoke Mining Division										
Mastodon	Revelstoke	Mastodon Zinc Mines Ltd., Vancouver	15,532	Zinc concentrates, 2,062 tons	8	3,010	......	97,778	2,478,430	12,141
Slocan Mining Division										
Anna	Slocan	Silver King Mines Ltd., Vancouver	4	Crude ore	......	757	......	34	13	......
Banker	Ainsworth	P. Gilchrist and C. Hartland, Ainsworth	57	Crude ore	......	1,134	......	67,685	3,861	......

			Tons		Oz.	Oz.	Lb.	Lb.	Lb.	Lb.
Bluebell	Riondel	The Consolidated Mining & Smelting Co. of Canada, Ltd., Trail	255,571	Lead concentrates, 17,251 tons; zinc concentrates, 29,554 tons	......	354,397	368,000	25,688,460	29,904,260	141,387
Bosun	Silverton	W. H. McLeod, Silverton	14	Crude ore	......	326	——	1,062	4,566	......
Crow Fledgling	Ainsworth	T. Lane, Ainsworth	125	Crude ore	......	246	——	14,514	6,534	21
Empire (Rusty No. 2)	Kaslo	E. Muller and E. Augustine, Kaslo	35	Crude ore	1	300	——	9,725	9,655	......
Highlander	Ainsworth	T. G. Laughton, lessee from Yale Lead & Zinc, Toronto	4,325	Lead concentrates, 357 tons; zinc concentrates, 164 tons; crude ore, 25 tons	3	8,879	——	565,213	186,693	868
Kootenay Florence	Ainsworth	M. B. Sirak, lessee from Western Mines Ltd., Ainsworth	590	Lead concentrates, 138 tons; zinc concentrates, 96 tons	......	3,392	——	191,688	94,155	......
Krao	Ainsworth	T. Lane, Ainsworth	64	Lead concentrates, 3 tons; zinc concentrates, 3 tons; crude ore, 4 tons	......	169	——	6,535	3,129	13
Laura M.	Ainsworth	M. B. Sirak, Ainsworth	539[1]	Lead concentrates, 45 tons; zinc concentrates, 32 tons	......	1,064	——	63,242	33,536	141
Lone Bachelor	Sandon	E. Perepolkin, lessee, Hills	698	Lead concentrates, 93 tons; zinc concentrates, 120 tons; crude ore, 83 tons	8	21,969	——	249,345	159,366	891
Millie Mack	Burton	W. Isaacs and J. Figner, Burton	14	Crude ore	6	137	——	669	362	......
Ottawa	Slocan	Skylane Mines Ltd., Slocan	14	Crude ore	......	2,966	——	189	94	......
Ruth Hope	Sandon	E. H. Petersen, Sandon	2	Crude ore	......	187	——	2,130	78	......
Shirley	Kootenay Bay	F. W. Stainton, Trail	1	Crude ore	......	16	——	346	57	......
Silver Mountain	Sandon	Silver Mountain Mines Ltd. (and Reco Leasers), Sandon	115[1]	Lead concentrates, 10 tons; zinc concentrates, 13 tons	......	1,036	——	13,876	14,154	86
Utica	Kaslo	Lajo Mines Ltd., Kaslo	4,000[1]	Lead concentrates, 93 tons; zinc concentrates, 132 tons	2	34,872	——	68,376	123,858	817
Victor	Sandon	Violamac Mines Ltd., New Denver	6,227	Lead concentrates, 481 tons; zinc concentrates, 1,030 tons	104	99,176	——	675,045	1,214,182	8,252
Western Mines	Ainsworth	Western Mines Ltd., Ainsworth	......	Thickener clean-up: Lead concentrates, 16 tons; zinc concentrates, 20 tons	......	299	——	17,722	19,083	108
Wonderful	Sandon	E. H. Petersen, Sandon	2	Crude ore	......	191	——	2,376	62	......
Yale Mill	Ainsworth	Yale Lead & Zinc Mines Ltd., Ainsworth	367	Mill clean-up: Lead concentrates, 39 tons; zinc concentrates, 27 tons	......	1,038	——	48,916	32,761	124
Trail Creek Mining Division										
I.X.L.	Rossland	J. A. Ruelle, Rossland	0.04	High-grade ore	19	4	——	——	——	——
Velvet	Rossland	Mid-West Copper & Uranium Mines Ltd., Vancouver; lessees, Velvet Leasers, Rossland	4,264	Concentrates, 308 tons	355	1,066	146,171	——	——	——
W.D.	Trail	W.D. Mining Co. Ltd., Trail	30	Crude ore	21	3	——	60	60	......

[1] Estimated.

TABLE XV.—LODE-METAL MINES EMPLOYING AN AVERAGE OF TEN OR MORE PERSONS DURING 1960[1]

Name of Mine or Operator	Days Operating		Tons		Average Number Employed	
	Mine	Mill	Mined	Milled	Mine	Mill
Shipping Mines						
Cariboo Gold Quartz Mining Co. Ltd.	284	365	39,113	39,113	102	9
Sullivan (Cons. M. & S. Co. of Canada Ltd.)	253	254	2,522,554	2,522,554	933	323
Mineral King (Sheep Creek Mines Ltd.)	308	360	195,702	195,702	87	11
McKinney Gold Mines Ltd.	260	—	4,370	—	15	—
Highland-Bell Ltd.	240	274	18,204	18,204	41	5
Mother Lode (Consolidated Woodgreen Mines Ltd.)	357	357	201,497	201,497	20	18
Phoenix Copper Co. Ltd.	365	365	346,638	346,638	44	12
Bralorne Pioneer Mines Ltd. (Bralorne Division)	365	334	153,482	153,482	366	24
Bralorne Pioneer Mines Ltd. (Pioneer Division)	242	242	50,163	50,163	99	14
H.B. (Cons. M. & S. Co. of Canada Ltd.)	366	366	464,408	464,408	108	13
Jersey (Canadian Exploration Ltd.)	366	366	364,424	364,424	153	10
Reeves MacDonald Mines Ltd.	252	356	411,282	411,282	96	25
French Mines Ltd.	282	366	13,553	13,553	14	8
Mastodon-Highland Bell Mines Ltd.	124	109	15,532	15,532	29	4
Bluebell (Cons. M. & S. Co. of Canada Ltd.)	253	356	255,571	255,571	165	18
Victor (Violamac Mines Ltd.)	365	—	6,227	—	20	—
Howe Sound Co. (Britannia Division)	280	281	409,751	409,751	165	18
Blue Grouse (Cowichan Copper Co. Ltd.)	258	219	66,419	66,419	44	9
Giant Nickel Ltd.	365	365	250,261	250,261	137	22
Empire Development Co. Ltd. and Mannix Co. Ltd. (Iron Production Division)	245	226	1,046,989	1,046,989	110	10
Nimpkish Iron Mines Ltd.	310	310	479,250	479,250	36	38
Texada Mines Ltd.	296	347	869,873	867,736	197	37
Non-shipping Mines						
Craigmont Mines Ltd. and Kie Mine Co. Ltd.	—	—	—	—	115	—
Duncan Group (Cons. M. & S. Co. of Canada Ltd.)	—	—	—	—	22	—
Noranda Exploration Co. Ltd.	—	—	—	—	30	—
Kennco Explorations Ltd.	—	—	—	—	40	—
Newmont Mining Corporation of Canada Ltd.	—	—	—	—	22	—

[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.

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 the *Placer-mining Act,* administer these Acts and other Acts relating to mining. Mining Recorders, in addition to their own functions, may also exercise the powers conferred upon Gold Commissioners with regard to mineral claims within the mining division for which they have been appointed. Similar duties may be performed by Mining Recorders with regard to placer claims but not in respect of placer-mining leases. Recording of location and of work upon a mineral claim as required by the *Mineral Act* and upon a placer claim or a placer-mining lease as required by the *Placer-mining Act* must be made at the office of the Mining Recorder for the mining division in which the claim or lease is located. Information concerning claims and leases and concerning the ownership and standing of claims and leases in any mining division may be obtained from the Mining Recorder for the mining division in which the property is situated or from the Department's offices at Victoria, and Room 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 58.

Central Records Offices (Victoria and Vancouver)

The transcripts of all recordings made in Mining Recorders' offices throughout the Province are sent to the office of the Chief Gold Commissioner in Victoria twice each month, and include the names of lessees of reverted surveyed mineral claims. These records and maps showing the approximate positions of mineral claims held by record and of placer-mining leases may be consulted by the public during office hours at Victoria and at the office of the Gold Commissioner at Vancouver, Room 101, 739 West Hastings Street. The maps conform in geographical detail, size, and number to the reference and mineral reference maps issued by the Legal Surveys Branch of the Department of Lands and Forests, and the approximate positions of mineral claims held by record and of placer-mining leases are plotted from details supplied by the locators. Provision has been made to supply the general public, on request to the office of the Chief Gold Commissioner, with copies of the maps. The charge for these maps is $1 plus 5 per cent tax for each sheet.

List of Gold Commissioners and Mining Recorders in the Province

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

Gold Commissioners' and Mining Recorders' Office Statistics, 1960

Mining Division	Free Miners' Certificates		Lode-mining						Placer-mining					Revenue		
	Individual	Company	Mineral Claims Recorded	Certificates of Work	Cash in Lieu	Certificates of Improvements	Bills of Sale, etc.	Mineral Leases	Placer Claims Recorded	Placer Leases Granted	Certificates of Work	Cash in Lieu	Bills of Sale, etc.	Free Miners' Certificates	Mining Receipts	Total
Alberni	106	2	893	316	$2,700.00	—	105	4	2	1	6	—	—	$730.00	$7,329.25	$8,059.25
Atlin	144	3	278	113	900.00	—	11	5	8	7	57	$2,000.00	7	970.00	8,262.00	9,232.00
Cariboo	773	16	541	709	900.00	—	49	3	4	96	371	2,000.00	52	5,207.00	26,565.75	31,772.75
Clinton	48	—	187	112	1,300.00	—	102	1	—	1	9	—	8	240.00	3,155.50	3,395.50
Fort Steele	182	2	304	228	1,900.00	—	28	1	—	12	36	500.00	5	1,115.00	5,884.00	6,999.00
Golden	124	3	160	483	1,500.00	—	28	—	—	11	34	—	10	920.00	4,023.25	4,943.25
Greenwood	106	3	834	604	900.00	—	67	22	—	1	9	—	—	832.00	8,576.50	9,408.50
Kamloops	333	2	1,873	1,359	1,300.00	—	149	3	1	2	7	—	10	1,820.00	10,817.00	12,637.00
Liard	318	1	570	645	3,600.00	—	66	—	—	10	50	—	—	1,746.50	9,464.25	11,210.75
Lillooet	207	4	590	392	700.00	—	39	7	—	28	22	250.00	21	1,385.00	6,884.50	8,269.50
Nanaimo	116	2	241	435	5,440.00	—	67	—	1	11	—	—	9	680.00	8,013.00	8,693.00
Nelson	286	9	325	399	1,300.00	—	29	6	1	4	12	—	—	2,185.00	3,622.25	5,807.25
New Westminster	313	2	406	214	5,000.00	—	141	1	—	7	28	500.00	6	1,787.00	8,615.75	10,402.75
Nicola	43	—	965	964	300.00	4	72	5	—	—	—	—	—	215.00	6,011.00	6,226.00
Omineca	245	2	503	745	3,400.00	31	54	5	3	26	63	750.00	22	1,375.00	13,834.75	15,209.75
Osoyoos	162	3	298	254	1,100.00	—	18	1	—	—	—	—	—	1,010.00	2,703.20	3,713.20
Revelstoke	97	6	235	210	2,800.00	4	22	1	—	10	26	—	19	1,180.00	6,471.25	7,651.25
Similkameen	107	3	360	691	5,000.00	—	71	3	1	8	19	—	8	785.00	10,230.50	11,015.50
Skeena	213	2	1,158	2,266	4,400.00	—	68	10	—	—	1	—	—	1,215.00	15,705.00	16,920.00
Slocan	142	2	356	815	200.00	—	30	17	—	—	—	—	—	915.00	4,759.00	5,674.00
Trail Creek	89	2	28	18	—	—	3	1	1	1	—	250.00	1	651.00	478.25	1,129.25
Vancouver	1,513	175	245	634	2,000.00	—	26	3	—	—	1	—	—	22,975.00	4,620.50	27,595.50
Vernon	216	—	120	81	400.00	—	87	1	8	10	52	—	11	1,100.00	2,260.00	3,360.00
Victoria	298	29	278	470	500.00	—	32	—	—	2	8	—	—	4,372.00	3,909.75	8,281.75
Totals for Province, 1960	6,181	273	11,748	13,157	$47,540.00	39	1,364	100	30	248	811	$6,250.00	189	$55,410.50	$182,196.20	$237,606.70
Totals for Province, 1959	6,743	278	13,455	13,818	$54,615.00	409	1,729	101	31	321	813	$10,875.00	218	$54,245.50	$203,377.80	$257,623.30

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, 1960

Licences—		
Fees	$725.00	
Rental	9,897.95	
		$10,622.95
Leases—		
Fees	$100.00	
Rental	343.95	
Cash in lieu of work	400.00	
		843.95
		$11,466.90

Acreage of Crown Petroleum and Natural-gas Rights Held

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Petroleum and natural-gas permits (acres)	754,288	1,848,407	4,186,269	10,601,910	21,755,799	36,193,672	31,423,767	26,157,897	26,308,127	27,760,553	28,240,628	29,531,092	45,954,755	32,572 749
Petroleum and natural-gas leases (acres)	—	—	—	—	—	—	—	—	281,489	434,274	1,228,357	3,310,423	4,086,032	5,354,823
Natural-gas licences (acres)	—	—	—	—	—	—	—	—	—	—	—	50,084	190,718	372,492
Natural-gas leases (acres)	—	—	—	—	—	—	—	—	—	—	—	153,842	203,917	330,608
Drilling reservations (acres)	—	—	—	—	—	—	—	—	—	—	—	44,734	271,920	541,885
Petroleum leases (acres)	—	—	—	—	—	—	—	—	—	—	—	1,284	3,853	2,568
Totals	754,288	1,848,407	4,186,269	10,601,910	21,755,799	36,193,672	31,423,767	26,157,897	26,589,616	28,194,827	29,468,985	33,091,459	50,711,195	39,175,125

Petroleum and Natural-gas Revenue

	1947/48[1]	1948/49[1]	1949/50[1]	1950/51[1]	1951/52[1]	1952/53[1]	1953/54[1]	1954	1955	1956	1957	1958	1959	1960	Cumulative, 1947–60
Rentals and Fees															
Permits	$18,392	$124,064	$257,974	$886,556	$2,232,977	$2,241,364	$2,576,133	$2,425,599	$3,465,295	$2,773,067	$2,737,989	$3,307,732	$3,000,337	$3,202,923	$29,250,402
Drilling reservations	—	—	—	—	—	—	—	—	—	—	—	5,147	76,115	136,945	218,207
Natural-gas licences	—	—	—	—	—	—	—	—	—	—	—	10,157	4,521	29,648	44,326
Petroleum, natural-gas, and petroleum and natural-gas leases	—	—	—	—	—	—	—	1,147	78,288	122,157	430,177	990,383	1,695,153	3,339,790	6,657,095
Total rentals	$18,392[1]	$124,064[1]	$257,974[1]	$886,556[1]	$2,232,977[1]	$2,241,364[1]	$2,576,133[1]	$2,426,746	$3,543,583	$2,895,224	$3,168,166	$4,313,419	$4,776,126	$6,709,306	$36,170,030
Sale of Crown Reserves															
Permits	—	—	—	—	—	—	—	$788	$605,307	$1,614,325	$1,342,813	$4,144,059	$3,486,337	$1,650,324	$12,843,953
Drilling reservations	—	—	—	—	—	—	—	—	—	—	—	72,370	1,004,711	2,136,105	3,213,186
Leases	—	—	—	—	—	—	—	—	—	—	—	293,694	6,499,766	2,400,198	9,193,658
Total Crown reserve sales	—	—	—	—	—	—	—	$788	$605,307	$1,614,325	$1,342,813	$4,510,123	$10,990,814	$6,186,627	$25,250,797
Royalties															
Gas	—	—	—	—	—	—	—	$761	$2,612	$2,826	$7,264	$433,546	$492,053	$912,102	$1,851,164
Oil	—	—	—	—	—	—	—	—	17	37,196	104,569	140,158	231,403	219,156	732,499
Processed products	—	—	—	—	—	—	—	—	—	—	—	62,105	69,998	76,059	208,162
Total royalties	—	—	—	—	—	—	—	$761	$2,629	$40,022	$111,833	$635,809	$793,454	$1,207,317	$2,791,825
Miscellaneous fees	—	—	—	—	—	—	—	$3,604	$12,392	$12,428	$10,027	$12,870	$14,722	$13,220	$79,263
Total petroleum and natural-gas revenue	$18,392[1]	$124,064[1]	$257,974[1]	$886,556[1]	$2,232,977[1]	$2,241,364[1]	$2,576,133[1]	$2,431,899	$4,163,911	$4,561,999	$4,632,839	$9,472,221	$16,575,116	$14,116,470	$64,291,915

[1] Administered under the *Department of Lands and Forests* until March 31st, 1953. Details of revenue are not available by calendar years; total revenues are shown under permits and by fiscal years ending March 31st.

ANALYTICAL AND ASSAY BRANCH

By S. W. Metcalfe, Chief Analyst and Assayer

Rock Samples

During 1960 the chemical laboratory in Victoria issued reports on 1,842 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)	1,232	1,210	3,075
Prospectors (grantees)	343	343	915
Departmental engineers	267	104	629
Totals	1,842	1,657	4,619

Samples submitted to the laboratory for identification are examined by the Mineralogical Branch of the Department. During the year such samples numbered 108.

Petroleum and Natural-gas Samples

Reports were issued on 120 samples. Of this number, 111 were samples of formation water from wells being drilled for gas and oil in the Province; five were samples tested for oil; three were samples tested for natural gas; and one was a sample of animal excrement. One hundred and forty-one spectrographic analyses were reported on samples in this category.

Coal Samples

Reports were issued on sixty-three samples of coal submitted for proximate analysis and calorific value. Of this number, sixty-two were analysed for the Purchasing Commission and one for a prospector in the Province.

Miscellaneous Samples

Reports were issued on sixty-six samples of a miscellaneous nature.

For the British Columbia Research Council, spectrographic analyses were performed on nine samples.

For the Purchasing Commission, two spoons were compared for resistance to corrosion in common food materials.

For the Department of Agriculture, analyses were performed on two marls, two waters, and one sewage sludge. In addition, fluorine was determined in one sample of hay and in one chemical fertilizer.

* 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.

For the Department of Highways (Materials Testing Branch), four waters were analysed, and a scale from a highway tunnel was subjected to a spectrographic analysis as well as an X-ray powder diffraction analysis.

For the Department of Lands and Forests (Forest Research), spectrographic and chemical analyses were performed on twelve rock samples; ninety-six chemical analyses were performed.

For the Petroleum and Natural Gas Branch of the Department, spectrographic analyses were performed on a clay and an alloy.

For the Provincial Museum, a spectrographic analysis was performed on a Polyporus tuberaster. A metallic disk thought to be an old coin was subjected to an X-ray fluorescence analysis.

For the Queen's Printer, three type metals were spectrographed.

For British Columbia Hydro, a filter-clogging sediment was identified and a method for its removal suggested.

For Cassiar Asbestos Corporation Limited, a spectrographic analysis was performed on a coal ash.

For Bralorne Pioneer Mines Limited, spectrographic analyses were conducted on four rock samples.

Eighteen samples of water were examined, of which thirteen were for the Victoria and Esquimalt Health Department, three were for Oak Bay Municipality, and two were for citizens of the Province.

X-ray Powder Diffraction Analyses

Seventy analyses of this type were performed for identification purposes.

Examination for Assayers

A Provincial Government examination for certificates of competency and licence to practise assaying in British Columbia was held at Trail in December. The five candidates who were examined were successful in passing the 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
J. E. Merrett, Inspector and Resident Engineer	Vancouver
A. R. C. James, Inspector and Resident Engineer	Vancouver
J. D. McDonald, Inspector and Resident Engineer	Nelson
D. R. Morgan, Inspector and Resident Engineer	Fernie
David Smith, Inspector and Resident Engineer	Kamloops
W. C. Robinson, Inspector and Resident Engineer	Prince Rupert

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

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

Instructors, Mine-rescue Stations

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

Staff Changes

Joseph J. Haile retired on December 31st, 1960, after nineteen years' service as instructor at the Fernie mine-rescue station. He was replaced by Arthur Williams, who was transferred from the Cumberland station. W. High was appointed on a part-time basis for the Cumberland station.

Board of Examiners for Coal-mine Officials

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

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

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

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

Professional Staff

On December 31st, 1960, the professional staff included the following engineers classified as geologists or mineral engineers: H. Sargent, Chief of the Mineralogical Branch; M. S. Hedley, S. S. Holland, J. W. McCammon, N. D. McKechnie, G. E. P. Eastwood, J. T. Fyles, A. Sutherland Brown, J. M. Carr, W. G. Jeffery, W. C. Jones, A. F. Shepherd, and J. E. Hughes.

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 the editor for English, Mrs.

Rosalyn J. Moir. Messrs. Hedley and Holland assisted in directing and supervising field work. Most of the other members of the professional staff are assigned to mapping the geology of selected areas and of mineral deposits. Mr. McCammon is responsible for studies of industrial minerals and structural materials, and Mr. Shepherd for records and library.

Field Work

A. Sutherland Brown continued the geological mapping of the Queen Charlotte Islands. Mapping was done in parts of Graham and Moresby Islands accessible by road, and parts of Moresby Island reached from lakes to which the party was transported by aircraft.

J. M. Carr continued detailed geological studies in the Guichon batholith in the Highland Valley area, and of the Promontory Hills area and the Craigmont mine near Merritt.

G. E. P. Eastwood mapped an area on Lawless Creek and Tulameen River.

J. T. Fyles, assisted by Dr. Paul Clifford, began a detailed study of the geology of an area including the west side of Kootenay Lake from Coffee Creek north and the area north of Kootenay Lake including Duncan Lake.

S. S. Holland examined properties in Bridge River, Tweedsmuir Park, Cariboo-Wells, Telkwa-Hazelton, Terrace, Portland Canal, and Cariboo-Likely areas.

J. E. Hughes made a geological study of the Bullhead rock sequence in the Peace River Canyon area, and on the Pine River near Mount Bickford.

W. G. Jeffery began geological mapping of an area that includes the Empire iron mine and the Coast Copper property on northern Vancouver Island.

W. C. Jones spent the season examining and mapping sites for proposed dams on the Fraser, Clearwater, North Thompson, McGregor, and Stuart Rivers, and preliminary study of several sites on the Liard River.

J. W. McCammon examined and mapped industrial-mineral deposits in several parts of the Province, and examined and looked for limestone deposits in the Shuswap Lake-Okanagan Lake area and Rock Creek-Grand Forks area. Other deposits examined included gypsum in the East Kootenay, with special attention to the Lussier River area, a deposit of gypsum in the northwestern part of the Province near Rainy Hollow, deposits of barite and fluorite near Summit Lake and Liard Hotsprings on the Alaska Highway, and asbestos at Cassiar and King Mountain.

N. D. McKechnie examined and mapped lode-mineral properties in the southern Interior, including Hedley, Greenwood, Phoenix, and on Vancouver and Texada Islands.

PETROLEUM AND NATURAL GAS BRANCH

The Petroleum and Natural Gas Branch is responsible for the administration of the " Regulation Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas," made pursuant to the *Petroleum and Natural Gas Act, 1954*. The regulation provides for the use of efficient and safe practices in the drilling, completion, and abandonment of wells; for the orderly development of fields discovered within the Province; and for conservation and the prevention of waste of oil and natural gas within the reservoir and during production operations.

Investigations are made of complaints of property damage resulting from geophysical and test-hole drilling programmes. The " Geophysical Regulations " are administered by the Chief Petroleum and Natural Gas Commissioner.

Staff

J. D. Lineham, Chief of the Branch ... Victoria
R. R. McLeod, Senior Petroleum Engineer and member of the Board of Arbitration ... Victoria
A. N. Lucie-Smith, Senior Petroleum Engineer and Chairman of the Conservation Committee ... Victoria
W. L. Ingram, Petroleum Engineer ... Victoria
K. C. Gilbart, Petroleum Engineer ... Victoria
S. S. Cosburn, Geologist ... Victoria
D. L. Griffin, Geologist ... Victoria
D. M. Callan, Assistant Geologist[1] ... Victoria
T. A. Mackenzie, Statistician ... Victoria
P. K. Huus, Engineering Assistant ... Victoria
G. E. Blue, District Petroleum Engineer ... Charlie Lake
H. B. Fulton, Geologist ... Charlie Lake
G. V. Rehwald, Petroleum Engineer ... Charlie Lake
H. A. Sharp, Engineering Assistant ... Charlie Lake
M. A. Churchill, Engineering Assistant ... Charlie Lake

Staff Changes

There were no resignations from or additions to the professional or technical staff.

Staff increases were limited to one clerk for the Statistics and Well Records Section at Victoria and one building service worker for general duty at the new field office headquarters at Charlie Lake.

Administration

The Petroleum and Natural Gas Branch is subdivided for administrative purposes into five sections, each of which is headed by a supervisor who is responsible for a specific phase of Branch work. There is a field office at Charlie Lake. The sections and respective section heads are as follows: Reservoir Engineering, R. R. McLeod; Reserves and Evaluation, A. N. Lucie-Smith; Development Engineering, W. L. Ingram; Geology, S. S. Cosburn; Statistics and Well Records, T. A. Mackenzie; and Field Office, G. E. Blue.

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, responsible to the Minister of Mines and Petroleum Resources, held one hearing in 1960 at Fort St. John.

Three applications concerning right of entry came before the Board. Of these, one was settled by an award order of the Board and two were pending at the end of the year.

Conservation Committee

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

[1] On educational leave of absence from July 25th.

Although no major problems were referred to the Committee by the Minister of Mines and Petroleum Resources during 1960, it acted on several routine matters during the course of the year.

GRUB-STAKING PROSPECTORS

Under authority of the *Prospectors' Grub-stake Act* the Department 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.

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. 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 sixty 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 grant is usually made in two payments: the first at the beginning of the season and the second after he has completed sixty 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. Any discoveries made, staked, and recorded are exclusively the grantee's own property. 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 a grub-stake. 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 in order to take adequate care of medical and other expenditures which may be incurred in the event of an accident.

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

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

Seventy-seven applications were received in 1960, and fifty-two grub-stakes were authorized. Two of the grantees were unable to go out, and they returned their initial payments. Seven other grantees were unable to complete the terms and conditions of the grant and received only partial payment. Thirty-one prospectors were given grants for the first time, and five proved unsatisfactory. Five grantees used aircraft for transportation to their prospecting areas. Five grantees were affected by injury or sudden illness, but in each instance they were accompanied by a partner who was able to take care of them.

D. H. Rae again gave able service in interviewing applicants and supervising grantees in the field. He was able to contact forty-one grantees in the field, of whom eighteen were contacted at the actual scene of prospecting. 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.—At Muchalat Inlet large outcrops of limestone were investigated. Considerable black sand was panned from Ucona River. Some old mine workings in the Gold River area were examined, and copper-bearing float was found nearby.

Atlin Mining Division.—Southeast of the junction of King Salmon Creek and Taku River, in the King Salmon Mountain area, a considerable amount of prospecting was done. Mineralized quartz stringers were observed cutting altered sedimentary rocks. On the northwest slope of the mountain, granitic sills, sparsely mineralized with pyrite, azurite, and malachite, were noted. A quartz vein showing erratic mineralization of pyrite, azurite, and malachite was traced for 1,300 feet—the widest section was 40 inches and values were subcommercial. Along the Sittakanay River, argillite containing pyrite produced unimportant gossan zones.

Southeast of Atlin Lake the O'Donnel River valley was prospected toward Taysen Lake. During the course of this work some short-fibre asbestos occurrences were investigated. Prospecting was done in the Silver Salmon valley to the Nakina River, in the Katina Creek area, and near Mount O'Keefe. Disseminated native copper was observed on Copper Island in Atlin Lake, and much rusty stain was observed in Llewellyn and Sloko Inlets on Atlin Lake. Volcanic Creek valley to the north end of Gladys Lake, Davenport Creek, and Windy Camp Creek received some attention. Many barren quartz veins were observed cutting limestone and argillite.

Cariboo Mining Division.—Inconclusive work was done in the vicinity of George Creek, McLeod River, McDougall River, and Carp Lake. At Purden Lake a large deposit of bentonite was discovered. On Sugarbowl Mountain, chalcopyrite float was found. Nothing of importance was noted in either the Bowron River area nor near Aleza Lake. A quartz vein 7 feet wide in a shear zone was noted near Kelley Lake. At an unnamed lake 90 air miles northeast of Prince George an attempt was made to find continuity in a mineral zone in limestone, unsuccessfully, although large masses of chalcopyrite in unaltered limestone were exposed on the surface in one location. Barren quartz veins were observed in limestone to the northeast and to the east of the lake. Canyons on the Murray River were prospected from south of Monkman Pass nearly to the Fraser River.

Skin-diving technique was used in prospecting certain deep sections of Canyon Creek, Hixon Creek, Cottonwood River, and Horsefly River. Some prospecting was done north of Cottonwood River at the P.G.E. bridge.

Some work was done on the east side of the highway between Dragon Mountain and Soda Creek. Along Melinda Creek dark serpentine containing narrow stringers of asbestos fibre was seen. Three miles south of the forks on the Quesnel River a long ridge of volcanic rocks was seen to contain some iron sulphides showing a little copper stain. Near Horsefly volcanic rocks containing minor amounts of native copper were prospected thoroughly; this appears to be of economic interest.

Clinton Mining Division.—Ten miles north of Cache Creek short-fibre asbestos in serpentine was investigated. No commerical amount was found.

Kamloops Mining Division.—From a base camp established on Hobson Lake a thorough job of prospecting both shoreline and adjacent creek valleys was carried out. Fine gold in gravel was found close to Summit Lake, and scattered galena in narrow quartz stringers. Between Hobson Creek and Clearwater River several large but barren quartz veins were found. Granite dykes cutting limestone were also prospected, as well as a wide quartz vein sparsely mineralized with galena and pyrite. On Clearwater Lake granite tongues cutting schist and a few narrow pegmatite dykes were investigated.

Eleven miles southeast of Vavenby a wide quartz vein sparsely mineralized with galena was prospected. Close to the railway a few miles north of Clearwater, silver-bearing mineralized zones were investigated and sampled. Further work will be done here. In the Raft River area minor amounts of copper and molybdenum were found associated with narrow pegmatite dykes. Near Avola a mineralized zone containing small amounts of zinc was prospected. Some work was done on the southwest side of Adams Lake. Some galena float was found in Louis Creek 7 miles east of the main highway.

Iron-stained granite bluffs near La Jeune Lake were investigated, but nothing of interest was found. West of Stump Lake, along Moore and Frogmore Creeks, considerable work was done on a quartz vein in monzonite showing considerable disseminated molybdenite.

Liard Mining Division.—Further work was done in the Tootsee Lake area close to the Silver Tip discovery, but nothing of importance was reported. North of Dease Lake, in the vicinity of Table Mountain and in the valleys of Pooley Creek, Quartzrock Creek, and Troutline Creek and on Needlepoint Mountain some prospecting was done. Narrow quartz veins showing some copper stain, short-fibre asbestos in serpentine, several small gossan areas, and some barren-looking skarn were reported.

Considerable work was done east and southeast of McDame Lake. East of Mount McDame, outcrops of schist and limestone were prospected. In the Turnagain valley a small amount of short-fibre asbestos was investigated. Slate and serpentine were reported between Wheaton Creek and Mount Shea. In the Alice Shea Creek valley large bodies of serpentine were prospected, and between Ferry Creek and Greenrock Creek disseminated chromite was found in serpentine. A large area of decomposed quartz was uncovered. Prospecting was done in the Kehlechoa River valley, south of King Mountain, along Wheaton Creek, and in the Tanzilla River valley. At Mile 10 on the Stikine River, molybdenite and chalcopyrite float were found. Some prospecting was also done along the Tahltan River, on Beatty Creek, on Gnat Creek, and through a 10-mile-wide stretch of country up to 10 miles east of Dease Lake, some interesting float was found, but nothing of importance in place.

A large area 35 miles up the Racing River from the Alaska Highway received considerable attention. Nothing of importance was found, although some new occurrences of chalcopyrite and bornite in narrow quartz veins were reported.

Lillooet Mining Division.—On Stirrup Creek high-grade gold-bearing quartz float was found. Northwest of Lillooet, near Mount McLean, serpentine outcrops were prospected.

Nelson Mining Division.—In the Hazel Creek valley, near Kitchener, a considerable amount of work was done; a vein 10 to 15 feet wide and 1,000 feet long containing much specularite was prospected. A 5-foot-wide quartz vein on a diorite-quartzite contact was investigated, but no commercial values were obtained. Prospecting was done on Englishman Creek, Young Creek, Kid Creek, and Little Moyie River. Work was done in the area extending back 10 or 12 miles on the west side of Kootenay Lake. The batholithic contact on Irvine and Procter Creeks received some attention. Two miles west of the old Bayonne mine a quartz vein in granodiorite was prospected. In the valleys of Blazed and Bluebird Creeks pyritized limestone is cut by numerous barren quartz veins.

New Westminster Mining Division.—The old road from Aurum Siding to the Home Gold property was made passable for foot travel, and some prospecting was done in that vicinity. The headwaters of Ladner Creek, Siwash Creek, Fifteen Mile Creek, and Cedarflat Creek received some attention, but nothing of interest was reported. A small area above the old Emancipation mine workings was looked at, and work was done easterly on Sowaqua Creek. Some traces of molybdenite were found in rock cuts on the pipe-line. The serpentine belt, extending easterly from Jessica, received some attention, and the area adjacent to the Kettle Valley Railway from Mile 29 to Mile 38.5 was investigated. Some heavily oxidized and rusty slate was reported. Some work was done at Hope Mountain and in the vicinity of Haig.

Some skin diving was done in the Fraser River from Hope to Yale and to Alexandra Bridge, in Siwash Creek opposite Yale, and in the Coquihalla River near Jessica.

Nicola Mining Division.—Some prospecting was done in the area adjacent to the Guichon mine.

Omineca Mining Division.—Considerable work was done in the Nation Lakes area in an unsuccessful attempt to find extensions of copper showings uncovered in 1959. Ground in reach of Tchentlo Lake, Kwanika Creek valley, and the west end of Tsayta Lake was investigated. A contact on Albert Lake proved disappointing, and a quartz vein on Kwanika Creek carried no values.

A good deal of work was done in the area contiguous to Germansen Lake, Twenty Mile Creek, and Manson Creek. On the west side of Boulder Creek the Manson fault showed some scattered sulphide mineralization. Quartz veins showing some sulphides were encountered. On Slate Creek a greenish-coloured basic rock gave low assays in nickel. At the headwaters of Lost Creek low assays in tungsten were obtained from dark material along a granite contact. On the north slope of Blackjack Mountain a limy band of carbonaceous material contained quartz stringers and small amounts of zinc, a quartz vein showed scattered bands of pyrite, and banding in a major fault zone contained low values in nickel. A faulted mineralized zone was found on Blackjack Mountain. On the east fork of Kwanika Creek minor amounts of molybdenite were found along a granite-argillite contact. At Wasi Lake stringers of barite were observed in sheared volcanics. Some work was done at the junction of Wasi Creek and Osilinka River, near Wolverine Lake, along Lost Creek, on the north slope of Blackjack Mountain, and at the lower end of Mosquito Creek. Near the east end of Germansen Lake metamorphosed argillite containing considerable mixed sulphides was prospected. On the west fork of Klawli Creek some visible molybdenite and powellite were observed in several outcrops. West of Nina Creek sheared volcanics and a strong quartz vein in sheared andesite were noted, also a mineralized carbonate zone containing minor chalcopyrite and a quartz vein carrying small amounts of free gold. On the north side of the Osilinka River, 12 miles above the bridge, granite was observed containing aplite and basic dykes showing minor amounts of magnetite and pods of chalcopyrite. On Wolverine Creek chalcopyrite in quartz was seen, and in the lower part of Kildare Gulch a quartz vein containing considerable zinc. One important discovery, a wide mineral zone showing fair to good values in silver, was made west of the centre of Germansen Lake, more will be heard of this in 1961. The Gaffney Creek valley received some attention.

At a small lake northeast of Takla Landing oxidized zones in limestone were examined. Work was done in the Slug Lake area and in the valleys of Sowchea Creek and Sutherland River. Some inconclusive work was done in the Seven Sisters area near Hazelton and at Wolf Creek and south of the Nation River. South of Eutsuk Lake red-stained volcanics were found to contain some pyrite and chalcopyrite.

Osoyoos Mining Division.—In the Richter Pass area low values in copper were found in pyritized and iron-stained areas in schist and volcanics. Close to Mount Kobau a copper-stained gossan area was examined; no commercial values were obtained in any of the samples taken. Quartz veins were prospected near Blue Lake, and in the vicinity of Tinhorn and Togo Creeks; nothing of interest was reported. On Dividend Mountain a minor occurrence of scheelite was found. Some work was done at Lorne Lake in the Apex Mountain area, and at Ellis Creek.

Revelstoke Mining Division.—Considerable work was done in the Martha Creek area, and near McCulloch Creek some quartz veins and narrow pegmatite dykes were prospected. At Albert Canyon narrow veins of galena and chalcopyrite were prospected along an argillite-limestone contact. Nothing commercial was reported, although the area merits further work. Near Three Valley Lake some small pegmatite dykes and narrow quartz veins containing minor amounts of chalcopyrite and pyrite were prospected. The west side of the Columbia River between Death and Priest Rapids was checked. A deposit of kyanite was investigated.

Similkameen Mining Division.—Considerable work was done at Sunday Creek, on copper showings on Rabbitt Mountain, and on a well-mineralized shear zone in the same area. On Granite Creek a sulphide zone was investigated. On the north side of Mount Kathleen traces of molybdenite were prospected, and on the south side of Dillard Creek, in the Missezula Mountain area, some claims were staked.

Some copper sulphides were found at Olivine Mountain and in the Lawless Creek valley. Work was also done on Boulder Creek, Mount Spearing, Otter Creek, Grasshopper Mountain, west of Eagle Creek, Granite Creek valley, around Aspen Grove, and on Friday Mountain. Nothing of commercial importance was discovered. The Thynne Creek valley received some attention, and one 5-foot-wide quartz vein carrying minor amounts of galena was uncovered.

Skeena Mining Division.—On Brown Island (near Jap Inlet) unimportant mineralization was noted, and a few fairly good assays in zinc were obtained. At Hunt Inlet some magnetite was found; at Limestone Bay (on Banks Island) some minor amounts of copper and molybdenite were observed. On Pitt Island minor amounts of magnetite were observed.

In Kitkatla Inlet (Porcher Island) some molybdenite was found in small quartz veins. At Lime Creek (Alice Arm) some silicified pyritized zones were examined. Some work was also done near Stewart, at Glacier and Gracey Creeks. A high-grade copper-silver-gold zone was encountered at Ealue Lake.

Work was done at many places, including Kwinamass River, Mylor Peninsula, Chambers Creek, Stuart Anchorage, Pitt Island, Khutzemateen River, Alder Creek, Nasoga Gulf, Finlayson Island, Somerville Island, and Gibson Island. On Kennedy Island some pyrrhotite and chalcopyrite were observed in an interesting area.

West of Anahim Lake, at Kahylskt Creek (Burnt Bridge River), an interesting copper showing was found, and more work will be done on it at a later date. Much of the granite in the surrounding area shows appreciable copper stain.

Slocan Mining Division.—In the Lardeau area, float containing gold in quartz was found in both Poplar and Tenderfoot Creeks. At the headwaters of Canyon Creek a deposit showing native silver, galena, and tetrahedrite was investigated. On Mobbs Creek galena float was picked up.

Vancouver Mining Division.—Prospecting was done in Thompson Sound, Fitz Hugh Sound, Lagoon Bay, Knight Inlet, Glendale Cove, and Viner Sound, and on Midsummer Island and Fire Island.

Vernon Mining Division.—Some work was done in Whiteman Creek valley and in the vicinity of Bouleau Creek, Monashee Creek, McIntyre Creek, upper Kettle River, and Keefer Lake. Some float was found, but nothing of importance was found in place.

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 truck-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 31st, 1961, were as follows:—

Mining-roads	Miles	Cost
Construction	72	$94,804.16
Maintenance	131	32,617.08
Photo interpretation and terrain analysis	94	3,622.50
Bridge-site survey	----	4,643.43
Total	----	$135,687.17

In addition to the above, work was continued on the Cassiar–Stewart road. This road is being constructed under the " Roads to Resources " agreement between Canada and British Columbia. The construction is being supervised by the Department of Highways on behalf of the Department of Mines and Petroleum Resources. At the north end of the road, construction of the 30.5-mile section from Sawmill Point on Dease Lake to Tanzilla River was completed. The Tanzilla River to Stikine River section, 26.6 miles long, was 63 per cent completed at the end of 1960, and the Stikine River to Eddontenajon Lake section of 23.33 miles was 39 per cent completed. At the south end of the road the Bear Pass section of 11.6 miles was 53 per cent completed.

For the purpose of facilitating the development of the petroleum and natural-gas resources in the northeastern part of the Province, it was decided, in conjunction with the Department of Highways, to construct a bridge across the Fort Nelson River at a point about 1 mile upstream from the mouth of the Muskwa River. At the end of 1960 an approach access, 4 miles long, had been built from the Alaska Highway at Mile 298.7 to the bridge-site. The bridge, completed early in 1961, is a single-lane double-single Bailey designed for 50-ton loading. It is approximately 780 feet long and is carried on twelve pile piers and two abutments. On the evening of April 25th, 1961, a large piece of ice carried by the swift-flowing river crashed into the bridge and took out three of the piers.

MUSEUMS

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

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

British Columbia material includes specimens collected by officers of the Department of Mines and 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 joint office in Vancouver, and in the offices of the Inspectors of Mines in Nelson and Prince Rupert, as well as in public libraries.

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

From the details supplied by the locators, the 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 and Forests.

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

The Provincial Department's Inspector and Resident Engineer, the Gold Commissioner and Mining Recorder for the Vancouver Mining Division, and the officers of the Federal Geological Survey occupy one suite of offices. All official information relating to mining is available to the public in the one suite of offices at 739 West Hastings Street, Vancouver 1.

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

Topographic Mapping and Air Photography

During 1960 the Legal Surveys, Topographic, Geographic, and Air Divisions of the Surveys and Mapping Branch continued to add to the variety of maps and survey information which is available for use by all departments of government and by the general public.

Legal Surveys Division issued 709 sets of instructions to surveyors in 1960. A total of 514 field books were received, covering the survey of 870 lots, of which twelve were surveyed under authority of the *Mineral Act* and the remainder under the *Land Act*. The 210 Departmental reference map-sheets showing cadastral information for the whole Province continued to be kept up to date. Prints of these maps are available to the public at the nominal price of $1 per sheet.

Among the field projects completed by the Legal Surveys Division in 1960 was the surveying of 140 new townsite lots at Fort Nelson, Wonowon, Chetwynd, and Bear Lake (north of Prince George). Also, 277 survey corners were remonumented, mostly as the result of ties made during new surveys. The continuing programme of highway survey included 13 miles on the Southern Trans-Provincial Highway (Moyie to Irishman Creek), 9 miles on the Cariboo Highway (Stone Creek to Red Rock), 17.25 miles on the Trans-Canada Highway (Cache Creek to Deadman River Indian Reserve), 17 miles of new road (Alberta Boundary to Pouce Coupe), and 12.3 miles on the Northern Trans-Provincial Highway (through Fort Fraser to Fraser Lake).

Aerial photography coverage for a total of 22,211 square miles and 2,936 lineal miles was obtained by the Air Division. Of the above totals, 20,215 square miles was narrow-angle photography at 1-inch-to-20-chains scale. A grand total of 24,959 photographs was made during aerial operations, and the number of negatives (Federal and Provincial) on file in the Air Photo Library increased to 493,635.

It is of interest to note that among requests for reprints and loans of air photographs during 1960, mining and oil and natural-gas companies accounted for 30,269 photos, or only slightly less than one-half of all photographs requisitioned by the general public.

Topographic Division survey parties established field control for 21½ Standard National Topographic map-sheets in 1960. Nine map-sheets were covered in the Nazko area north and west of Quesnel, four in the Stuart Lake area, and the remainder in and around Wells Gray Provincial Park. Another accomplishment was the completion of survey ties from existing geodetic and Provincial triangulation to survey monuments on the Alaska Highway between Mile 374 and Mile 626.

A total of fifteen maps was published by Geographic Division in 1960. New maps included sheet 1JR, a six-colour relief map of the Province at 1-inch-to-30-miles scale. Also released were three new National Topographic maps at a scale of 1 inch to 2 miles, these being 82 L/NW (Shuswap Lake), 92 G/SW (Vancouver), and 92 I/NE (Kamloops Lake). Each of these sheets shows land status and is fully contoured.

Stocks of eighteen full-colour National Topographic maps at 1:50,000 scale were received by Geographic Division from mapping agencies at Ottawa. Additional maps of British Columbia published by Ottawa numbered fifty, of which major stocks were received for twenty-one sheets at 1:50,000 scale and three at 1:250,000 scale. A major policy change was announced by the Federal mapping agencies. The Army Survey Establishment ceased to handle the provisional mapping programme, and full control was assumed by the Department of Mines and

Technical Surveys. Furthermore, in order to speed the production of 1:50,000 National Topographic maps, permanent provisional maps in two colours are now being produced for wilderness regions. Full-colour 1:50,000 maps will continue to be issued for more settled areas.

Indexes of air-photo cover and of topographic, interim, and lithographed maps are contained in the 1960 Annual Report of the British Columbia Lands Service. For further information concerning Provincial and Federal mapping, contact the Director, Surveys and Mapping Branch, Department of Lands and Forests, Victoria, B.C.

Department of Mines and Technical Surveys

The Canadian Government Department of Mines and Technical Surveys performs many functions related to mining and the mineral industry in general. The Mines Branch, Geological Survey of Canada, and Surveys and Mapping Branch are the three branches of the Department of the most direct interest to the 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 a note on the Mines Branch.

GEOLOGICAL SURVEY OF CANADA

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

A branch office of the Geological Survey of Canada is maintained in Vancouver. Maps and reports on British Columbia can be obtained there. J. E. Armstrong is in charge of this office at 739 West Hastings Street, Vancouver 1.

Field Work by Geological Survey of Canada in British Columbia, 1960

R. B. Campbell completed field work in the Quesnel Lake West Half (93 A, W. ½) map-area.

D. B. Craig commenced detailed mapping of rocks near Revelstoke as part of the special investigation of granitic rocks of Canada being conducted by J. E. Reesor.

D. C. Findlay commenced a detailed investigation of the Tulameen ultrabasic complex as part of a study of the ultrabasic rocks of Canada.

R. J. Fulton commenced study and mapping of the surficial deposits of Nicola (92 I, E. ½) map-area for publication at 1 inch to 2 miles.

H. Gabrielse completed the geological mapping of approximately 80 per cent of Kechika (94 L) and Rabbit River (94 M) map-areas.

E. C. Halstead and B. Treichel completed a ground-water investigation of the east coast of Vancouver Island from Courtenay to Campbell River.

E. J. W. Irish continued field work in the Halfway River (94 B) map-area.

G. B. Leech completed the areal mapping of Fernie West Half (82 G, W. ½) map-area.

J. E. Muller completed most of the field work in Pine Pass (93 O) map-area.

B. R. Pelletier and E. T. Tozer combined parties to study the stratigraphy and palæontology of the Triassic rocks in the Foothills and Rocky Mountains of north-eastern British Columbia.

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

J. E. Reesor continued his detailed studies of the Valhalla complex in Passmore (82 L/12) and Burton (82 L/13) map-areas, as part of the " Study of Granite in Canada " project.

J. G. Souther almost completed the field mapping of the Sumdum (104 F) and Tulsequah (104 K) map-areas.

A. M. Stalker completed the study and mapping of the surficial deposits of Fernie East Half (82 G, E. ½) map-area.

D. F. Stott completed the field study of the Upper Cretaceous Smoky group in the foothills of Alberta and British Columbia between Smoky River and Peace River.

G. C. Taylor commenced the mapping of the MacDonald Creek (94 K/10) map-area on the Alaska Highway.

H. W. Tipper completed the mapping of the Prince George (93 G) map-area.

J. O. Wheeler continued the mapping of Rogers Pass (Illecillewaet) (82 N, W. ½) map-area.

Publications of the Geological Survey

A total of twenty-seven publications of the Geological Survey of Canada relating to British Columbia was received by the British Columbia Department of Mines and Petroleum Resources in 1960. A list of the twenty-seven publications will be supplied on request.

MINES BRANCH

The Mines Branch has branches dealing with mineral resources, mineral dressing and process metallurgy, physical metallurgy, radioactivity, and fuels and explosives. A total of eighteen publications of the Mines Branch pertaining to British Columbia was received in 1960 by the British Columbia Department of Mines and Petroleum Resources. A list of these publications will be supplied on request. They included tabular pamphlets dealing with coal mines, gold mines, stone quarries, petroleum refineries, and milling plants in Canada.

MINERAL RESOURCES DIVISION

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

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

Lode Metals

CONTENTS

GENERAL REVIEW

All principal metals but lead showed an increase in the average Canadian price paid in 1960 as compared to 1959. The price for lead decreased a very small amount. The price for gold was up about 1 per cent owing to a slight change in the average rate of exchange. The price for silver increased a little over a cent an ounce, the price for copper increased about a cent and a quarter, and the price for zinc increased about a cent and a half, compared to 1959. The New York price for silver was steady at 91.375 cents per ounce. The United States price for copper started 1960 at 31 cents per pound and closed just below 27 cents per pound. The New York price for lead was steady at 12 cents per pound, only to fall to 11 cents in December. The East St. Louis price for zinc started 1960 at 12.5 cents per pound and fell to 12 cents at the end of the year.

Gold, silver, copper, lead, and zinc produced at British Columbia lode mines in 1960 had a value of $112,735,769. Miscellaneous metals, including iron ore, nickel, tin, and minor metals recovered at the Trail smelter, had a value of $17,714,969. The total quantity of ore mined at all lode mines amounted to 8,242,703 tons and came from sixty-seven mines, of which thirty-one produced 100 tons or more. The average number employed in the lode-mining industry in 1960, including mines, concentrators, and smelters, was 7,423.

In 1960 twenty-eight mills were operated—sixteen throughout the year and six on a seasonal or intermittent basis. Of the latter, two were operated by lessees and one accepted custom ore. Four mills closed and one small mill at Tofino operated for the first time. The Pioneer mine shut down after thirty-five years of continuous operation, Cowichan Copper after three years, and Hualpai Enterprises after less than one year. At the Mastodon mine, after a seven-year closure, production was resumed in June and ceased in October. Of the year-round operating mills, three treated ores of gold, three copper, seven silver-lead-zinc, two iron, and one nickel.

The Trail smelter recorded custom receipts of 10,043 tons of ore from thirty properties, 9,468 tons of which, from seven properties, obtained a silica bonus in excess of the treatment charge. The smelter also recorded custom receipts of 1,228 tons of lead concentrates and 35,331 tons of zinc concentrates. Totals of approximately 15,470 tons of lead concentrates and approximately 41,660 tons of zinc concentrates were shipped out of the Province for smelting. Copper concentrates were shipped to the Tacoma smelter, except for the output of Cowichan Copper, the copper concentrates recovered by Texada Mines Ltd., and the copper contained in bulk nickel concentrates from Giant Nickel Mines Limited, all of which went to Japan. All iron-ore concentrates, amounting to 1,156,297 tons, were shipped to Japan.

The production of gold was higher than in 1959 and, due partly to a slightly higher value of the American dollar, the total value was approximately 10 per cent higher than in 1959. This was because of increased production at Bralorne, new production at Premier and Camp McKinney, and an increase in the production of copper, of which gold is a by-product. The Pioneer mine closed in August due to depletion of reserves, after thirty-five years of continuous operation. Total production for the life of the mine was approximately 1,331,500 ounces of gold from almost 2½ million tons of ore. The Cariboo Gold Quartz' Aurum mine encountered a better grade of ore than in 1959, and the company was engaged in opening up the new Burnett ore zone in the Mosquito Creek section of the property. The old Cariboo Amelia at Camp McKinney produced again after a lapse of fifty-seven years since the last company operation and, aided by the bonus for siliceous ore, shipped direct to the Trail smelter.

The output of silver ore was less than the average for some years past. However, more silver was produced than in 1959, because of the increased production of lead.

Copper production about doubled, and was paid for at about 1¼ cents per pound more than in 1959. Cowichan Copper closed down for lack of ore late in 1960, but at the same time it was announced that the Sunloch property had been leased and that the mill at Cowichan Lake would be transferred to the Sunloch at Jordan River.

At Craigmont, preparation of an open pit began in June, and at the end of 1960 construction was under way at the site of the proposed 4,000-tons-per-day mill. At Bethlehem no agreement had been reached at the end of 1960, although a considerable amount of investigational work had been done by the company on behalf of Sumitomo Metal Mining Company of Tokyo. The Old Sport mine of Coast Copper Company Limited was being readied for production, after twenty years of inactivity; the concentrates will go to Japan.

Exploration for copper continued at a good pace, although there was a weakening of activity in some parts of the Merritt-Highland Valley area. Some ground has been gone over by more than one company, and it would seem that techniques for the demonstration of anomalies have rather overshadowed the techniques for their elucidation. Recent work has in no way narrowed the " copper belt," but it has shown that orebodies are not easy to find.

Copper exploration continued in the northwest part of the Province, at several localities, extending from the vicinity of Stewart to the Alsek River. Geological mapping done by Newmont Mining Corporation in the general Leduc-Unuk Rivers area demonstrated an exploration technique new in British Columbia. This was systematic regional mapping, of a sort usually done by governmental agencies, carried out over two seasons by a group of geologists supported by helicopter. As a result, a decision was reached early in January, 1961, to do additional development work on the Granduc property and to investigate other recently discovered showings.

The production of lead was up 16 per cent from that of 1959, an increase largely the result of mining ore with a higher lead content at the Sullivan mine. The output of the other larger mines was lower, and there was a drop in production from the Slocan. The production of zinc showed little change compared to 1959. The Mastodon mine, which had a short period of production in 1952 and had lain idle for nearly seven years, was reopened and the mill operated for five months. The operation failed owing to lack of ore and inability to recover oxidized sulphides.

Work on the Duncan Lake property by Consolidated proved the existence of a mine, but the outlook for lead was deemed too unsatisfactory to warrant an operation at present, and the development crew was withdrawn. Interest in the area did not diminish, however. In other parts of the Province, exploration for lead and zinc was at a low ebb.

The importance of the magnetite deposits in the coastal region continued to grow, in spite of the fact that one operation was closed. Prospecting was done, and several properties were under development or exploration. A magnetite deposit of relatively large apparent size was discovered just east of Kennedy Lake on Vancouver Island, and was at once investigated by diamond drilling. The Annual Report of the Minister of Mines for 1902 records the presence of a " very marked magnetic attraction " at this site and the fact that an unsuccessful attempt had been made to reach bedrock to investigate the cause of the attraction.

Nickel was exported to Japan in the form of a bulk concentrate from the Giant Nickel operation, after termination of a contract with Sherritt-Gordon Mines Ltd.

An activated raise platform, or, more simply, a raise machine, was used at two properties to drive vertical raises 310 and 465 feet. These machines have saved time and expense in driving long raises. Ammonium nitrate blasting agent, introduced into British Columbia quarries in 1957, was the most used blasting material in open-pit mines and quarries in 1960, when more than a million and a half pounds was used, twice the quantity used in 1959.

NOTES ON METAL MINES

ALSEK RIVER*

Copper-Cobalt

Windy and Craggy (Ventures Limited) (59° 137° N.W.) Head office, 25 King Street West, Toronto. H. V. Fraser, president; Alex. Smith, manager; J. McDougall, geologist in charge. The Windy and Craggy groups comprise fourteen recorded mineral claims and are about 20 miles north of the junction of the Alsek and Tatshenshini Rivers.

Copper and cobalt mineralization, occurring in a massive pyrrhotite replacement of pillow lavas, outcrops between the head wall of a cirque and precipitous bluffs to the north. Using a Hiller 12E helicopter for transportation, a 9- by 12-foot prefabricated building was assembled on the property. The helicopter was used to service a crew of eight.

In the period July 28th to October 1st, eleven packsack holes, totalling 800 feet, were drilled and a topographical and geological survey of the property was made.

The property was not visited.

CASSIAR†

Gold

Copco (59° 129° S.W.) This property consists of seventy-three recorded claims—Copco Nos. 1 to 69 and Cote Nos. 1 to 4. These claims, which were located by J. J. Copeland and J. I. Couture, cover the showings formerly held by Benroy Gold Mines Limited and originally known as the Cornucopia group. The group is on the east slope of Quartzrock Creek valley and 2 to 3 miles north of McDame Lake. The showings have been described in the 1947 Annual Report.

During the summer of 1960 a Gibson self-amalgamating mill was installed near the lower extremity of the exposed part of one of the quartz veins containing visible gold. It has been reported that this mill treated 25 tons of vein material during the season.

Work on the property, which was carried out by three men, included the construction of approximately half a mile of road between the Cassiar road and the mill-site.

[References: *Minister of Mines, B.C.*, Ann. Repts., 1946, p. 61; 1947, pp. 70–72.]

PORTLAND CANAL

†Exploration activities supplied by aircraft based at Stewart were carried on by Granduc Mines, Limited, Newmont Mining Corporation of Canada Limited, and The Granby Mining Company Limited.

The Granduc company, under the supervision of G. W. H. Norman and employing a large crew of geologists and geophysical operators, made extensive air-borne geophysical surveys, ground geophysical surveys, and geological surveys in the area lying between Granduc mine and the Unuk River. As a result of their air-borne geophysical surveys, the company in June located twenty-four claims on the north side of Fewright Creek, 248 claims along the Unuk River on the north slope of McQuillan Ridge, and seventy-eight claims at the junction of Gracey Creek and south Unuk River.

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

The Newmont company, under the direction of D. M. Cannon, did some exploration work on Surprise Creek west of Meziadin Lake on claims located by R. K. Watson, of Stewart, also on their Todd Creek showing, which was located in September, 1959.

The Granby company prospectors were supervised by Keith Fahrni.

TIDE LAKE (56° 130° S.E.)*

Gold-Silver

East (Dempster Exploration Company Ltd.) Company office, 2281 Yonge Street, Toronto. L. Dempster, president; C. Riley, consulting geologist. The property, which is on the west side of the Tide Lake valley, consists of fourteen recorded claims held under option from A. Phillips, of Stewart. The property has been described in the 1946 Annual Report. Work in 1960, which was carried out by a crew of five men under the direction of D. Irving, commenced on June 1st and was suspended on September 30th. Initial work consisted of the cleaning-out of underground workings to make them accessible for the detailed geological examination which followed. Subsequently, 1,248 feet of drilling was done underground and 691 feet of drilling was done on the surface.

Equipment on the property included a Bull Moose C 25 crawler. This tractor was used to construct an airstrip, measuring 1,350 by 60 feet, on the Tide Lake flats. This airstrip enabled the camp to be serviced by wheel-equipped aircraft based at Stewart. The property was not visited.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1927, pp. 106, 107; 1930, p. 117; 1939, p. 66, under the name " Pioneer group "; 1944, p. 53; 1946, pp. 68–72; 1950, p. 76; 1953, p. 90.]

BOWSER LAKE (56° 129° S.W.)*

Copper

Todd Group Fifty-two recorded mineral claims, Todd Nos. 1 to 52, are held by Newmont Mining Corporation of Canada Limited. The claims are at the head of Todd Creek, approximately 30 miles north of Stewart. The showings are reported to consist of chalcopyrite-pyrite bearing quartz impregnated fault zones in brecciated dacite. The structures are continuous over distances in excess of 2,000 feet. Quartz and sulphide mineralization are restricted to situations at and near the intersections of two such faults. Minor gold values are associated with the chalcopyrite.

Work commenced in May and continued to September. The work was done by an average crew of eight men under the supervision of T. C. Osborne. Four holes, totalling 1,150 feet, were diamond drilled. Outlying showings were investigated by surface trenching and packsack drilling.

The property was serviced by a Piper Supercub aircraft, which landed on a previously prepared landing-strip. The property was not visited.

BEAR PASS (56° 129° S.W.)*

Lead-Zinc

Surprise Group This property it at the head of a tributary of Surprise Creek, east of Bear Pass, and consists of twenty claims held by record. It has been reported that the showings consist of pods of nearly massive mixed galena, sphalerite, and pyrrhotite in highly fractured limestone at and near its contact with quartzite.

* By W. C. Robinson.

Work during 1960, which commenced in August and was completed in September, was done by Newmont Mining Corporation of Canada Limited. The geology in the vicinity of the showings was mapped in detail and six packsack-drill holes were put down to test the mineralization below the zone of oxidation.

Three men were employed, the crew being serviced by Piper Supercub aircraft which landed on the glacier. The property was not visited.

SALMON RIVER (56° 130° S.E.)*

Gold-Silver-Lead-Zinc

Silbak Premier Mines Limited Company office, 844 West Hastings Street, Vancouver 1. A. E. Bryant, president; Hill, Starck and Associates, consulting engineers. Under a lease from the company that terminated on September 23rd, 1960, Bermah Mines Ltd. (that is, T. J. McQuillan and his two partners) and a crew of eight men mined and shipped ore from a small high-grade shoot in a newly discovered vein lying on the footwall side of the old Premier glory-hole.

The vein was found in 1959 by one of the partners who walked down through the old glory-hole and found high-grade float which had sloughed from a vein parallel to and 15 feet on the footwall side of the main vein that had been stoped in the glory-hole. During the latter part of 1959, McQuillan and his partners shipped 62 tons of high-grade ore sorted from the slough in the bottom of the glory-hole. This 62 tons of ore contained a total of 650 ounces of gold and 16,829 ounces of silver.

In 1960 a short sublevel drift 30 feet long was driven along the new vein and a raise put through to surface in ore. High-grade ore as a shoot about 35 feet long, 4 feet wide, and 100 feet down dip was benched down through the raise and drawn off through the sublevel.

On the termination of the lease on September 23rd, the company bought the lessees' equipment and, with a crew of twelve men, continued to mine high-grade ore until November 1st, 1960, when operations ceased.

Production during 1960 amounted to 1,282 tons of high-grade ore, 1,239 tons being mined by Bermah Mines Ltd.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1947, pp. 74–82; 1956, pp. 17, 18; *Geol. Surv., Canada,* Mem. 175, pp. 161–166.]

ALICE ARM†

Silver

Wolfe (Dolly Varden Mines Ltd.) (55° 129° N.W.) Company office, 355 Burrard Street, Vancouver 1. W. Clarke Gibson, president; Hill, Starck and Associates, consulting engineers. The property, which comprises four Crown-granted mineral claims, is held under option from the estate of the late Victor Spencer. The claims are on the east slope and bottom of Kitsault Valley about one-quarter of a mile south of Trout Creek. The property has been described in the 1951 Annual Report. During October, 1960, eight holes totalling 1,400 feet were diamond drilled to check the downward extensions of the main vein.

Transportation was by helicopter, although the property can be reached by following 17 miles of good motor-road up the Kitsault Valley from Alice Arm to the old Torbrit mine and thence by 2 miles of tractor-road.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1916, pp. 52, 77; 1928, pp. 85–86; 1951, pp. 97–98; *Geol. Surv., Canada,* Mem. 175, p. 87.]

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

(Aerial oblique photo B.C. 510:44.)

Looking down Bear River valley to Stewart at the head of Portland Canal. Junction of American Creek in foreground and of Bitter Creek in mid distance.

(Aerial oblique photo B.C. 510:42.)

Head of American Creek and north end of Bear River ridge. Salmon glacier in centre distance. Adjoins photo above.

Molybdenum

Alice (Kennco Explorations (Western) Limited) (55° 129° S.E.) Head office, 25 King Street West, Toronto 1. C. J. Sullivan, president; J. R. Woodcock, engineer in charge of property. A total of sixty-eight claims are held—fifty-five by record and thirteen by option. The property is on Lime Creek about 5 miles southeast of Alice Arm. A circular stock, about one-half mile in diameter, intrudes greywacke of the Hazelton group. It has a quartz stockwork and molybdenum mineralization throughout a large part of the northern half of the stock.

Work on the property commenced May 15th and was suspended on October 15th. The average crew consisted of twenty-two men. Twenty holes totalling 12,486 feet were diamond drilled. Some bulldozer and hand trenching was done and approximately 1 mile of road was constructed.

The camp was supplied by coastal boat to Alice Arm and thence by helicopter, as well as by air drops from Beaver aircraft based at Prince Rupert.

Roundy Creek (55° 129° S.E.) Fifty-eight recorded claims and two fractions, which extend up Roundy Creek from tidewater, were held under option agreement by Southwest Potash Corporation until December 1st, 1960. On Roundy Creek, and about 1¼ miles from tidewater, showings of molybdenite occur in quartz veins and as disseminated flakes in granite, which intrudes folded hornfelsed rocks of the Hazelton group of Jurassic age.

During 1960 exploratory investigations of these showings consisted of geological mapping and the diamond drilling of six holes totalling 2,500 feet. Twelve men, under the supervision of R. W. Hodder, carried out the work from May to September.

In conjunction with the exploration work on Roundy Creek, seven men, under the direction of J. R. Loudon, were engaged in reconnaissance exploration of the Alice Arm-Stewart area from May to September.

Transportation to Roundy Creek was by coastal boat and aircraft, while a helicopter was used extensively for the reconnaissance work.

OBSERVATORY INLET*

Copper

Double Ed (The Consolidated Mining and Smelting Company of Canada, Limited) (55° 129° S.W.) G. A. Derry, development superintendent. This property of fifteen recorded claims is on Bonanza Creek, 3 miles west of Anyox. During the early part of 1960, work continued on the crosscut adit, which was driven at about 500 feet elevation to investigate further the surface showing of copper mineralization, which is about 500 feet higher than the adit. The adit, which was 1,898 feet long at the end of 1959, was driven an additional 976 feet in 1960, making it 2,874 feet long when completed. Copper mineralization was encountered in the adit, and a total of 14,224 feet of diamond drilling was done underground.

The showing consists of several steeply dipping zones which are siliceous pyrite replacements of sheared andesite flows. Disseminated chalcopyrite is also present in these zones.

* By W. C. Robinson.

An average crew of twenty men was employed. Coastal boats and float-equipped aircraft were used for transportation to Bonanza Creek landing, and trucks were used on the access road to the camp.

Work ceased in June, 1960, and all buildings and equipment were removed from the property.

QUEEN CHARLOTTE ISLANDS*

Graham Island

Manganese

Shag Rock

(54° 132° S.W.) This property is 25 miles west of Masset on the east side of Klashwun Point near Shag Rock. It can be reached by sea or air, but landing may present difficulties in either case. The property is held by Joseph Pauloski, of Masset, by two claims located in 1955. The claims extend northward along the east side of the point from Indian Reservation No. 13, and extend 300 feet or more offshore.

Rock is exposed in the area only along the wide tidal zone, and the showings are on the shore. Basaltic lavas of the Masset formation here strike north to northeast and dip 15 to 20 degrees eastward. The lavas are cut by a north-trending fault, on the east of which the lavas are underlain by dark-grey shale and buff calcareous shale to sandstone of about 75 feet exposed thickness. The fault strikes north 15 degrees east, subparallel to the shore, and dips about 80 degrees eastward. It is filled with 5 to 15 feet of basalt breccia that is cemented by variable amounts of manganite. Fragments in the breccia are angular and as much as 2 feet across, although commonly the large fragments are only 6 to 8 inches across. Fragments range downward in size from these dimensions to a few millimetres; still smaller sizes were not seen. Veinlets of manganite also extend into the volcanic rocks of the west wall of the fault. The mineralization is primary and is Tertiary in age. It is probably related to the Masset volcanism.

The fault and the showings are exposed along the shore for about 550 feet from the beach near the Indian reservation northward to where the shore trends sharply to the west. The best showings appear to be in the northern third of the exposure. Large hand specimens may be taken that contain as much as 50 per cent manganese. At the northern end, where the breccia outcrops like a dyke, one of the higher-grade lenses, about 8 feet high by 50 feet long by 5 feet wide is estimated to contain between 30 and 40 per cent manganese.

Moresby Island

Iron

Harriet Harbour (Silver Standard Mines Limited)

(52° 131° S.E.) Company office, 808, 602 West Hastings Street, Vancouver 2. H. B. Gilleland, manager; A. C. Ritchie, general superintendent. Harriet Harbour is on Skincuttle Inlet, on the southeastern coast of Moresby Island, and is 70 miles south of Sandspit. The properties on Harriet Harbour controlled by Silver Standard Mines Limited were reviewed fully in the 1959 Annual Report. The general geological setting is shown on the preliminary geological map of the southern Queen Charlotte Islands issued by this Department in March, 1960. The main orebody is east of the south end of Harriet Harbour on the Jessie (Lot 1861) Crown-granted claim and the Limestone recorded claim. Additional orebodies have been explored on the Adonis (Lot 1865) Crown-granted claim east of the Jessie on the trail to Ikeda Cove, and on the Magnet (Lot 79) and

* By A. Sutherland Brown.

Dingo (Lot 87) Crown-granted claims southwest of the south end of Harriet Harbour.

A total of ninety-five holes and 19,531 feet of EX core has been diamond drilled since exploration was first started in June, 1959. After a short winter shutdown, drilling recommenced and continued until July, 1960. Of all the drilling done, fifty-three holes totalling 16,364 feet have been drilled on the Jessie and Limestone claims, thirteen holes, totalling 1,081 feet on the Adonis, twenty-two holes totalling 1,531 feet on the Magnet, and seven holes totalling 553 feet on the Dingo. The camp was closed with a caretaker at the end of August, awaiting the arrangement of suitable financing. An agreement for sale of concentrates to the Sumitomo Metal Mining Company of Japan had been completed in December, 1959.

The annual report of the company at June 1st, 1960, stated the ore reserves consisted of 2,238,262 long tons of proven ore containing 51.8 per cent iron and 381,000 long tons of probable ore, mostly in the Jessie ore zone. The small amount of drilling completed since June, 1960, has not altered these reserves.

[References: *Minister of Mines, B.C.,* Ann. Rept., 1959, pp. 11–14; Sutherland Brown, A. and Jeffery, W. G., Preliminary Geological Map of Southern Queen Charlotte Islands, *B.C. Dept. of Mines.*]

ECSTALL RIVER*

Pyrite-Zinc-Copper

Packsack (Texas Gulf Sulphur Company)

(53° 129° N.E.) Executive office, 75 East Forty-fifth Street, New York. C. O. Stephens, New York, president; W. R. Bacon, manager of British Columbia operations. This property consists of sixteen claims, a double row of eight claims extending northward from the big bend of the Ecstall River. A description of the property was given in the 1958 Annual Report.

During the summer of 1960 eleven drill-holes, totalling 2,891 feet, were put down to sample the mineralized zone that had been found by prospecting and traced for a strike length of 2,000 feet beneath overburden by electromagnetic work. All the holes are reported to have intersected pyrite mineralization, much of which is massive.

No further work is planned for this property. The property, which was serviced by helicopter, was not visited.

SCOTIA RIVER*

Zinc

Scotia (Texas Gulf Sulphur Company)

(54° 129° S.W.) Executive office, 75 East Forty-fifth Street, New York. C. O. Stephens, New York, president; W. R. Bacon, manager of British Columbia operations. This group of four claims is about 10 miles south of Skeena River, on the north bank of an easterly flowing tributary of Scotia River. In 1958 investigation of a rusty hillside revealed the presence of a high-grade zinc showing with minor amounts of lead and copper. The host rock is reported to be a granitic gneiss containing pegmatitic material. The highly irregular showing is on the west flank of an anticline that plunges southward at 30 degrees. In addition to sphalerite, minor galena, and less chalcopyrite, there is a light general development of pyrite and pyrrhotite in the immediate vicinity.

In 1960 ten short drill-holes, totalling 1,865 feet, partially tested the showing over a strike length of 250 feet.

Transportation was by helicopter. The property was not visited.

* By W. C. Robinson.

KITIMAT*

Iron

Iron Mountain (Quebec Metallurgical Industries Ltd.) (54° 128° S.W.) Company office, 602, 88 Metcalfe Street, Ottawa. N. B. Davies, president; Alex. Smith, engineer in charge. The property is on Iron Mountain, about 6 miles north of Kitimat. It consists of four Crown-granted claims and nine recorded claims. Work on the property commenced in April and was suspended in December, 1960. Five to six men were employed under the direction of H. S. Lazenby. Sixteen EX holes, averaging about 400 feet long, and five packsack-drill holes, averaging 100 feet long, were drilled. A magnetometer survey was also carried out on the property during 1960.

Near the Wedeene River crossing of the Kitimat branch of the Canadian National Railway, a camp, consisting of office, cook-house, bunk-house, and dry, was constructed. The camp was serviced by the railway, which passes through the southern portion of the property.

[References: *Minister of Mines, B.C.*, Ann. Repts., 1929, p. 72; 1959, p. 15.]

CEDARVALE

SEVEN SISTERS MOUNTAIN (54° 128° N.E.)*

Molybdenum

Telkwa Prospector's Club In 1958 a group, known as the Telkwa Prospector's Club, located twenty claims on the northern slope of Seven Sisters Mountain. Molybdenum mineralization occurs on this property in a showing exposed at the head of the valley of Whiskey Creek and about 300 feet below an area covered by permanent snow. Flakes of molybdenite occur in narrow quartz veinlets in diorite. Although molybdenite is present in only some of the veinlets in a rather limited area, a further mineralized zone under the snow is indicated by the presence of molybdenite-bearing float above the showing.

Access to the property is by 8 miles of foot-trail from the Gull Creek crossing of Highway No. 16.

HAZELTON*

Silver-Lead

Silver Standard (Silver Standard Mines Limited).—(55° 127° S.W.) Company office, 808, 602 West Hastings Street, Vancouver 2. R. W. Wilson, president. The property is on Glen Mountain, 5½ miles north of Hazelton. The mine was leased by John Gallo, of Hazelton. Thirty-seven tons of silver-lead ore was shipped to the Trail smelter during the early part of 1960.

SMITHERS*

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; Hill, Starck and Associates, consulting mining engineers. The property is on the east slope of Cronin Mountain, about 30 miles by road from Smithers. P. Kindrat, lessee, again operated the mine and mill during part of 1960. Seventy-nine tons of lead concentrate and 66 tons of zinc concentrate were produced and shipped to the Trail smelter.

* By W. C. Robinson.

EUTSUK LAKE*

Molybdenum

CAFB

(53° 127° S.E.) Phelps Dodge Corporation of Canada, Limited, 904, 1030 West Georgia Street, Vancouver 5, holds by record fifty-six mineral claims extending northward from Haven (Bone) Lake toward the summit of Red Bird Mountain. Haven Lake is 8 miles west of Pondosy Bay on Eutsuk Lake. The claims cover a small stock of granite porphyry which contains some molybdenite mineralization.

During June a tent camp was established near timberline on the south slope of Red Bird Mountain, and a crew of four men under the direction of J. W. Bryant did some surface trenching and ground sluicing.

The granite porphyry stock on the south side of Red Bird Mountain intrudes a succession of tuffs and volcanic rocks of the Hazelton group. There has been some silicification and pyritization of the granite together with some disseminated molybdenite mineralization. The adjacent Hazelton formation is hornfelsed at and near the contact and is partly silicified along zones of shearing which contain a small amount of molybdenite.

Unmelted snow extending below timberline during June prevented effective prospecting or stripping being done except in a few small areas of exposed ground. Work was stopped and the camp abandoned early in July.

OMINECA†

Mercury

Snell Group

(55° 125° N.E.) This property is on Silver Creek, 9 miles south of Omineca River, and consists of thirty claims held by record. It has been reported that diamond drilling had previously indicated two zones of mercury mineralization—one near the east bank of Silver Creek, and another approximately 600 feet to the east. It has been reported that in 1943 and 1944 two attempts were made by The Consolidated Mining and Smelting Company of Canada, Limited, to drive a crosscut to intersect the eastern zone. Both attempts encountered an old channel and the adits were abandoned.

In 1959 hydraulic stripping exposed a surface showing approximately 600 feet northward from the westerly zone previously indicated by diamond drilling. This surface showing consists of lenses of cinnabar mineralization in dolomitic limestone along the Pinchi Lake fault zone. Cinnabar mineralization exists on either side of a fault striking northward. The predominant rock type on the eastern side of the fault is a tuff which contains no cinnabar in the areas exposed.

Work in 1960, which began on May 4th, included the replacement of four bridges and a number of culverts west of Twin Creek on the access road from Germansen Lake. On the property, further ground-sluicing was done in an attempt to expose bedrock north of the showing. Bedrock had not been reached when shortage of water forced a stoppage of work on August 1st.

Work on the property was done by four men under the supervision of E. Bronlund. The project was a joint effort by Bralorne Pioneer Mines Limited, Noranda Exploration Company, Limited, and Canex Aerial Exploration Ltd. Transportation was by truck and aircraft.

Silver-Gold-Zinc

Lustdust

(55° 125° N.E.) This group of fifteen claims, held by option, is on Kwanika Creek, 20 miles south of Omineca River. The showings, indicating a sulphide mass, are reported to contain

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

values in zinc, silver, and gold. Four men under the supervision of E. Bronlund are reported to have drilled a number of short test-holes and done a considerable amount of trenching by bulldozer. Work commenced on August 1st and ended for the season on October 18th. The project was a joint effort by Bralorne Pioneer Mines Limited, Noranda Exploration Company, Limited, and Canex Aerial Exploration Ltd. The property was not visited.

CARIBOO

Gold

WELLS-BARKERVILLE (53° 121° S.W.)

Aurum, Mosquito Creek (The Cariboo Gold Quartz Mining Company Limited)*

Company office, 1007 Royal Bank Building, Vancouver; mine office, Wells. Dr. W. B. Burnett, president; Marcel Guiguet, general manager; J. J. Stone, mill superintendent. Capital: 2,000,000 shares, $1 par value. Changes in the Cariboo Gold Quartz mine have been marked since the purchase of the Island Mountain (Aurum) mine in August, 1954. Following the purchase, the Aurum mine has supplied most of the ore; the original mine closed in September, 1959, and the Mosquito Creek property started production in May, 1959. The Aurum, which was purchased for $300,000 and which was believed to have less than a year's reserves, has since produced over $4,000,000 in bullion. The bulk of this has come from replacement ore, much of which has been found adjacent to previously mined bodies by drilling test-holes with pneumatic drills using flexible drill steel. Current production from the whole mine averages 3,460 tons of ore per month with an average gold content of 0.483 ounce per ton. About 15 per cent of current production comes from the new ore zone, the Burnett zone of the Mosquito Creek property. For the mine as a whole, 67 per cent of the tonnage and 77 per cent of the gold now comes from replacement stopes.

One of the main reasons for the purchase of the Aurum mine was to provide access to the Mosquito Creek property held by the company. Although no ore was proven on this property, its potential was thought good because not only was it on strike with the ore-bearing limestone beds, but " ore making " northerly faults were known to cross it. Furthermore, Mosquito Creek has been a rich placer-gold creek. A drive on the 3000 level was started in January, 1958. This encountered a new fault, the Burnett fault, 2,300 feet northwest of the shaft. This fault strikes north to north 16 degrees east and dips 67 to 80 degrees east, and hence is similar to the main group of northerly striking normal faults of the Wells camp. Ore dragged by the Burnett fault confirms that the post-ore movement has been normal. Significant replacement orebodies are found on both sides of the fault, in M1 stope northwest and 64 stope southeast of the fault. M1 stope has produced to August 31st, 1960, 4,864 tons of ore with an average gold content of 0.60 ounce per ton. M1 has been mined up to the fault above the 3000 level. The 64 orebody has a length of 280 feet on the down-dip side and a thickness of 4 to 8 feet. It was being prepared for mining in September, 1960. In the summer of 1960, hydraulic mining by J. J. Gunn in Mosquito Creek exposed replacement mineralization about 1,000 feet northwest of the Burnett fault, in what appear to be the same strata. To develop the known orebodies and to explore for others, two drifts were started on the levels immediately above and below the 3000 level. It is planned to drive the 3125 level 800 feet and the 2850 level 2,700 feet. To pay for this development, $200,000 in first mortgage bonds has been issued. The drifting on the 3125 level was completed in November. The 2850 drift was still being driven at the year-end and is expected to reach the zone of projected replacement ore in April, 1961.

* By A. Sutherland Brown and A. R. C. James.

The geological environment of the new ore zone is very much like that of the best area of the Aurum mine. The Burnett fault cuts and repeats a large dragfold that is similar in size to the Aurum mine dragfold (*see* Fig. 1). The folding is in

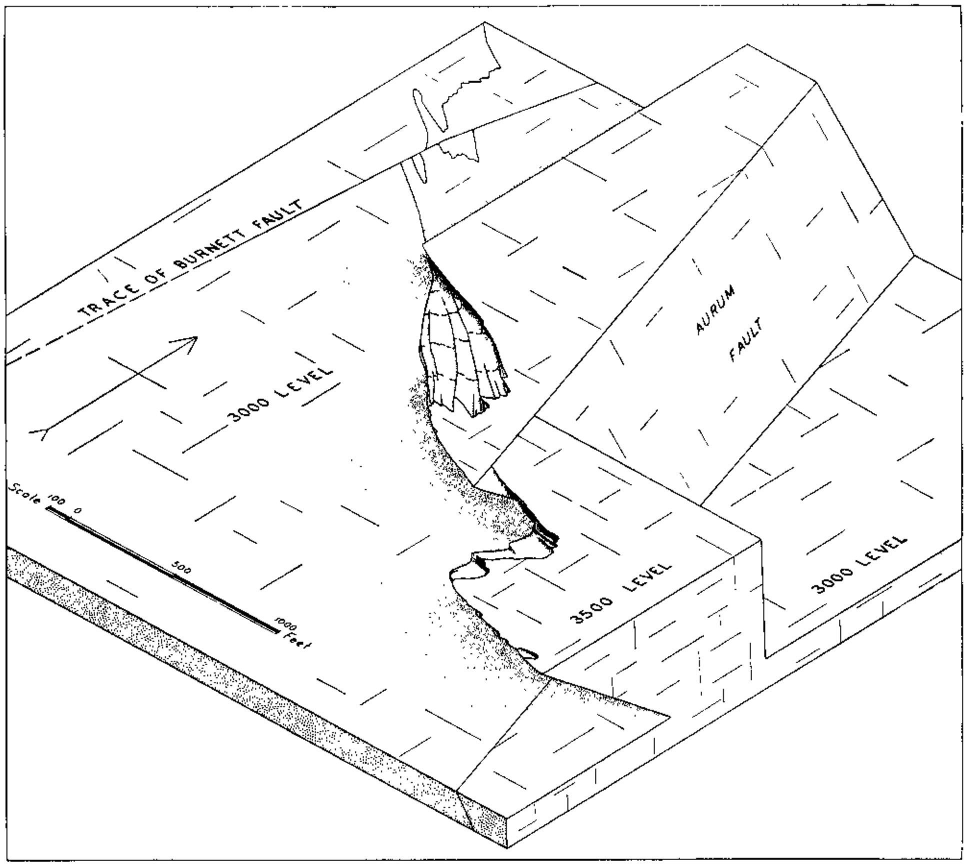


Figure 1. The Cariboo Gold Quartz Mining Company Limited. Isometric sketch showing relation of Aurum dragfold and fault to Burnett dragfold and fault as outlined by the " Rainbow-Baker " contact.

the same sense, involves the same beds, and is of the same attenuated and complexly dragfolded type. Figure 1 shows diagrammatically the relation between the two folds. The Aurum fold is encountered first on the 2625 level, where it plunges at about 22 degrees to the northwest. It flattens and becomes smaller at the 3250 level and appears to die out just below the 3125 level. On the 3000 level it is absent, but 800 feet northwest of the projected position of the Aurum fold the new fold appears. This is repeated in the same manner as the Aurum fold is repeated by the Aurum fault. The Aurum fold was a particularly favourable locus of replacement deposits, especially close to the fault and in the anticline. The size and grade of the M1 and the 64 orebodies indicate that the same may be true of the newly discovered Burnett fold and fault.

The following is a summary of development work done at the mine in 1960:—

	Feet
Drifting and crosscutting—	
Current development	2,188
Capital development	1,929
Total	4,117
Raising	819
Diamond drilling	15,452
Ribbon steel test-holes	9,488

In addition to the development work being done in the Burnett fault zone, small orebodies or extensions of existing orebodies continue to be found in the older section of the mine. The mine is developed from a main haulage adit at the 4000 level. Eleven levels have been developed from the Aurum shaft, which is a three-compartment internal shaft 1,450 feet deep and collared at the 4000 level. The working stopes are all between the 3250 and 2700 levels.

At the end of the year a crew of 116 men was employed, of which seventy-two were underground. The accident rate at the mine shows a striking improvement on past years. There was only one lost-time accident in 1960, giving an accident rate of 4.1 accidents per million man-hours worked, the lowest of any mine in the Province. This compares very favourably indeed with the rate of 32.6 for 1959, and 64.2 for the average of the last five years. A full-time safety director is employed and regular safety meetings and inspections are carried out.

A total of 39,113 tons of ore was milled, yielding 19,555 ounces of gold. This is approximately a 10-per-cent increase in gold production over 1959 and a 16-per-cent decrease in the amount of ore milled.

[Reference: *B.C. Dept. of Mines,* Bull. No. 38, Geology of the Antler Creek area, pp. 74–79, 82–85.]

Silver

Scarn* Nine recorded mineral claims and fractions extending northeastward up Copper Creek from the twin bridges on the Cariboo–Hudson road make up the Scarn group held by Daniel Jorgenson, of Barkerville. The claims are reached by 16 miles of road east from Barkerville. In an area north of the north branch of Copper Creek, the claims cover mineralized quartz veins containing silver values and some scheelite as well as other scheelite showings along the south branch of Copper Creek previously described in British Columbia Department of Mines Bulletin No. 34, pages 77 and 78.

This report covers only those veins lying north of the north branch of Copper Creek.

Over the past ten years Dan Jorgenson has done a very large amount of prospecting and hand-trenching on the Scarn group. The surface work has been extremely thorough and the vein characteristics are well displayed. In a drift-covered area underlain by black argillite, siltstone, and thin limestone beds belonging to the Midas formation along and east of the Copper Creek fault, he has found and trenched at least six quartz veins. The veins strike 20 to 40 degrees west of north, dip steeply, and cut across the more northwesterly striking formations. Vein quartz is mineralized with silver-bearing tetrahedrite, galena, and small amounts of pyrite and sphalerite. In some instances scheelite is present. The mineralization is for the most part across widths of 3 to 8 inches in veins that are

* By Stuart S. Holland.

3 feet or more wide and in which the balance of the quartz is essentially devoid of mineralization. As a consequence, only narrow widths of well-mineralized quartz were sampled (*see* table of assays). One of the quartz veins cuts a bed of limestone, and in several open cuts along it scheelite is present in the adjacent limestone as well as in the vein.

Fifteen samples were taken from five veins. The widths and assay results are shown in the accompanying tabulation and the sample locations are shown on the accompanying plan, Figure 2.

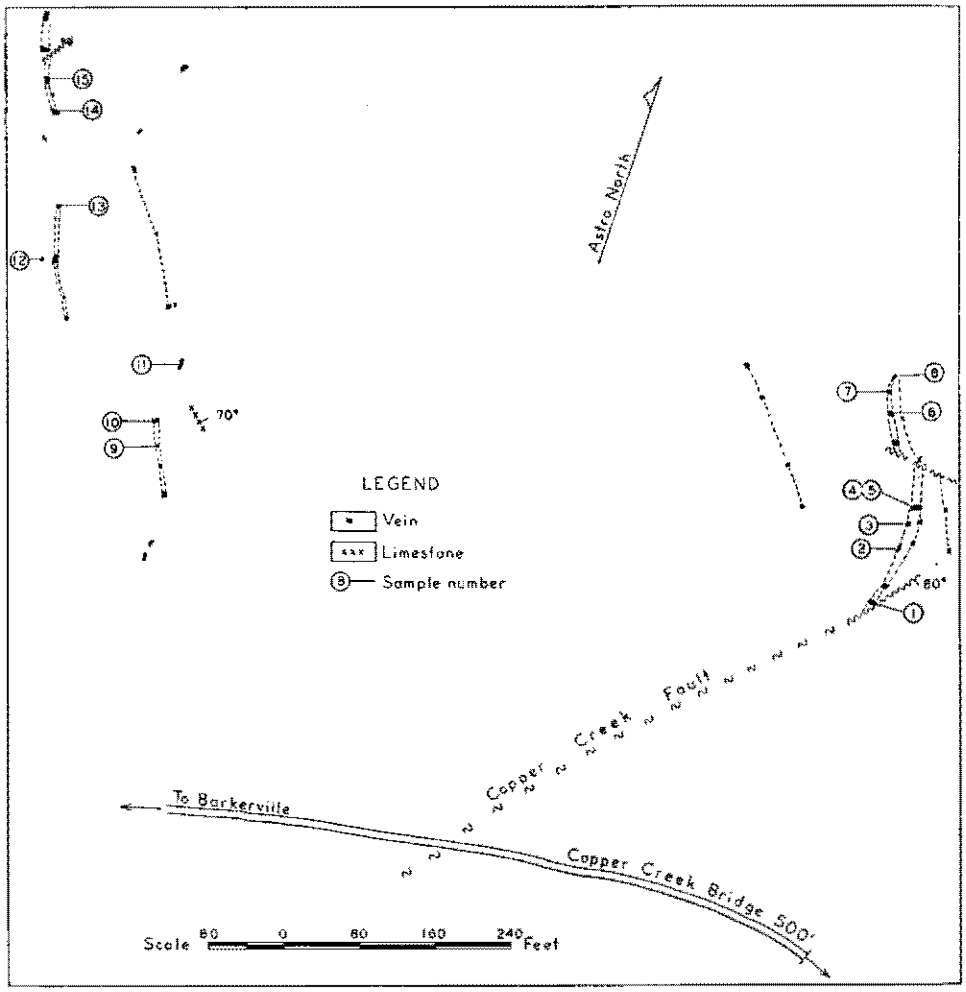


Figure 2. Scarn group. Plan showing veins and sample locations.

In the quartz veins, high silver values are present only where the quartz is well mineralized with tetrahedrite; the gold content is generally very low, and the tungsten content is erratic and controlled in part by the near presence of limestone.

Assays of Samples from the Scarn Group

No.	Width of Vein	Width Sampled	Gold	Silver	Copper	Tungstic Oxide
			Oz. per Ton	Oz. per Ton	Per Cent	Per Cent
1	10'	Selected from 6"	0.03	114.2	4.16	*Nil*
2	3'	10"	0.01	88.6	2.15	Trace
3	3'	3'	Trace	14.5	0.42	0.04
4	8'	2'	*Nil*	Trace	0.01	0.25
5	18"	18"	Trace	0.3	0.04	0.21
6	7'	12"	Trace	0.1	----	0.06[1]
7	7'	2'	Trace	12.8	0.37	0.08
8	3'	12"	Trace	0.4	----	0.34
9	8'	48"	0.01	9.3	0.51	0.05
10	8'	6-8"	*Nil*	3.9	0.17	0.11[1]
11	2'	2'	Trace	2.9	0.23	0.59
12	7'	2'	0.02	7.7	0.68	0.19
13	18"-2'	4-6"	*Nil*	9.1	0.46	0.01
14	6'	3"	0.025	27.8	1.83	0.05
15	3½'	3½'	0.01	2.9	0.26	Trace

[1] Silicified limestone.

Yanks Peak (52° 121° N.E.)*

Gold

Jim The Jim group consists of eight claims and fractions held by F. H. M. Codville, of Duncan. The property is near Yanks Peak and is 12 miles by road from Keithley Creek ranch. The upper part of the road is best travelled by four-wheel-drive vehicle. The showings comprise quartz veins and lenses containing gold values that outcrop at elevations of from 5,720 to 5,780 feet on the Ridge No. 4 and Jim claims. The showings have been explored underground from an adit at 5,638 feet elevation by about 1,200 feet of drifts and crosscuts.

Work done in 1960 consisted of four diamond-drill holes totalling 500 feet. These holes were drilled in the adit. A crew of from two to three men was employed from June 30th until August 17th.

[Reference: *B.C. Dept. of Mines*, Bull. No. 34, 1954, pp. 65–68.]

CLINTON*

Poison Mountain (51° 122° S.W.)

Copper

Copper Nos. 1 to 4 (New Jersey Zinc Exploration Company (Canada) Ltd.) Vancouver office, 905, 525 Seymour Street, Vancouver 2. This property comprises four recorded claims (Copper Nos. 1 to 4) optioned from H. Reynolds, of Lillooet, and sixteen recorded claims held by the present company. The claims are mainly on the west side of Poison Mountain, about 40 miles northwest of Lillooet near the headwaters of Yalakom River and Churn Creek. The property may be reached by 36 miles of jeep-road from Big Bar ferry on the Fraser River, but the easiest approach now is from Lillooet via the Yalakom River road as far as Blue Creek. From here a 12½-mile jeep-road has been made to the camp on Poison Mountain Creek at 5,400 feet elevation. The principal showings are east of Poison Mountain Creek and on the lower westerly slope of Poison Mountain from 5,600 to 6,000 feet elevation. The claims are underlain by sandstones, argillites, and greywacke. These sediments are intruded by diorite porphyry. Recent work indicates complex structure with many flat-lying

* By A. R. C. James.

faults and complex alteration. The mineralization, comprising disseminations and fracture fillings (mainly chalcopyrite and pyrite), is associated with the alteration of both sediments and porphyry.

The showings were apparently first discovered in 1935. A number of pits and trenches were dug between 1935 and 1946 on the exposures on the Copper No. 1 claim north of Copper Creek, a small creek flowing west into Poison Mountain Creek. In 1956 The Granby Consolidated Mining Smelting and Power Company Limited optioned the Copper group of claims and recorded additional ones in the area. This company did a considerable amount of stripping, and diamond drilled ten holes totalling 1,973 feet. All this work was done on what was then thought to be the most favourable zone of mineralization adjacent to and north of Copper Creek. The average assay of a large number of samples taken near the western end of this zone was 0.60 per cent. The Granby company subsequently dropped their option. In 1959 the present company optioned the property and carried out a comprehensive magnetometer and soil-sample survey.

In 1960 a 12½-mile jeep-road was constructed from the Yalakom River road at Blue Creek to the camp at Poison Mountain. A number of bulldozer trenches and access roads were made on the claims (the overburden cover averages about 15 feet) to investigate anomalies indicated by the 1959 surveys. Fifteen vertical holes were diamond drilled, totalling 2,000 feet. The work indicated fairly widespread areas of mineralization, but copper values were generally low, and the option was terminated at the end of the season. A crew of eight men was employed under the supervision of E. Livingstone.

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

PORCUPINE MOUNTAIN (51° 122° S.E.)

Gold

Porcupine Mountain (Empire Valley Gold Mines Ltd.) Company office, Box 100, Chilliwack. G. H. Clarke, president. This company holds by record ten mineral claims and three fractions on Porcupine Mountain between the Fraser River and Churn Creek. The property, which is at an elevation of from 6,500 to 7,300 feet, is reached by 29 miles of road from the Fraser River bridge near the Gang Ranch. The principal showings consist of a number of gold-bearing quartz veins in dark-green volcanic rocks. Intermittent work has been done on the showings since they were discovered in 1947.

Approximately two weeks' work was done in September and October, 1960, by a crew ranging from four to eight men (all directors of the company) under the supervision of Earl Brett. It is reported that 2,500 feet of road was built in order to facilitate drilling on the lower levels of the Ogden and Turret claims. The road to the Sugar Bowl fraction was cleared. Repairs were made to the roofs of camp buildings.

[References: *Minister of Mines, B.C.*, Ann. Repts., 1948, pp. 92–95; 1954, pp. 98–100.]

LILLOOET*

BRIDGE RIVER (50° 122° N.W.)

Gold

Ace† The Ace Mining Company Ltd., 404, 510 West Hastings Street, Vancouver 2, holds forty-nine recorded mineral claims, ten mineral leases, and forty-four Crown-granted mineral

* By A. R. C. James, except as noted.
† By Stuart S. Holland.

claims covering a considerable area lying for the most part north of the Bridge River and extending for 4 miles west of the junction of Gun Creek. It includes the Wayside, Congress, and Minto mines.

In the autumn of 1959 a new vein was exposed to view about 3,000 feet west of the Congress mine in a rock cut on the new Bridge River road. In December an agreement with Bralorne Pioneer Mines Limited was reached whereby the latter company is to provide funds for exploration work. In the first half of 1960 the showing was traced uphill to the north by a number of irregularly spaced trenches. Surface diamond drilling confirmed the presence of the vein structure down dip to a depth of several hundred feet. In June a drift was started below the Bridge River highway, to explore the shear at depth. The work was done under the direction of J. P. Weeks, chief geologist at Bralorne mine.

The showing, as exposed in the original road cut, is a strongly oxidized mineralized shear striking north and dipping about 55 degrees west. The shear is occupied by quartz mineralized with stibnite, arsenopyrite, and pyrite. A sample taken across 20 inches of strongly sheared and oxidized material assayed: Gold, 0.73 oz. per ton.

Trenching uphill to the north of the road cut picked up the shear along strike for about 500 feet and with exposed widths of as much as 9 feet. Assays of surface samples were sufficiently encouraging for the company to institute surface diamond drilling which confirmed the extension of the vein shear and associated gold values to a depth of at least 200 feet.

By mid-September the drift on the vein shear had been driven a distance of 277 feet. In the drift the shear is seen to have a variable width and to reach a maximum of 5 feet. The shear is not continuously mineralized, but is occupied by several discontinuous lenses of quartz mineralized with stibnite and arsenopyrite. From one a sample taken across 26 inches assayed: Gold, 0.32 oz. per ton. Drifting terminated for the winter on October 31st, at which time the drift was 507 feet long.

A small amount of stripping was done elsewhere on the property in conjunction with the geological mapping done by W. Chinn, of Bralorne mine.

Eight diamond-drill holes totalling 4,848 feet were drilled. Two of these holes, totalling 3,050 feet, were drilled in the Congress mine, and the remaining six in the vicinity of the Discovery vein.

At the end of the season a representative sample of ore from the Congress mine was taken for a metallurgical investigation to be carried out during the winter.

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

Bralorne Pioneer Mines Limited

Company office, 355 Burrard Street, Vancouver 1; mine office, Bralorne. F. R. Joubin, president; J. E. McMynn, general manager; C. M. Campbell, Jr., resident manager; J. S. Thomson, superintendent of mines; C. D. Musser, superintendent of mills. At the end of 1960 this company was operating only the Bralorne mine. The Pioneer mine was closed down in August as a result of the mining out of existing reserves in the 27 vein. The results of development on No. 30 level on this vein proved disappointing, and other exploration failed to indicate new sources of ore. The Pioneer mine was first located in 1897 and has been in continuous production since 1924. In the early thirties it was the leading gold mine in the Province, and in 1933 a total of 82,519 ounces of gold was produced, valued at $2,400,000. By 1944 the Main vein was mined out, but the mine gained a new lease on life when the 27 vein was discovered. In the ensuing years, production again rose to a maximum of 56,198 ounces in 1957. During the whole lifetime of Pioneer mine a total of nearly 2½ millions tons of ore has been mined, yielding approximately 1,330,000 ounces of gold. The average grade of the ore throughout the working life of the mine was 0.54 ounce of gold per ton. In 1960, 50,163 tons of ore was milled.

Bralorne Mine.—The Bralorne mine is on Cadwallader Creek, a tributary of the Bridge River. It is reached by 51 miles of road from Shalalth or 75 miles from Lillooet, both stations on the Pacific Great Eastern Railway. The property was described in some detail in the 1958 Annual Report. The extensive workings are in a generally northwesterly trending vein system which is now being mined at depths of between 3,200 and 4,100 feet below the surface, with development work proceeding up to a depth of 5,000 feet below the surface.

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, 2,000 feet deep from No. 26 to a point just below No. 39 level. The major portion of present production is mined in cut-and-fill stopes between No. 26 and No. 33 levels, the 77 vein being the principal producing vein. 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. In the mill the ore is treated by amalgamation, blanket concentration, and flotation. A sulphide concentrate made by flotation is shipped to the Tacoma smelter. During the latter half of the year, work was in progress on the erection of an entirely new 600-ton cyanide mill to replace the old mill and to provide greater efficiency and improved recovery. It is planned to have the new mill in operation in May, 1961. In 1960, 153,482 tons of ore was milled.

Development work comprised 1,893 feet of drifting, 444 feet of crosscutting, 1,038 feet of raising, and 19,343 feet of diamond drilling. The Queen shaft was sunk from a point 91 feet below No. 37 level to a point 24 feet below No. 39 level station, a distance of 224 feet. A station has been cut at No. 38 level, and a crosscut driven toward the 77 vein; at the end of the year this crosscut was within 250 feet of the vein. Exploratory drifting and diamond drilling was also done on the 51B vein at No. 4 level, and rehabilitation of the Taylor Bridge River crosscut on No. 20 level was carried out with a view to investigating the possibilities of downward extensions of the King structures below No. 14 level.

A sand-fill plant was designed and installed during the year, to use mill-tailings for the hydraulic filling of stopes in place of the present waste fill. The sand and water mixture is pumped from surface to a central reservoir on No. 8 level. From there it is passed downward to the lower workings through a 2⅜-inch diamond-drill hole. The plant is to go into operation in January, 1961, and all new stopes from this date will be sand-filled. Existing stopes will continue to be waste-filled until completion.

The ventilation raise, started in the summer of 1957, was completed by the middle of 1960. This raise, which is 12 feet in diameter and extends from the surface at the old Blackbird portal (No. 4 level) down to No. 25 level, a vertical distance of 3,000 feet, provides an entirely new intake air-shaft and permits cool air from the surface to be supplied direct to the mine workings. A radial fan on the surface at the collar of the raise draws 80,000 cubic feet of air per minute into the mine. Provision is made at the fan housing for installing a second fan in parallel, which could increase the air flow to 120,000 cubic feet per minute. The exhaust air now passes out of the workings via the Crown and Empire shafts and No. 8 and

No. 3 level adits. A comparison of temperature readings taken in various parts of the Queen shaft area in October, 1957, and October, 1960, shows a 5-per-cent drop in dry bulb temperature (from 83.5 to 78.9 degrees) despite the fact that the present workings are deeper. Average relative humidity in the mine was reduced 8 per cent (88 to 81 per cent) over the same period. Average temperature at Queen shaft stations was down 11 per cent from 83.5 degrees in 1957 to 72.3 degrees in 1960.

The number of men employed was 384, of whom 274 were employed underground. Although the year was marred by one fatal accident, it is pleasing to be able to report a marked improvement in the accident rate over last year. The fatal accident occurred in the Queen shaft sinking operations on August 18th. Harold Jessome, an employee of Patrick Harrison and Company, engaged in contract sinking of the Queen shaft, was killed as a result of a Cryderman mucking-machine breaking loose and falling down the shaft. A more detailed description of this accident will be found elsewhere in this Report. Of the non-fatal accidents, a total of twelve compensable accidents was reported during the year. This is a rate per million man-hours of 15.1, which may be regarded as very satisfactory. The accident rate for all lost-time accidents also showed a remarkable improvement. For 1960 this was 19.0 accidents per million man-hours, as compared with 37.3 accidents per million man-hours in 1959, a drop of 49 per cent. When compared with the average lost-time accident rate over the past five years of 47.9, the improvement is even more notable. An active safety organization at this property receives the full backing of management, and regular safety meetings and inspections are held.

Bridge River United Mines Ltd. Company office, 404, 510 West Hastings Street, Vancouver 1. Raymond R. Taylor, president. Capital: 4,500,000 shares, no par value. This company controls twenty-one Crown-granted claims and fractions on the lower reaches of Hurley River, extending for a distance of 2 miles up the river from a point 1½ miles above Gold Bridge. The property includes the Ural, Forty Thieves, and Why Not claims, which were first located in 1896 and 1897. Intermittent exploration work, both surface and underground, has been done for many years on these claims, which lie on the east side of the deep and rugged canyon of the Hurley River. The claims are underlain mainly by andesite of the Pioneer formation and diorite of the Bralorne intrusions, bounded on the west by an outcrop of serpentinized pyroxenite. Quartz-filled fractures occur in the andesites and diorites, some of which have been traced for over 900 feet. These veins in places contain gold values, but the vein matter has hitherto not generally been found to be of ore grade. A number of adits have been driven at various points at the foot of the canyon bluffs to explore the Forty Thieves, Why Not, Jewess, and other veins which outcrop either close to or on the canyon bluffs. Until the present company began work in 1959, the property had been dormant since 1946.

In 1960, work on the property was begun on May 15th and continued until the end of the year. The first work done was to widen and improve the road along the bottom of the Hurley River canyon, which extends about 1½ miles to the foot of the Why Not bluffs. In September a contract was signed with Rayrock Mines Limited for this company to participate in the exploration of the property. By the end of the year 2,300 feet of diamond drilling had been done, mainly on the Why Not vein structure, and detailed geological mapping of the Why Not tunnel was completed. The Ural No. 3 tunnel (giving access to underground workings on the Forty Thieves vein) was reopened for inspection and geological mapping in December, after a large amount of rock had been bulldozed away from above the caved adit. A crew of from three to ten men was employed under the supervision of R. R. Taylor. The work was under the general direction of W. E. Clarke, of Rayrock Mines Limited.

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

Hurley River Mines, Ltd. Company office, Box 305, Lillooet. President, Paul Polischuk, Bralorne. Capital: 3,000,000 shares, $1 par value. This company controls several properties in the Bridge River area and one near the head of Lillooet Lake. The largest property is a group of fifty-six claims in the general area northwest of Hurley River about 2½ miles west of Bralorne. The claims extend on either side of Gwyneth Lake and for 1¾ miles southwest of the lake. The property is approached by a road from Bralorne by way of the Alma prospect and the Hurley dam-site. The claims are largely underlain by argillaceous, limy, and volcanic rocks of the Hurley formation, with some granitic intrusives immediately to the east of Gwyneth Lake. Interest in 1960 has been centred on the contract of an easterly striking felsite dyke with the aforementioned rocks on the Gary claim 2,300 feet south-southeast of Gwyneth Lake. Approximately 200 feet of packsack diamond drilling was done here in the spring by Paul Polischuk, and it was reported that significant gold values were obtained in some of the holes. Rayrock Mines Limited optioned the property in June and diamond drilled six holes totalling 1,800 feet in the same area drilled by Paul Polischuk. A crew of five men was employed under the supervision of B. Nekrasov. The option was subsequently dropped.

The company also holds a group of claims, known as the Spruce group, in the upper part of Truax Creek. Some diamond drilling and surface stripping was done on these claims, and a crew of four men was employed under the supervision of Paul Polischuk.

Fraser River (50° 121° N.W.)

Copper

Askom (Tombac Exploration Ltd.) Company office, 510 West Hastings Street, Vancouver 1. Isaac Shulman, president. Capital: 5,000,000 shares, no par value. In January this company optioned a group of twenty-four recorded claims, known as the Askom group, from A. Jenner and John Rickard, of Lillooet. The property is on the west side of the Fraser River in the vicinity of Nesikep Creek, about 15 miles southeast of Lillooet. It is reported that there are four or five outcrops with indications of copper mineralization over a distance of approximately a mile. Work was done on the property over a three-month period in the early part of the year with a total of four men employed under the supervision of J. Sullivan. A number of trenches were dug and sampling was done in the mineralized zones. The assay results from the sampling is reported by the company to have averaged a low percentage of copper, and the option was subsequently dropped.

ANDERSON LAKE*

Gold

Golden Contact (Cassiar Copperfields Limited) (50° 122° N.E.) Company office, 928 West Pender Street, Vancouver 1. John A. McKelvie, president and manager. Capital: 5,000,000 shares, $1 par value. This company holds under option agreement the Golden Contact property, on the north slope of McGillivray Creek about 5 miles by

* By A. R. C. James.

jeep-road from Ponderosa Ranch on the Pacific Great Eastern Railway. The main showings are quartz veins, locally mineralized and containing gold values, within a schistose host rock. The showings were discovered in 1898, and a considerable amount of underground exploration has been carried out over three separate periods—1900–1903, 1932–1938, and 1947–1953. There are six adit levels from the No. 1 at 3,615 feet elevation to the Pep adit at 2,938 feet elevation. The underground workings were inaccessible when the present company took over.

The present company began work in May, 1960. The camp at the 3,000-foot level was rehabilitated. While attempting to open the Fortyniner adit on June 1st, two of the crew were trapped by a cave-in. This involved a major rescue operation, which is described elsewhere in this Report. The men were released safely after thirty hours. After this incident it was decided to bulldoze the unconsolidated and weathered material away from the portals of both the Fortyniner and the Pep adits. Over 8,000 yards of material was moved from the two portals before solid rock was reached. The new portal at the Fortyniner adit was finally set up on October 29th and access was gained to the old tunnel. The Pep adit was opened in July, but caving conditions in the tunnel made progress very slow. In one section a diversion tunnel 110 feet long had to be driven. By the end of the year, access had been gained on this level to the underground workings. The object of this work is to prepare the property for a detailed geological examination and for sampling. The future programme will depend on the results of these findings.

A crew of six men was employed from July to December under the supervision of John McKelvie.

HIGHLAND VALLEY*

Copper

Trojan Consolidated Mines Ltd. (50° 120° N.W.) Company office, 809, 837 West Hastings Street, Vancouver 1. G. L. Conn, president. This company holds about eighty claims and fractions north and east of the south peak of Forge Mountain. For most of 1960 the property continued under option to Rio Tinto Canadian Exploration Limited, which did geophysical and geochemical surveying. A surface diamond-drill hole 341 feet long was drilled about 2,000 feet southeasterly from the Highland shaft. An average crew of six men was employed from May to October under the supervision of L. B. Gatenby and N. G. Mattocks.

Krain Copper Ltd. (50° 121° N.E.) Company office, 1004, 850 West Hastings Street, Vancouver 1. D. F. Farris, president. This company holds about eighty claims and fractions which adjoin the north boundary of the Trojan property. In 1960 a part of the property was optioned for a time by Rio Tinto Canadian Exploration Limited, which did geophysical work and drilled one hole 530 feet long on the D.W. group. This hole was in volcanic rocks for its total length.

Beaver (50° 120° N.W.) This group lies southwest of the Lodge group and is held jointly by Farwest Minerals Limited (company office, 1075 Melville Street, Vancouver) and Beaver Lodge Uranium Mines Limited, of the same address. In 1960 ten claims in the north part of the group were optioned for a time by Rio Tinto Canadian Exploration Limited, which did geophysical surveying.

* By J. M. Carr.

Lodge

(50° 120° N.W.) This group of about forty-seven claims and fractions lies between the Trojan and Bethlehem properties and is held by Northlodge Copper Mines Limited (company office, 1075 Melville Street, Vancouver).

In 1960 the group was optioned for a time by Rio Tinto Canadian Exploration Limited, which did geophysical and geochemical surveying and drilled one hole 565 feet in length.

Bethlehem Copper Corporation Ltd.

(50° 120° S.W.) Company office, 814, 402 West Pender Street, Vancouver 3. H. H. Huestis, president; C. J. Coveney, chief geologist. This company holds about 158 claims and fractions immediately east of Quiltanton (Divide) Lake, about 30 miles by road southeast of Ashcroft. In 1960 work was mainly done in the vicinity of the East Jersey mineralized zone, on behalf of Sumitomo Metal Mining Company of Tokyo. It included two raises, each about 100 feet in length, from which percussion drilling was done. About 12,000 feet of surface diamond drilling was done, together with some trenching. In addition, three churn-drill holes, each about 300 feet deep, were drilled for water near Witches Brook, of which two were productive. Detailed topographic surveys were made of prospective open-pit and plant sites. Five men were employed, together with a mining crew provided by Intermountain Construction Ltd.

Jericho Mines Limited

(50° 120° S.W.) Company office, 104, 569 Howe Street, Vancouver 1. Hamlin B. Hatch, president. This company holds about eighty claims south of Witches Brook, about 7 miles east of Quiltanton (Divide) Lake. In 1959 the company built a road from about 1 mile west of the camp on Witches Brook to a showing where trenching was then done. This showing is 1 mile northwest of a lake which is known locally as Billy Lake and which lies 1 mile northwest of the Billy Lake shown on published maps.

Work done in 1960 included diamond drilling which was partly at this showing and partly at a locality near the road about 2 miles north of Billy Lake. A geophysical survey was also made.

MERRITT*

Geology of the Promontory Hills

Introduction

This account is designed to accompany a geological map of an area of about 24 square miles, extending south and west from the Craigmont mine (Fig. 3). The northern boundary of the area lies partly north of Birkett Creek, on which the mine is situated, and partly south of David Creek. The western boundary is on Indian Reserve No. 9, due north of Canford, and the southern and eastern boundaries are along the valleys of Nicola River and both Stumbles (Ten Mile) and Guichon Creeks, which join the Nicola River near Lower Nicola. The country is only moderately rugged and in part has a pronounced east-northeasterly grain. It is dominated by a dissected ridge whose highest feature is Lookout Point (5,688 feet). North of the ridge, the terrain is typical of the Interior Plateau and is more diversified, with rather bare or park-like south-facing slopes which descend interruptedly to the main valleys, which are at about 2,000 feet elevation. One or two benches and high-level valleys afford rough pasturage or farm land, and in recent

* By J. M. Carr, except as noted.

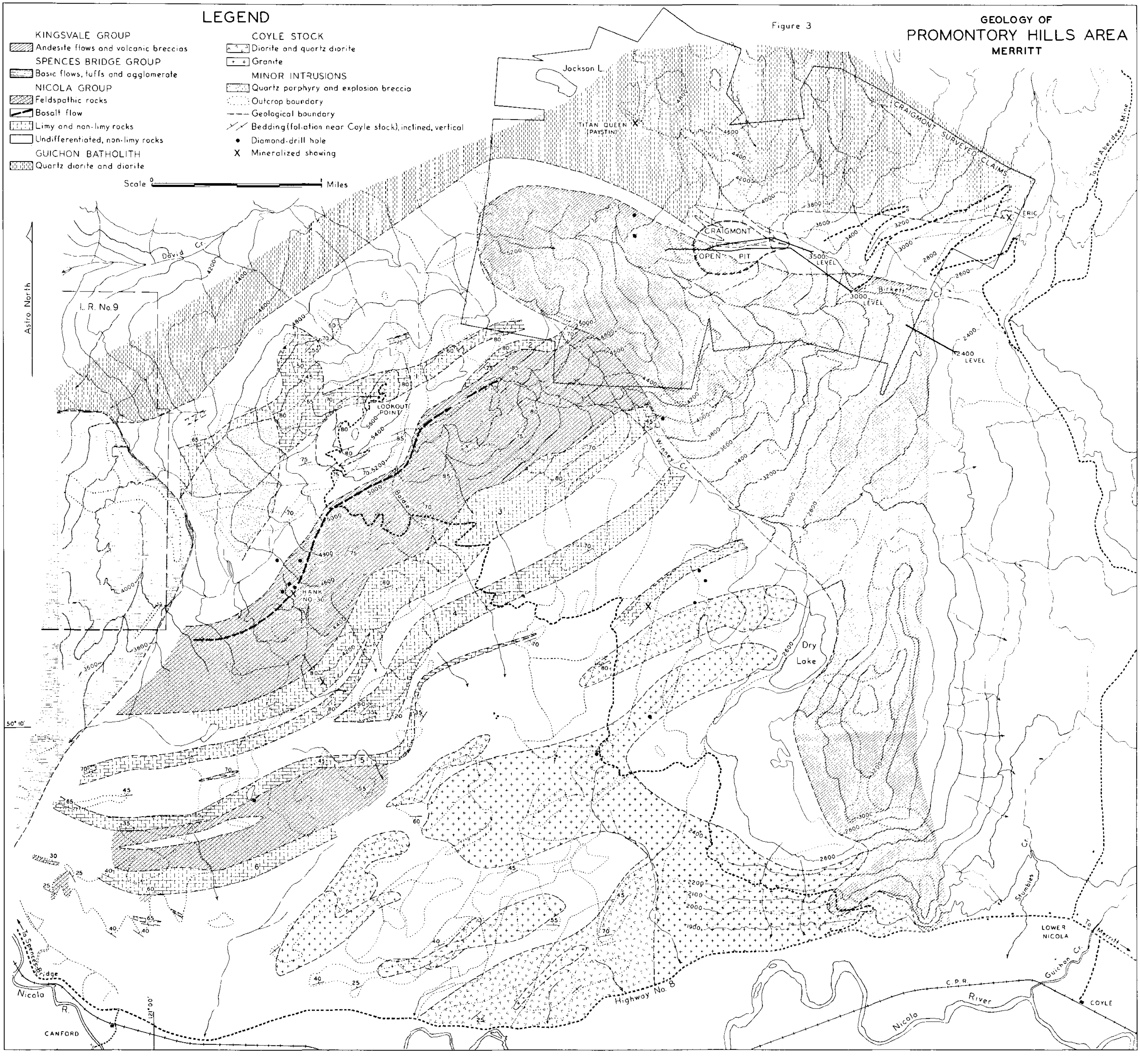


Figure 3
GEOLOGY OF
PROMONTORY HILLS AREA
MERRITT
LEGEND
KINGSVALE GROUP
Andesite flows and volcanic breccias
SPENCES BRIDGE GROUP
Basic flows, tuffs and agglomerate
NICOLA GROUP
Feldspathic rocks
Basalt flow
Limy and non-limy rocks
Undifferentiated, non-limy rocks
GUICHON BATHOLITH
Quartz diorite and diorite
COYLE STOCK
Diorite and quartz diorite
Granite
MINOR INTRUSIONS
Quartz porphyry and explosion breccia
Outcrop boundary
Geological boundary
Bedding (foliation near Coyle stock), inclined, vertical
Diamond-drill hole
Mineralized showing
Scale 0 1 Miles
Astro North
Jackson L.
TITAN QUEEN (PAYSTIN)
CRAIGMONT SURVEYED CLAIMS
CRAIGMONT
OPEN PIT
3500 LEVEL
3000 LEVEL
2400 LEVEL
Birkett Cr.
ERIC
To the Aberdeen Mine
David Cr.
I. R. No. 9
LOOKOUT POINT
HANK NO. 30
Dry Lake
Stumbles Cr.
LOWER NICOLA
To Merritt
Guichon Cr.
COYLE
C.P.R.
Nicola River
Highway No. 8
To Spences Bridge
Nicola R.
CANFORD
50° 10'
121° 00'

years there has been considerable logging of Douglas fir and red pine in this part of the area. The climate is semi-arid and no permanent streams occur in the area. Several creeks flow radially from the ridge and are partly linear in course. Access to the area is mainly by an all-weather road to Lookout Point that is 8 miles long and leaves the Merritt–Spences Bridge highway about 7 miles west of Merritt. This road serves the forest lookout and the microwave station at Lookout Point and connects with logging-roads of lesser quality which give wide access to the rest of the area. It also connects with a recently completed jeep-road from Craigmont mine, at a point about 1 mile south of the lookout. Principal access to the mine is by a road leaving the highway at Lower Nicola, which is 6 miles to the west of Merritt and near the Canadian Pacific Railway branch line at Coyle. Natural-gas and oil pipe-lines pass through Lower Nicola and Merritt, respectively.

The Craigmont orebody is on the eastern slope of Promontory Hills, about 2½ miles east-northeast of Lookout Point. It is a massive deposit of chalcopyrite, magnetite, and specular hematite, and occurs in skarns of the Nicola group close to the margin of the Guichon batholith. After the orebody was discovered in 1957, this and adjacent areas have been heavily prospected by a variety of means, including magnetic, electrical, geological, and soil-sampling surveys. Large parts of the area remain covered by mineral claims in good standing, and prospecting still continues. Despite all this work, which is some cases included trenching and diamond drilling, no other mineral occurrences of significance have yet been found. Much of the area either is underlain by rocks of post-mineral age or is obscured by superficial deposits, and probably less than 3 per cent of it is occupied by Nicola outcrops.

The present mapping made use of existing geological information and was done in 1959 and 1960. A preliminary geological map was made by R. Lee, using vertical air photos obtained from Hunting Survey Corporation and transferring the field information to a provisional base map on a scale of 1 inch to 1,000 feet. Following limited additional work in 1960, the final map was compiled on a topographical base map of the same scale, made available by Canadian Exploration Limited and associated companies. A summary of the geological features recognized during preliminary mapping has already been published, together with a general account of the Craigmont orebody, in the 1959 Annual Report. The present account makes no attempt to describe in detail the geology and structure of the Craigmont mine, which are still being investigated.

[References: *Geol. Surv., Canada,* Mem. 249, Nicola Map-area, 1948; *Minister of Mines, B.C.,* Ann. Repts., 1957, p. 28; 1958, pp. 24–27; 1959, pp. 31–34.]

Nicola Group

Strata of the Nicola group, of Upper Triassic age, directly underlie about half the mapped area and contain the Craigmont orebody. They are intruded by the Guichon batholith and by a stock northwest of Lower Nicola, as well as by numerous smaller igneous bodies which are variously of basalt, andesite, and quartz porphyry, or quartz-porphyry breccia. The Nicola rocks are chiefly tuffs, tuffaceous sediments, and limestone together with impure limy beds. Except to the southwest, they generally possess steep dips. The stratigraphy is still uncertain, largely because no reliable marker beds have been recognized and the fossil content of these and other Nicola rocks has so far been insufficiently studied. Lithological mapping has distinguished two kinds of assemblage, characterized by feldspathic and limy rocks, respectively, which occupy a number of more or less extensive belts. These belts strike northeastward across the main part of Figure 3, and are separated by belts in which the rock types have not been differentiated. Correlation of any of the belts with rocks farther east at the Craigmont mine is not yet possible.

Feldspathic Rocks.—Feldspathic rocks comprise the whole of a persistent belt some 2,500 feet wide and occur less exclusively in two more southerly belts. They are mainly tuffs, with some tuff breccia and volcanic conglomerate, and are characterized by a prevalent purple-red colour as well as abundant white feldspar crystals, which accompany volcanic rock fragments in a dense matrix. Although commonly reddish, the colour of the rocks may show gradations to pale green or white. These differences may be due partly to reduction of iron oxides and to dissemination of epidote by hydrothermal alteration. Rare beds of white quartz tuff and tuff breccia, as much as 100 feet wide, could be traced for no more than a few hundred feet. The rocks are mostly massive or thick bedded, and commonly exhibit a poor to moderate bedding foliation. Thin beds of fine red tuff occur and are generally regular and undeformed. Graded bedding and related sedimentary structures have not been observed.

The feldspathic rocks contain varying proportions of detrital volcanic rock fragments, crystals, and matrix. The rock fragments are of red, brown, green, grey, or black aphanitic material, which is only feebly porphyritic or vesicular. They occur in amounts ranging from as much as 25 per cent in volcanic conglomerates and pebble beds, through intermediate amounts in tuff breccias, to about 10 per cent in medium-grained tuffs. Rounding of the fragments increases with their size—the tuffs and tuff breccias commonly contain unmodified, irregular, or angular fragments which seldom exceed one-quarter inch, whereas the conglomerates have abundant, well-rounded or ovoid fragments as much as 6 inches in size. Southeast of Lookout Point, some beds resembling agglomerate contain unstratified, subangular blocks of volcanic rock as much as 1 foot across.

The crystal detritus, which comprises as much as 25 per cent of most rocks, consists chiefly of whole or broken laths of plagioclase feldspar as large as 2 millimetres, which are in places accompanied by a few quartz grains of similar size. Like the volcanic rock fragments, the crystal debris is distributed haphazardly in the matrix, without perceptible sorting. The matrix itself is a generally dark, tough, and aphanitic material comprising at least one-third of the rock.

Under the microscope the tuffs show additional features. Volcanic fragments are seen to range in size downward to less than 1 millimetre, and to consist of chloritic andesites or basalts showing wide textural variations, from holocrystalline, microporphyritic rocks to glassy microvesicular types. Feldspar fragments show no evidence of attrition following breakage, and the quartz grains are identified as crystals which show magmatic corrosion and are deeply penetrated by the flow-banded matrix. Small well-shaped crystals of augite occur in some rocks, which also contain minute shard-like shapes of fine-grained quartz or feldspar. Magnetite is well disseminated and accounts for the pronounced magnetic susceptibility of the rocks, which can be tested with a suspended hand-magnet. The matrix of the rocks appears as a turbid, largely unresolvable fine-grained aggregate of medium refractive index and is partly flow textured.

In all three belts of outcrop the feldspathic rocks are accompanied by rare flows of basalt lava, which are the only extrusive Nicola rocks seen in the area. The flows are as much as 50 feet thick and may extend laterally for some thousands of feet. They consist mainly of a dark-grey porphyritic rock with abundant small phenocrysts of plagioclase feldspar and others of a dark mineral oriented in the plane of flow. Under the microscope this rock is holocrystalline and consists chiefly of labradorite feldspar, hornblende, and augite with hornblende mantles, together with much accessory magnetite and some chlorite and epidote. Near the top of a flow the non-vesicular rock passes rapidly into a vesicular, less porphyritic variety which within a few feet may become intimately mixed with red scoriacous lava, and this, by decrease in the number and size of enclosed masses of the vesicular rock, may grade upward into a fissile red rock resembling fine-grained tuff. Where these relationships are sufficiently exposed, they provide the only fully reliable means of identifying the top of any of the Nicola rocks. Unfortunately, only one flow in the main feldspathic belt is exposed in this way.

Limy Rocks.—Limy belts which contain roughly equal proportions of limy and non-limy rocks are numbered southward successively from 1 to 6 (Fig. 3). There are, in addition, scattered outcrops of limy rocks which have not been correlated with the recognized belts. In each belt, all gradations exist between pure limestone and non-limy rocks. The limy rocks are limestones, limy tuffs, tuffaceous limy greywackes, and limy argillites, whilst the non-limy rocks are similar to the undifferentiated rocks which occur elsewhere. As mapped, the belts are lenticular or braided, with a thickness as great as 1,400 feet and commonly much less.

Poorly to well preserved fossils appear restricted to the limy rocks. The pelecypod *Halobia* was identified by W. R. Danner from outcrops in belt No. 1 at Lookout Point and indicates that these rocks belong to the Karnian stage of the Upper Triassic.

The limestones commonly weather grey or tan coloured and are either massive or foliated. Bedding is not generally seen, except at interfaces with other beds or where impure laminæ are revealed by differential weathering. Massive limestone appears confined to the south of the main feldspathic belt, and is the principal component of beds whose thickness is between 50 and 100 feet in belts Nos. 3, 4, and 5, and less elsewhere. It is a grey or white rock which is either porcellainous or unevenly grained and somewhat porous, with casts or fragments of fossils. A somewhat impure variety was seen under the microscope to consist predominantly of fine-grained calcite together with a few clastic grains of calcite, quartz, feldspar, and volcanic rocks.

Foliated limestone is widely distributed and may locally be associated with massive limestone, from which it is probably derived by partial recrystallization under conditions of stress. All limestones seen to the north of the main feldspathic belt and in the eastern part of belt No. 3 are foliated. They occur in beds which seldom exceed 40 feet in thickness and which commonly contain thin layers of rocks similar to those forming adjacent beds. The foliated limestone is a black, grey, or less commonly white rock which seldom contains fossils and has a compact, generally fine-grained texture. Foliation is expressed by differential weathering as a lineated, often contorted or swirly pattern whose strike commonly differs from that of the beds. Some outcrops show a flaggy or platy jointing that is partly curved or warped, and is thought to be mainly controlled by the foliation. The fabric of the limestones is frequently complicated by structures which combine flowage of limestone with brecciation and disintegration of the enclosed thin beds. These structures are described below. Fragments derived from the brecciated beds are dispersed in the limestone, which therefore assumes a very heterogeneous appearance. Some of the foliated limestones are pebbly or gritty, and contain crowded, subangular, or rounded pebbles and smaller fragments of volcanic rocks or occasionally limestone. This sedimentary detritus is oriented more with the foliation than with the bedding and may therefore be hard to tell, in some outcrops, from dispersed tectonic fragments. The foliated limestones and rocks adjacent to them are sparingly traversed by calcite veins. Under the microscope the limestones are seen to be marbles consisting of foliated even-grained aggregates of inequidimensional calcite crystals in common alignment. Exceptionally, the rocks have an average grain size as great as 3 millimetres. The black foliated limestones differ from the others only in containing carbonaceous streaks and wisps.

Other limy rocks closely resemble their non-limy counterparts amongst the undifferentiated rocks. For example, a tuffaceous limy greywacke may differ from an undifferentiated rock only in the lime content of its fine-grained matrix. This rock would typically consist mainly of lithic or glassy volcanic detritus, quartz, and feldspar grains, together with a plentiful fine-grained matrix. A typical limy vitric tuff is quartz free, and consists largely of closely spaced fragments of volcanic glass set in a limy aphanitic matrix. Such tuffs occur as beds ranging from a few inches to as much as 80 feet thick, and are mainly coloured light to dark brown or green. Although poorly sorted, they frequently possess a granular foliation which may be primary if parallel to bedding but which may, alternatively, lie across the bedding and therefore be secondary.

Limy argillite occurs as beds not more than a few feet in thickness, in association with beds of limestone. It is a soft, fissile, rather fossiliferous, fine-grained rock which is black, brown, or grey in colour and may be banded. Under the microscope it appears foliated and semi-opaque, and contains much finely divided calcite together with scattered angular fragments of quartz and feldspar.

Undifferentiated, Non-limy Rocks.—The undifferentiated, non-limy rocks show a considerable range of fabric and composition. They include lithic, vitric, and quartz tuffs, tuffaceous greywacke, and argillite, all of which are widely distributed. The tuffs and argillite occur either as massive beds as much as 100 feet thick or in thin- to medium-bedded sequences with a variety of other rocks, some of which may be limy. Tuffaceous greywacke is generally restricted to these varied sequences, which are best seen to the north of the main feldspathic belt.

The *lithic tuffs* are hard, compact rocks coloured variously green, grey, dark red, or black. They are mostly of fine- to medium-grained appearance and are characterized by abundant volcanic rock fragments set in a dense matrix which comprises from one-quarter to more than one-half of the rock. They differ from the feldspathic rocks principally in their wider colour range and lack of conspicuous feldspars. The rocks are mostly poorly sorted. The rock fragments, although generally similar to those in the feldspathic rocks, seldom exceed one-quarter inch in size and include pale glassy fragments not seen in the latter rocks. Most are angular or irregularly globular in shape, but in some beds they are lenticular and confer a foliation on the rock. Crystal detritus is subordinate in the lithic tuffs and consists of partly broken plagioclase feldspars up to 1 millimetre in size together with, in some rocks, rounded or broken quartz crystals which are both small and scarce. The aphanitic matrix is coloured either light or dark green, grey, or red and occurs in sufficient quantity to prevent almost all contact between the rock or crystal fragments. Under the microscope it shows the same ultrafine appearance as the matrix of the feldspathic rocks, which it closely resembles. It includes slender microlites of feldspar together with finely granular areas, which may have formed by partial devitrification of the otherwise glassy material. In places the matrix shows a banding. Some of the rocks contain well-disseminated magnetite and possess a pronounced magnetic susceptibility.

The *vitric tuffs* are distinctive, greyish-green or buff-coloured rocks which are tough and well foliated, and characterized by a lenticular granular texture. They occur in alternating beds of differing grain size, ranging from fine to medium grained. In hand specimens they exhibit rather closely packed, lenticular or rudely ovoid fragments of assorted murky-white, grey, or greenish volcanic glass, each with a somewhat fretted outline emphasized by a narrow white border. The fragments are oriented in a wispily foliated, glassy matrix of pale-greenish, grey, or buff colour, and are seldom accompanied by more than a few small crystal grains of feldspar and occasionally of quartz. Under the microscope a typical specimen of vitric tuff consists predominantly of flow-textured, glassy and microcrystalline fragments, many of which are scarcely distinguishable from the quartzofeldspathic matrix. The latter encloses a few poorly shaped feldspars, either as single or aggregated crystals or, in another specimen, as partly broken grains accompanied by others of quartz. The vitric fragments are mostly between one-half millimetre and 2 millimetres long, and the length is generally about twice, and rarely as much as eight times, the width of the fragment. The shape and common orientation of the fragments, together with the variable, foliated crystallinity and flow-oriented texture of both fragments and matrix, is responsible for the excellent foliation possessed by these rocks.

The *quartz tuffs* are characterized chiefly by conspicuous quartz grains and a porphyritic aspect. They form massive beds which weather white, buff, or dark brown, and are tough grey rocks containing crystals of quartz and white feldspar set in a copious matrix of light- or dark-grey colour. Some of dacitic composition resemble quartz porphyry, and their clastic, bedded nature is obvious only on weathered surfaces or under the microscope. Aphanitic fragments comprise about one-quarter of the dacitic quartz tuffs and blend almost invisibly with the matrix, which differs from the fragments only in a more chloritic and unevenly granular appearance, as seen microscopically. Whole crystals and jagged fragments of plagioclase feldspar as much as 3 millimetres in size are accompanied in the matrix by others of quartz, which also forms rare single crystals within aphanitic fragments. Whether in the fragments or in the matrix, the unbroken quartz crystals possess shapes indicative of magmatic resorption. The crystals include and are veined, embayed, and mantled, partly or completely, by a fine-grained quartzofeldspathic material, which is identical to the aphanitic fragments and is of igneous origin. Another quartz tuff, darker and more foliated than the dacitic quartz tuffs, shows fewer pyroclastic features and a diversity of lithic fragments, of which some are of rather basic, fine-grained rocks. It has an appreciable magnetic susceptibility, which is explained by its relatively high content of disseminated magnetite.

The *tuffaceous greywackes* are thin- to medium-bedded rocks ranging in grain size from siltstones to grits, and occurring as sequences as much as 100 feet thick. They are comparatively well sorted and foliated, and appear to have formed by the rapid deposition of predominantly volcanic detritus, largely of dacitic composition. Stratigraphic tops seem to be indicated in places by scoured or graded beds, but the latter may show a reversed gradation and must therefore be used with caution. Wavy and truncated bedding suggest some pre-consolidational movement or slumping, but effects of this sort are hard to tell from those due to later deformation.

The *greywackes* are grey rocks that commonly weather buff and consist of lithic and crystal fragments set in an aphanitic matrix. A typical rock is estimated to consist of: Quartz, 45 per cent; feldspar, 15 per cent; lithic fragments, 15 per cent; matrix, 25 per cent. The lithic fragments are partly identical with those in the dacitic quartz tuffs and partly microvesicular, flow-textured glassy volcanic rocks. They are mostly subangular to irregular in shape. The crystal grains and fragments vary in both size and roundness; the smaller are mostly freshly broken chips and the larger are about 2 millimetres in size and of varied shape. Some of the quartz is similar to that in the quartz tuffs, and is therefore volcanic in origin. The matrix of the greywacke is a somewhat chloritic quartzofeldspathic aggregate of fine but variable grain size. Some of the greywackes are cherty, partly banded rocks, in which the matrix is excessive and encloses a few lithic fragments as well as numerous small feldspar fragments and quartz granules.

Argillite is a soft, grey, dark-brown, or black partly banded rock which frequently contains pyrite and so weathers rust coloured. It forms lenses and beds which range in width from a fraction of an inch rarely to as much as 100 feet, and which persist in some cases for several hundreds of feet along the strike. The rock is unfossiliferous and uniformly fine grained, and breaks either subconchoidally or with a poor fissility, but where it is locally strongly deformed a perfect cleavage develops. Under the microscope the rock is seen to consist largely of unresolvable dark material containing stray fragments of quartz and feldspar.

Spences Bridge Group

Rocks of the Lower Cretaceous Spences Bridge group occupy the western boundary of the mapped area and include flows, tuffs, agglomerate, and dykes of a general basic composition. They have not been examined in detail and their structure is poorly known. No contacts with adjacent rock units were observed, but the group presumably overlies both the Nicola rocks and the Guichon batholith. The rocks are brown, grey, or green, and weather with a prevalent brown colouration. Porphyritic basalt or andesite is widely distributed and is a massive rock consisting predominantly of a dark, microcrystalline or glassy groundmass in which occur scattered, partly saussuritized laths of plagioclase feldspar together with small crystals of pyroxene and magnetite. A rude flow orientation afforded by the feldspars varies greatly in direction. Lithic tuff is widespread. It is a medium-grained rock somewhat resembling but less indurated than the feldspathic rocks of the Nicola group; in places it contains carbonaceous impressions of plant stems. The tuff consists chiefly of partly rounded black or red fragments of glassy volcanic rocks, some of which are vesicular and others porphyritic, together with varying quantities of whole or broken feldspar laths in a fine-grained matrix. Agglomerate in the northern part of the outcrop area consists of a tuffaceous matrix enclosing somewhat rounded fragments and blocks of porphyritic volcanic rocks at much as 2 feet across. Northerly trending dykes of basalt or andesite cut the Spences Bridge rocks and, in diminishing numbers, also cut the Nicola rocks farther to the east.

Kingsvale Group

Unmineralized andesites and volcanic breccias which occupy a large eastern part of the area are assigned to the Kingsvale group of upper Lower Cretaceous age. The rocks are generally poorly stratified and their structure is obscure. At Craigmont, they overlie part of the orebody and rest on an unevenly eroded surface of weathered Nicola rocks, but to the east in the mine the contact is steep and faulted. A steep contact may also exist along part of the western margin of the Kingsvale rocks, adjacent to and parallel with the Winney Creek lineament.

Although the andesites show few of the features which normally serve to identify extrusive rocks, most if not all are considered to be flows. They are poorly to moderately vesicular, massive rocks, many of which possess a more or less well-developed trachytoid texture due to the linear or planar orientation of phenocrysts. This texture varies widely in attitude and may be steep. At Craigmont the rocks overlie local basal accumulations of tuff and are seen to be stratified. Volcanic breccia is widespread throughout the area and consists of rounded to angular fragments or blocks of andesite which are embedded in a matrix of argillized andesite tuff. The fragments are as much as 2 feet in size and are unsorted and unoriented. Some of the outcrops form cliffs which are eroded to produce hoodoos, such as the rock pinnacles that are seen near the highway. No true sediments have been observed in outcrop, but a coal-ball is reported to have been found in argillic material associated with Kingsvale volcanic rocks in the 3000 level at the Craigmont mine.

The Kingsvale rocks mostly weather grey or brown, but some layers show a pervasive reddish alteration, which appears chiefly to involve oxidation of magnetite and kaolinization of feldspar. Other layers are altered to a white colour, and these rocks are argillic and possess swelling properties due to a content of bentonite. At Craigmont, a bentonitic flow some 30 feet thick rests partly on Nicola rocks and is irregularly overlain by fresh andesite in a manner suggesting that the white alteration took place before the succeeding, unaltered rock was deposited. Throughout the Kingsvale rocks, veinlets containing either epidote, quartz, chalcedony, calcite, or a zeolite are sparingly present, and are very rarely accompanied by trace amounts of malachite.

The fresh andesites are light or dark grey, aphanitic rocks containing as much as 30 per cent by volume of phenocrysts. These invariably include prismatic crystals of brown or black hornblende and laths of clear plagioclase feldspar, together with smaller crystals of one or more of the following minerals: green clinopyroxene, brown orthopyroxene, and biotite. Vesicles are rare, small, and irregularly shaped, and may be lined or partly filled by zeolites or other white minerals. Under the microscope the feldspar in some rocks is labradorite, and the aphanitic groundmass of the rocks is seen to contain a little disseminated magnetite and very small crystals of the phenocryst minerals. In hand specimens, fresh andesite shows an appreciable magnetic susceptibility.

Intrusive Rocks

These include rocks of the Guichon batholith and the Coyle stock, and small intrusive bodies which chiefly occur in the Nicola rocks and the Coyle stock.

The Guichon batholith extends for some 40 miles to the north of the mapped area and is known to be of early Mesozoic age. Its eastern contact coincides approximately with Guichon Creek and probably joins the southern contact not far east of the present mapping. The southern contact, as represented in the area, is poorly exposed and has little or no topographic expression. With some irregularities, it strikes westward from the Eric showing for a distance of about 3 miles and then west-southwestward for about the same distance before apparently being covered by rocks of the Spences Bridge group. This western part of the mapped contact probably follows a southwesterly prong of the batholith, which apparently separates Nicola rocks in the present area from others that occur more than 1 mile farther northwest. Where exposed, the batholithic margin is relatively sharp. The marginal batholithic rocks contain dark, fine-grained inclusions and are perceptibly foliated in planes which generally dip steeply and mostly strike parallel to the mapped trend of the contact. The adjacent Nicola rocks are also foliated, and are principally either hornfels or schistose and gneissic rocks which are veined in network fashion by inhomogeneous dioritic material.

The batholithic rocks of the area are principally rather uniform quartz diorites or, at marginal localities such as at Craigmont, diorites. Granite or quartz monzonite was seen in small amounts at the Eric showing, in association with diorite or quartz diorite. A prevalent rock at places more or less removed from the contact is a medium-grained, poorly foliated quartz diorite whose estimated modal composition is typically as follows: Quartz, 15 per cent; orthoclase, 5 per cent; plagioclase, 45 per cent; biotite, 3 per cent; hornblende, 30 per cent; accessory minerals, 2 per cent. A more porphyritic quartz diorite occurs near the contact of the Spences Bridge group, and is a medium-grained rock containing hornblendes as much as 1 centimetre in size.

At Craigmont, two principal varieties of diorite were emplaced prior to mineralization. A finer grained variety enclosing the east end of the orebody is a somewhat foliated mesocratic rock containing small amounts of disseminated quartz and biotite. The other variety is more porphyritic and occurs apparently as tongue-like, partly flat-lying masses in the north wallrocks. It contains subhedral to anhedral hornblendes some of which are as much as one-half centimetre in size.

The Coyle stock intrudes Nicola rocks in the south-central part of the area and is of irregular shape. It apparently consists of several roughly concordant bodies, mainly of quartz diorite, and discordant bodies of granite or quartz monzonite. Its northwestern margin is gently convex and partly coincides with a pronounced topographic lineament that is devoid of exposures. In other directions the margins of the stock are obscured by Kingsvale rocks or by superficial deposits in the Nicola Valley.

In the dioritic bodies the prevalent rock is a fine- or medium-grained, mesocratic quartz diorite which consists chiefly of plagioclase, hornblende, and quartz, and may also contain orthoclase or biotite. This rock is somewhat foliated and encloses dark, fine-grained xenoliths of varied size and shape. The more elongate ones tend to lie in the plane of foliation, which generally strikes northeastward and dips in either direction.

The granitic bodies consist principally of medium- or coarse-grained pink rocks which are chiefly composed of quartz and microperthitic orthoclase in approximately equal proportions, together with plagioclase that may be sufficiently plentiful to justify naming the rock quartz monzonite. Dark minerals are generally less than 10 per cent of the rock, and are either partly chloritized hornblende or biotite, together with a small amount of disseminated magnetite. The rock is mostly massive and free of inclusions, but in places it is both foliated and xenolithic. The inclusions are small, have well-defined outlines, and are of fine-grained granitic composition. The granitic bodies are in contact with both dioritic and Nicola rocks, which are locally strongly chloritized. Where observed the major contacts are steep, irregular, and unchilled, and for considerable distances the country rocks are penetrated by veins of unchilled granite as much as 60 feet thick. Other veins are of aplite, and cut the granite as well as the country rocks.

Most of the Nicola rocks adjoining the stock are contact-metamorphosed equivalents of the undifferentiated strata, which have been partly converted to quartzofeldspathic hornfels, gneisses, and chlorite or sericite schists. Limestone or granular marble, noted in two places, showed no obvious effects of its closeness to the plutonic masses.

Dykes of andesite and basalt occur in all the mapped units except the Kingsvale group. They are, however, rarely seen in the mapped portion of the batholith and are most numerous in the Nicola group near its contact with the Spences Bridge group. Most of the dykes strike between north-northwest and northeast, but others are roughly concordant with easterly trending structural grains in Nicola and dioritic rocks. The dykes range from a few feet rarely to as much as 200 feet wide, and may be several thousands of feet long. They consist of dark compact rocks which weather variously grey, green, brown, or reddish-brown, and which possess an appreciable magnetic susceptibility. A diabase texture is developed in the centre of the thicker sheets, but elsewhere the rocks are aphanitic and contain phenocrysts rarely as much as one-half centimetre in size. The phenocrysts are principally of white plagioclase feldspar, as well as of hornblende or, less commonly, pyroxene. Although most dykes are poorly vesicular, some have small empty vesicles that occur partly oriented with the phenocrysts.

In the Nicola group these basic dykes are cut by less abundant ones of quartz porphyry and light-coloured andesite. Quartz porphyry dykes were also seen in dioritic and granitic rocks of the Coyle stock. Light-coloured andesite forms thick and rather scarce dykes which strike between north-northeast and north-northwest. It contains abundant small phenocrysts of plagioclase feldspar, prismatic black hornblende, and biotite, which are oriented in a pale-grey aphanitic matrix. The rock resembles others assigned to the Kingsvale group and is identical with andesite of post-mineralization age at Highland Valley.

Quartz porphyry is a tough greenish or grey rock of dacitic composition that weathers brown or buff. It consists of a plentiful aphanitic matrix with phenocrysts of quartz and plagioclase and less abundant hornblende and biotite. It forms dykes and sills as much as 60 feet wide and of diverse attitudes. Southwest of Lookout Point multiple emplacement of these dykes, mainly on north-northeasterly lines, has resulted in explosion breccia within an elongate zone which is as much as 4,000 feet long and 2,500 feet wide. The north end of this zone, which is the part best known, contains screens of massive porphyry which separate the breccia bodies and grade into them. The breccia consists of aphanitic porphyry fragments, crystal debris, and cherty matrix, and has the colour and toughness of massive porphyry. The fragments are angular or irregular in shape and seldom exceed 2 inches, being mostly between one-tenth and 1 inch in size. They are cream or pale buff coloured and contain rare euhedral crystals of quartz which are similar to others which occur partly broken in the breccia matrix. The matrix is a very fine-grained, partly cryptocrystalline, quartzofeldspathic material differing only slightly from the groundmass of the porphyry fragments. Both in outcrop and microscopically, the breccia exhibits a directional fabric which in some outcrops strikes north-northeastward and is parallel to the adjacent porphyry screens. Veins and replacement patches of quartz or epidote are abundant, and films of specular hematite occur rarely on joint surfaces. Pyrite is present in small amounts in porphyry just north of the breccia zone.

Rock Alteration and Mineralization

In the mapped area, the rocks of the Spences Bridge and Kingsvale groups contain no primary mineralization and exhibit, respectively, moderate and weak degrees of propylitic alteration. The Nicola and plutonic rocks show a widespread alteration of several kinds, in places accompanied by copper or iron mineralization.

The Craigmont orebody contains specular hematite, magnetite, and chalcopyrite with minor amounts of bornite, and the adjacent wallrocks are altered to epidote, actinolite, and garnet skarns, and are veined and replaced by orthoclase, quartz, calcite, chlorite, and tourmaline. Pyrite and pyrrhotite also occur near the orebody. Most of the above-mentioned minerals occur widely in the area, though they have not been found in such a comprehensive assemblage as at Craigmont. Skarn minerals are scarcely recorded elsewhere, the sole outcrop being immediately north of the quartz porphyry breccia zone, where a greenish discoloured marble contains a brownish-red mineral assumed to be garnet.

Orthoclase metasomatism seems to have occurred only within or close to the margins of the plutonic rocks, and orthoclase is a feature of some of the mineralized prospects mentioned below. The most widespread alteration is one involving epidote, chlorite, and quartz, together with calcite or ankeritic carbonate, and generally accompanied by small amounts of pyrite or specular hematite. Epidote is most abundant, and occurs as veinlets, alone or with other minerals, and as disseminations which may locally form as much as 20 per cent of some impure limy rocks, feldspathic tuffs, or flow rocks. Undifferentiated rocks which are affected by this type of alteration generally contain less epidote, are a greenish- or bluish-grey in colour, and are traversed by seams and veinlets of quartz, carbonate, epidote, and chlorite. Large expanses of these altered rocks occur on either side of the road to Lookout Point, north of the main belt of feldspathic rocks and continuing through the limy belt at Lookout Point. In the feldspathic belt, epidote alteration and weak hematite mineralization are widespread. To the southeast of Lookout Point, bedding joints in feldspathic rocks are commonly veneered by specular hematite, with the result that breakage to the joints forms southerly facing cliffs. Specular hematite occurs in several other units, generally together with epidote and chlorite. Pyrrhotite was noted only in bedded strata on Lookout Point, where it occurs weakly disseminated with pyrite and occasional chalcopyrite. Chalcopyrite is fairly common in the altered rocks of the mapped area, and more often than not is associated with hematite or pyrite in equally small amounts. The principal copper showings have all recently been trenched or diamond drilled and their positions are shown on Figure 3. The Titan Queen (Paystin) and Eric showings are about 5,000 feet northwest and 8,000 feet east of the Craigmont orebody, respectively, and are located respectively within and at the margin of the Guichon batholith. They are generally similar to other showings elsewhere in the batholith, and involve a locally intense replacement by chlorite, quartz, and tourmaline, accompanied by chalcopyrite or bornite, at faults or shear zones in orthoclase-enriched batholithic rock. Magnetite is reported at both showings, and the adjacent outcrops contain weak disseminations of chalcopyrite.

About 6,500 feet south-southwest of Lookout Point, on the Hank No. 30 mineral claim, diamond drilling intersected weak iron and copper mineralization in steeply dipping basalt flows and tuffs in the feldspathic belt. Adjacent outcrops are strongly epidotized and contain a little specular hematite, pyrite, and chalcopyrite. Parts of the core contain these metallic minerals and slender veinlets and minor disseminations of magnetite, together with garnet, albite, quartz, calcite, chlorite, and epidote. Rare sections of limy strata are partly converted to skarny rock. The drilled area coincides with a strong but narrow positive magnetic anomaly which is reported to trend north-northeastward, parallel to the strike of the layered rocks. An oriented 1-inch cube of flow rock cut from a piece of core from a vertical drill-hole showed magnetic polarization in a vertical direction when tested with a suspended hand-magnet. Observation of the cube showed that numerous magnetite veinlets, partly with chalcopyrite, tended to share a common strike and to dip at all angles. Flow orientation of feldspar phenocrysts in the cube of rock was variable but tended to be steep and to strike approximately parallel to the veinlets.

About 3,000 feet south-southeast of this anomalous area, in the vicinity of Hank No. 4 claim, trenches expose limy and non-limy strata and quartz porphyry, together with a weak mineralization which differs from the foregoing principally in the absence of magnetite.

Immediately east of the road to Lookout Point, hornfels is exposed together with marble in trenches adjacent to the northern margin of the Coyle stock, and is partly replaced and veined by orthoclase feldspar. Where brecciated and chloritized, the hornfels contains small amounts of specular hematite and chalcopyrite.

Structure

The present mapping affords only limited evidence of the structure of the Promontory Hills area, largely because it does not establish the stratigraphy of the Nicola rocks, which are those of greatest interest in the area. The following discussion of structure is based on the evidence available, which is by no means conclusive.

Part of the major structure of the Nicola group appears to be a steeply dipping homocline adjacent to the margin of the Guichon batholith. To the south, the strata are mainly north dipping and their structural relationship to the rocks close to the batholith is conjectural.

The strike of the Nicola rocks varies with that of the batholithic margin. In general, the strata strike northeastward in the central part of the area and eastward in the southwestern and northeastern parts. From the batholithic margin southward to, and inclusive of, limy belt No. 3, they mainly dip steeply or are vertical, but to the south of this belt they either are steep or dip northward at moderate angles. Stratigraphic tops can be verified at only a few places. In limy belt No. 1 at Lookout Point, graded bedding in two adjacent beds is in opposed directions, but scoured bedding in a third outcrop and graded bedding 1,500 feet to the southwest both suggest that the strata face south. This is confirmed by a flow top, already described, in the northern part of the main feldspathic belt to the southeast of Lookout Point. It is therefore tentatively concluded that the exposed sequence, at least as far southward as belt No. 3, is homoclinal and faces south.

No important faults are recognized in the area. Small faults and breccia zones are numerous in the older rock units and have also been seen in the Kingsvale rocks. In the Nicola rocks these small faults and breccia zones commonly dip steeply and strike parallel to the bedding. Strike faults of large displacement have not been recognized but might not have been found in the present mapping. Many topographic lineaments occur in the area, and are both concordant and discordant to the trend of the Nicola rocks. Lineaments on Winney and Birkett Creeks, respectively, coincide with the margin of the Kingsvale rocks. At Craigmont, these rocks are known to be partly faulted against the Nicola rocks, and similar relationships may be expected elsewhere. Other lineaments are not known to contain faults, although several are coincident with zones of rock alteration. One such lineament, about 2,000 feet long and of northerly trend, passes between the two described showings on the Hank group, in the west-central part of the area. At Craigmont, numerous small faults of pre-mineral age occur, in addition to others whose relative age is not known.

All the folds identified in the area are small and are closely associated with limestone. Folding on a somewhat larger scale may exist in certain places where limy rocks possess variable strikes and dips, for example, at the bulge in belt No. 1 and at the western limit of belt No. 5. Small steeply plunging dragfolds of Z-shape are numerous throughout all but the western parts of limy belts Nos. 1, 2, and 3, and also occur at Craigmont. Dragfolds of diverse shape and attitude and with amplitudes as great as 30 feet were noted during preliminary mapping to the south of belt No. 6 in the extreme southwestern part of the area, and occur locally elsewhere. The diverse plunge of dragfolds in the area cannot be explained by major folding into simple anticlines and synclines. At present no complete explanation of the dragfolding can be given, but it appears likely that the steeply plunging dragfolds have resulted from strike-slip movement in upturned beds. The direction of this apparent relative movement was right handed, or north side moving east, and its cause is so far unknown.

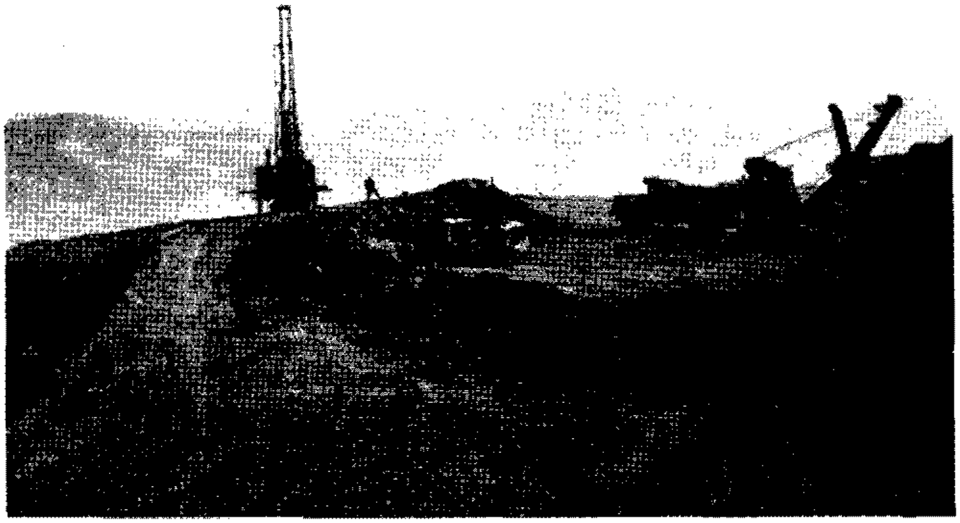
The complex structures prevalent in the northernmost limy belts were partly investigated by mapping on a scale of 50 feet to the inch at Lookout Point. This flat and relatively well-exposed area, which measures about 1,500 feet northeasterly and as much as 600 feet across, covers the full width of limy belt No. 1 at this point, and is about one-third underlain by outcrops. The strata in general strike eastward and are either vertical or dip steeply in one or other direction. Their lithological character has already been described. They comprise a variegated sequence of massive to thin-bedded rocks which include foliated limestones, thin beds of limy argillite and argillite, and granular to coarsely fragmental limy and non-limy rocks. Single beds could not in general be traced between outcrops, and the mapping consisted principally of recording the distribution, nature, and attitude of the secondary structures present in the rocks. The non-limy beds of thickness exceeding a few feet are massive, but the remaining beds show a variety of secondary structures which include foliation, cleavage, dragfolds, and less easily defined structures which have apparently resulted from the modification of the other structures.

Cleavage forms one or occasionally two sets of steeply dipping fractures striking between northeast and northwest in rocks other than limestone. The fractures are spaced at irregular intervals, ranging from one-quarter inch to several inches, and are discordant to other structures. They locally offset the bedding planes by successively repeated displacements, each not exceeding a fraction of an inch.

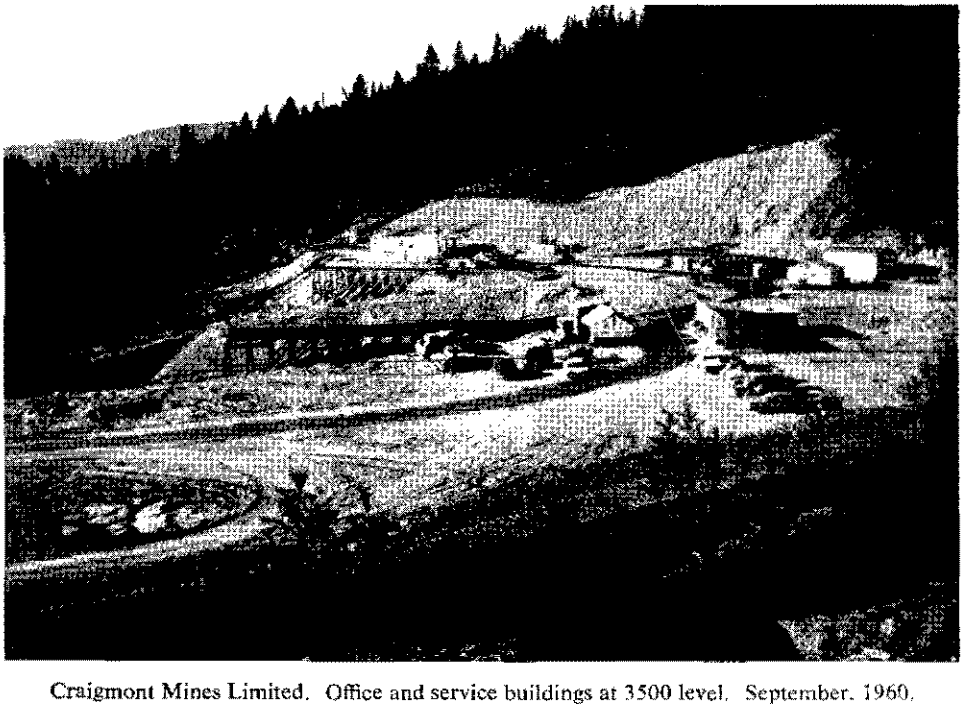
Foliation, in the restricted sense used in this discussion, is a secondarily imposed granular orientation which generally lies at variance with, and frequently obscures, the bedding. At Lookout Point, almost all the foliation strikes in various northeasterly directions and possesses steep dips, which are generally either vertical or toward the northwest but may occasionally be toward the southeast. In rocks other than limestone it strikes between north 35 degrees east and north 55 degrees east. In the limestones, it strikes in various directions, mostly ranging from north 35 degrees east to almost parallel with the bedding, and is locally dragfolded and interrupted, deflected, or convoluted adjacent to brecciated rock fragments contained in the limestone. The gritty and pebbly limestones, which are full of detrital rock fragments, are commonly foliated in a northeasterly direction subparallel to the bedding and the fragments are oriented in the foliation. Fine-grained, banded, non-limy beds, generally of siltstone or argillite, show plications or wrinkles of very small amplitude whose axial planes correspond in direction with the foliation of adjacent beds.

Dragfolds are small and confined within limestone beds, whose interfaces with adjacent, more competent beds are occasionally warped, buckled, or wrinkled, but are not dragfolded. The limestone beds include layers, 1 foot or less thick, of banded argillite, vitric tuff, or other compact rocks, which are separated by limestone layers ranging from an inch or two in thickness to several feet. The limestone beds may be as much as 40 feet thick, and they alternate with relatively non-limy massive assemblages as much as 80 feet thick. The dragfolds may be simple or complex, and may be either well preserved or greatly disrupted by brecciation. The amplitude of the unbrecciated dragfolds is generally not more than 1 or 2 feet, and may be much less. Exceptionally, it is as much as 15 feet, and such folds contain more of the competent layers and correspondingly less of limestone. The axes of the folds vary somewhat in plunge, but most are steep or vertical. With few exceptions, dragfolds are Z-shaped and their axial planes strike northeastward and dip steeply, roughly parallel to the foliation of the containing limestone. Simple S-shaped dragfolds are rare, and probably in all cases are subsidiary to larger adjacent Z-shaped dragfolds. Where the structure is least complicated, a limestone bed strikes uniformly between massive beds and contains thin and well-spaced layers of contrasted rock which are thrown into successive steep-plunging Z-shaped dragfolds. The dragfolds are several feet apart and correlate with those of adjacent layers along northeasterly steep axial planes that are parallel to the limestone foliation.

From such simple forms as this, the folds may show increasing degrees of complication, attenuation, and finally disruption. Their most disordered state is exemplified by a limestone bed containing trains of tabular rock fragments, dis-



Craigmont Mines Limited. Stripping the orebody at 4,100 feet elevation. September, 1960.



Craigmont Mines Limited. Office and service buildings at 3500 level. September, 1960.

persed along foliation planes which trend almost parallel to the bed but are partly contorted. Where the folds are less disrupted, flowage of limestone is shown by its penetration of the folded layers in a swirly foliated manner. Limited flowage is evidenced elsewhere by the entry of limestone into cleavage cracks in the confining beds, and by the lensing-out of thin limestone beds by dragfolding.

The foremost structural pattern at Lookout Point, of steeply dipping beds which are dragfolded predominantly in Z-shapes with steep axes, appears to persist in belts Nos. 1 and 2, and possibly in more southerly belts, as far eastward as the Kingsvale contact. In belt No. 1 it persists for some distance to the west of Lookout Point, but is then obscured by the complex structure present in the bulge in this belt.

At Craigmont, some 2½ miles easterly from Lookout Point, the same pattern of steep Z-shaped dragfolds occurs to the west of the ore zone. The observed dragfolds are small and widely spaced, and are broken by northerly striking shears with limited right-handed displacements. In the ore zone, small dragfolds of uncertain attitude are poorly preserved and appear disrupted in the manner described at Lookout Point. The orebody itself has a configuration suggestive of larger dragfolds. The significance of this configuration and the control of mineralization are not well known and are beyond the scope of this report.

Copper-Iron

Craigmont (Birkett Creek Mine Operators Ltd.)

(50° 120° S.W.) Head office, 700, 1030 West Georgia Street, Vancouver 5. R. G. Duthie, superintendent, Merritt. This company controls 115 claims and fractions on behalf of Craigmont Mines Limited. The Craigmont orebody is on Merrell Nos. 7 and 8 claims and McLeod Nos. 5 and 6 claims, and is south of the north fork of Birkett Creek at surface elevations between 3,800 and 4,200 feet.

In 1960 rapid progress was made in preparing this important new mine for production. From January to November, work done included 424 feet of crosscutting on the 3500 level and 2,620 feet of drifting and 459 feet of crosscutting on the 3000 level. A vertical ventilation raise 463 feet long was driven between the same two levels with an Alimak raise platform, and a third level was started from a portal site at approximately 2,400 feet elevation to the south of Birkett Creek, near the Aberdeen road. From January to October, 50,535 feet of diamond drilling was done, mostly from underground. Preparation of an open pit began in June and, by the end of October, about 1 million cubic yards of overburden together with 345,000 cubic yards of waste rock were removed. Construction began of four buildings on a plant-site near the portal of the 2400 level, a pit shop at 3,700 feet elevation, a power-line from the plant-site to 3,700 feet elevation, and two water pipe-lines, each 4 miles long, from Nicola River to the plant-site. At the end of the year about 177 men were employed at the mine, including twenty diamond drillers on contract and about 100 men employed by Kie Mining Company (Peter Kiewit Sons Company of Canada Ltd.), which held the contract for preparation of the open pit.

During the year a deep extension of the western part of the orebody was discovered. As presently known, the Craigmont orebody has a vertical range of about 1,500 feet and is about 2,200 feet long in horizontal projection. In November, semi-proven and probable ore reserves amounting to 22,241,000 tons grading 2.09 per cent copper and 19.8 per cent iron were estimated by both the consultants and the operators. Production of copper concentrates is planned to start in 1961 at a milling rate of 4,000 tons per day.

Betty Lou and Lou (Canex Aerial Exploration Ltd.) (50° 120° S.W.) Company office, 700, 1030 West Georgia Street, Vancouver 5. J. D. Simpson, president. This company holds about thirty claims and fractions in the adjoining Betty Lou and Lou groups at Lookout Point in the Promontory Hills. Work in 1960 consisted of trenching, line cutting, and geophysical surveying. Four men were employed for a few weeks under the supervision of A. Allen.

P.C.M., Cap, Domino, Hank, Freda (Britmont Mines Limited) (50° 120° S.W.) Company office, 402, 25 Adelaide Street West, Toronto 1. S. A. Perry, president. This company holds more than 100 claims on the south slope of Promontory Hills. Work in 1959 and 1960 included about 755 feet of diamond drilling and some geophysical surveying, followed by soil sampling. Drill-holes included two on the Hank group, two which are said to be on the Domino group, and one on the P.C.M. group. No significant mineralization is reported in the holes. A small crew was employed for a part of each year under the supervision of F. J. Hemsworth.

Copper

Aberdeen (Torwest Resources Limited)* (50° 120° S.W.) This property on Broom Creek, 11 miles north of Lower Nicola, consists of the Aberdeen and the Westlock Crown-granted claims and the Crown 21 to 28 recorded claims. The Aberdeen is an old property on which mining was carried out many years previously. A 250-foot vertical shaft was de-watered and retimbered in 1959, and in 1960 a one-compartment headframe was installed over it. A hoistroom was built and equipped with a small hoist obtained from the Copperado. Some underground sampling was done. A crew of three men was employed under the direction of R. E. Renshaw.

NICOLA LAKE*

Copper

Kim (Kennco Explorations (Western) Limited) (50° 120° N.W.) Company office, 1030 West Georgia Street, Vancouver 5. The Kim group of thirty-seven recorded claims is 3 miles north of the north end of Nicola Lake and one-half to 2 miles west of Moore Creek. Geochemical and geophysical surveys were made, and bulldozing and some diamond drilling were done. A crew of twelve men was employed under the supervision of R. W. Stevenson.

GREENSTONE MOUNTAIN*

Copper

D.R.G. (Kennco Explorations (Western) Limited) (50° 120° N.W.) Company office, 1030 West Georgia Street, Vancouver 5. The D.R.G. group of seventy-six recorded claims is 15 miles southwest of Kamloops in a straight line. It lies south of Greenstone Mountain and extends one-half mile south of Roper Lake. Geochemical prospecting, some geophysics, and some bulldozing were carried out. A crew of thirteen men was employed under the supervision of R. W. Stevenson.

* By David Smith.

TULAMEEN*

LAWLESS CREEK AREA

The Lawless Creek area is 22 miles west of Princeton and extends northwest from the Tulameen River along both sides of Lawless Creek. Most of the bedrock belongs to the Nicola group. Observations made in 1959 suggested that it might be possible to deduce the rock sequence and structure of that part of the Nicola group included within the Lawless Creek area. Unfortunately, these hopes were not realized in the 1960 mapping. For most of the area, only a general lithologic description can be given, together with notes on the structure. A small section about the mouth of Lawless Creek was studied more intensively than other parts of the area, and is described in more detail in order to illustrate the complexities.

The general geography of the area is outlined in Figure 4. The two main roads converge on Tulameen, 2 miles to the east, which is served by the Kettle Valley Railway and by roads from Princeton and Merritt. The more northerly road was built by the British Columbia Forest Service as an access road to assist potential logging. The principal streams are the Tulameen River and Lawless Creek. Three tributaries of Lawless Creek—namely, Grasshopper, Skwum, and Henning Creeks—divide the country to the west into four sub-radiating ridges, the most southerly of which is Grasshopper Mountain. Northeast of Lawless Creek is a mountain mass carrying several summits separated by shallow saddles; the south part of this mass is known as Mount Rabbitt and the north part as Spearing Mountain. The valley of Lawless Creek is generally steep-walled, and for much of its southern part is a canyon. Henning Creek enters at grade, and its valley is also steep-walled in its lower part. The valleys of Skwum and Grasshopper Creeks are hanging and are rather broad, with moderate slopes. The character of Tulameen River valley changes abruptly half a mile below the mouth of Lawless Creek. Above this point the valley is broadly V-shaped, with the river generally incised in a rock canyon. Below this point the river meanders over a broad alluvial floor.

Till covers a large part of the area. It is generally at least 20 feet thick on the slopes of Mount Rabbitt and Spearing Mountain and on the ridge between Skwum and Henning Creeks, and in these areas natural rock exposures are rare. Elsewhere in the area the till is generally thinner and more patchy, exposing a variable amount of rock; Grasshopper Mountain and the ridge between Henning and Lawless Creeks are typical. The crest of the ridge between Grasshopper and Skwum Creeks differs somewhat; it is veneered by only 1 to 3 feet of overburden, yet outcrops are scattered, small, and rubbly. This overburden, mainly till, thickens down the slopes of the ridge. Along the Tulameen River above the alluvial flats, and along Lawless Creek below the access-road bridge, the till has been largely eroded. Above the access-road bridge, outcrops along Lawless Creek are almost entirely restricted to the right bank.

Alluvial and talus deposits are small and scattered. Apart from the broad flood-plain of the lower Tulameen River, alluvium occurs as scattered terraces farther up the river and along upper Lawless Creek, as a valley flooring along Grasshopper Creek, and as stream-channel deposits. Talus cones are largely restricted to the south slope of Grasshopper Mountain.

Most of the area is thickly timbered with Douglas fir, balsam, spruce, hemlock, pine, and less cedar and poplar. Open patches occur on the southwest slope of Mount Rabbitt and the south slope of Grasshopper Mountain.

* By G. E. P. Eastwood.

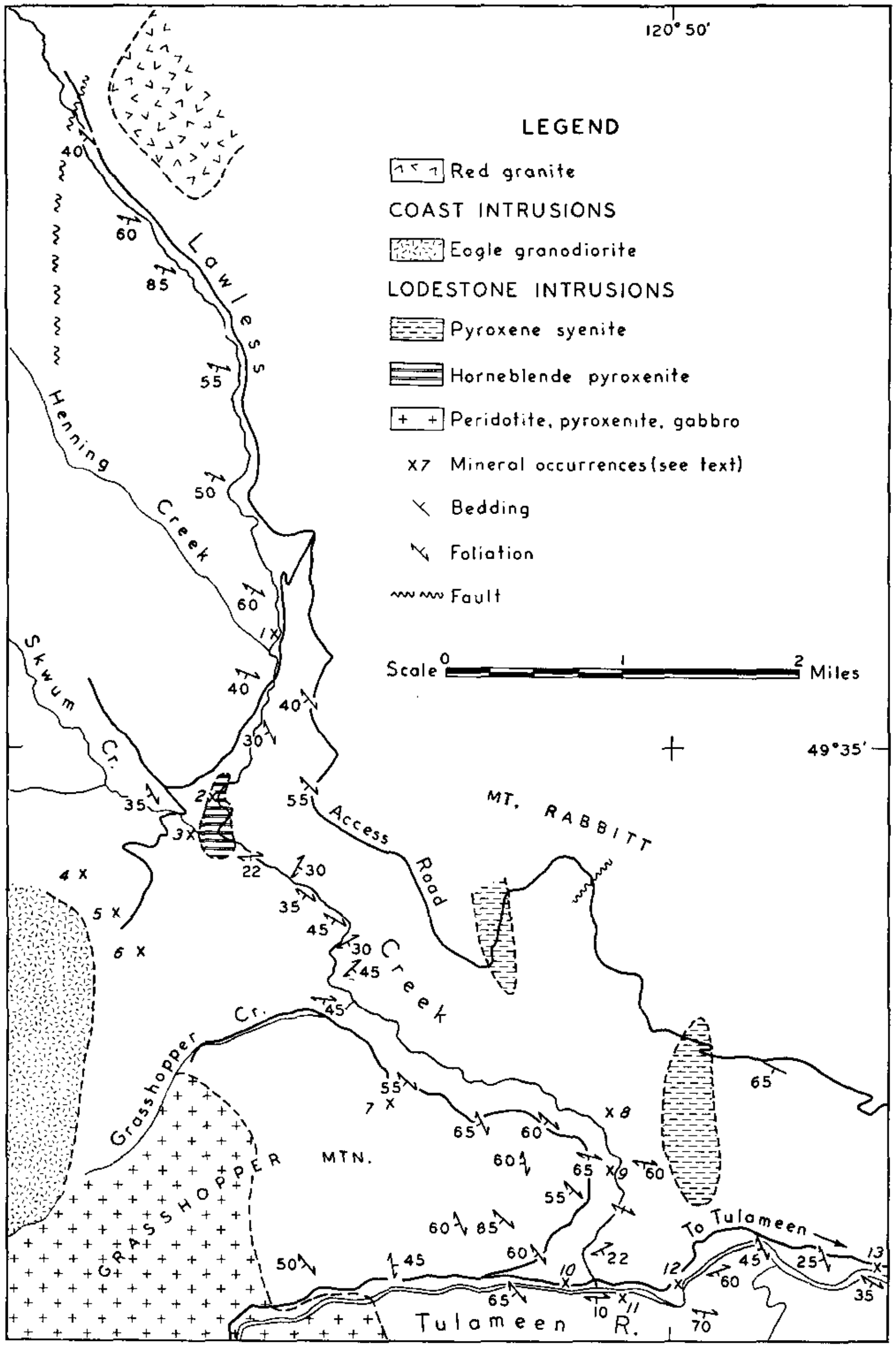


Figure 4. Outline map of Lawless Creek area showing mineral occurrences and principal intrusions.

Camsell included Lawless Creek in his geological mapping of the Tulameen district. Rice made minor rectifications when incorporating this mapping in the Princeton sheet. El Alamein mine and vicinity was geologically mapped by J. S. Stevenson in 1949. The 1960 mapping was on a base at 1 inch to 500 feet with 50-foot contour interval, aided by aerial photographs at 3 inches to the mile.

[References: Camsell, Charles (1913), Geology and Mineral Deposits of the Tulameen District, B.C., *Geol. Surv., Canada,* Mem. 26; Rice, H. M. A. (1947), Geology and Mineral Deposits of the Princeton Map-area, British Columbia, *Geol. Surv., Canada,* Mem. 243; Stevenson, J. S. (1949), *Minister of Mines, B.C.,* Ann. Rept., 1949, pp. 124–127.]

General Geology

TABLE OF FORMATIONS

	Alluvial and glacial deposits; minor talus.
Non-conformity.	
Otter intrusions?	Red granite.
Coast intrusions	Eagle granodiorite.
Lodestone intrusions	Pyroxene syenite, coarse-grained gabbro, pyroxenite, peridotite, dunite.
Intrusive contact.	
	Buff-coloured feldspar porphyry and aplite.
Relations unknown.	
	Medium- to fine-grained diorite and gabbro.
Intrusive contact.	
Nicola group	Lavas, flow breccia, and pyroclastics, mostly intermediate to basic; greenstone; subordinate sediments, including black argillite, siltstone, greywacke, conglomerate, schist, and limestone.

Nicola Group

The oldest volcanic and sedimentary rocks in the Tulameen district were named by Camsell the Tulameen group. They were subsequently correlated by Rice with Dawson's Nicola group, of Triassic and Lower Jurassic age. No fossils were found in the present mapping.

In Lawless Creek area these rocks are highly varied and show marked changes over short distances, along the strike as well as across it. They have undergone mild thermal metamorphism through most of the area, and are baked and recrystallized along contacts with some of the stocks. They have been squeezed and probably closely folded, with production of a coarse regional cleavage or foliation in most of the rocks. Finally, they have been shattered by a network of faults. The resulting pattern is kaleidoscopic. Outcrop is generally inadequate to unravel the complexities, and in any case an inordinate amount of time would be required.

A majority of the Nicola rocks in the area are dense or fine grained and dark greyish-green; they have not been closely identified, and are here termed greenstones. They may be andesitic in composition, and may include lavas, flow breccias, pyroclastics, greywacke, and mixed pyroclastics and greywacke. Interbedded with the greenstones, and in part intergrading or intertonguing with them laterally, are bands of dacite, rhyolite, fine-grained dark sediments, sedimentary schists, limestone, and minor pebble and granule conglomerate.

Relatively small bodies of dacite were identified, by field observation only, on the east end of Grasshopper Mountain, at the mouth of Grasshopper Creek, and in the northwest part of the area. Rhyolite was identified by Stevenson on lower Lawless Creek, but has not been identified elsewhere in the area. These rocks are described below, in the section on lower Lawless Creek.

Thin bands of dark sediments are sparingly interbedded with greenstones through most of the area, and somewhat larger patches of these rocks occur in the southwest. The rocks are black argillites, silty argillites, and phyllites, and dark-grey siltstones and impure quartzites. The bands range in width from a foot or two to a few tens of feet. Some are relatively isolated, others are grouped in zones, separated by thin bands of greenstone. Neither bands nor zones could ordinarily be traced from outcrop to outcrop, although a series of black phyllite exposures along Grasshopper Mountain road from near the Rabbitt mine to Grasshopper Creek may be of a single band. It is not known whether this apparent lack of continuity of bands is caused entirely by folding and faulting or also by lensy deposition. The larger patches of dark sediments were found on the Tulameen River above the foot of Grasshopper Mountain road, and on the south slope of Grasshopper Mountain toward the Lodestone stock; they could not be traced to the northwest.

Sedimentary schists, with subordinate limestone, appear to underlie a considerable part of the ridge between Grasshopper and Skwum Creeks east of the granodiorite. A wedge of these sediments reaches down to Lawless Creek just below the small pyroxenite stock, and scattered outcrops were found westward and southwestward to Law's Camp. The colour varies from creamy white to various shades of grey, brown, and green. Toward the contact with the Eagle granodiorite, seams of limestone are intercalated along the schistosity, growing generally thicker and more numerous westward. They culminate in two or three lensy bands of coarsely crystalline limestone, 200 or 300 feet wide, against the contact. This limestone-bearing zone can be traced southward along the granodiorite contact to Grasshopper Creek; it is covered to the northwest. A similar or the same limestone-bearing zone can be traced along the granodiorite contact from the summit of Mount Britton for many miles to the southeast.

Pebble conglomerate was found only in the southern part of the area. Small outcrops of it on lower Lawless Creek are described below. A larger band, about 100 feet wide, was followed 3,500 feet northwest from the southeast corner of the area, and it may extend to outcrops of pebble conglomerate on the access road 4,000 and 8,000 feet farther to the northwest.

The greenstones are characterized by a medium- to dark-green or greyish-green colour and generally by dense or fine-grained texture and well-developed but relatively widely spaced cleavage or foliation. Some are, however, porphyritic or medium grained. Commonly the foliation is the only structural feature apparent, but many outcrops exhibit greenstone fragments or calcite lenses, rarely pillow-like structures. These various types of greenstone are commonly closely interbanded and also grade into each other along strike.

Medium-grained greenstone is sparingly scattered through the area. The texture is generally granular rather than interlocking and suggests that the rock may be tuffaceous. One band contains chips of argillite.

Four types of greenstone with a porphyritic appearance were distinguished in the field; they are believed to have had diverse origins. One type containing equant feldspar grains is probably largely tuff or greywacke. A second type contains oblong creamy-white feldspar phenocrysts, as much as 7 millimetres long, set in a dense green groundmass. It is exposed on the access road opposite the mouth of Skwum Creek and as several other bands crossing Lawless Creek. The bands are thick, generally exceeding 100 feet, and are texturally uniform, suggesting that they may be lava flows. A third type is characterized by attenuated cream-coloured feldspar laths. The most striking exposure is beside the access road just east of the second switchback, where the laths attain lengths of 1½ inches and thicknesses of one-quarter inch. This rock could be a dyke or flow, but from varied occurrences it is concluded that the feldspar laths have been introduced. A fourth type is characterized by hornblende prisms about 1 millimetre across, and also by unusually dark-green colour and by hematite coatings on slip surfaces. This rock is exposed on Lawless Creek for 1,200 feet above the access-road bridge. Ankerite veins and zones of ankerite replacement are very common in this rock, though uncommon in Nicola rocks elsewhere in the area. It is suggested that considerable iron has been introduced, possibly with other constituents, and that the unique characters are metamorphic.

Fragmental greenstones are more common in the southern part of the area, and are described in the following section. Structures suggestive of pillow rinds were seen in two small patches on Lawless Creek, between Skwum and Grasshopper Creeks. Large epidote knots in a band of bluish-green greenstone on the Tulameen River below Lawless Creek may also represent pillows.

About 80 per cent of the greenstone effervesces with 6N hydrochloric acid. In some outcrops the calcite is not visible to the naked eye, and in others it occurs as tiny fracture veinlets or scattered grains or lenses. The origin(s) of these lenses is unknown. In some places, particularly on the Tulameen River just above Lawless Creek and in the northwest corner of the area, the lenses attain lengths of 2 to 3 feet and suggest fragments of disrupted limestone beds. Many lenses the size of a quarter or half dollar leave a deeply ribbed cavity surface when they weather out, possibly suggesting organic structures. Other lenses resemble amygdules. Weathered greenstone surfaces commonly look worm-eaten due to the solution of the smaller lenses.

Intrusive Rocks

Small bodies of diorite and gabbro scattered across the southern part of the area differ markedly in appearance from the Lodestone diorite and gabbro, and probably do not belong to the Lodestone intrusions. They appear somewhat more sheared, suggesting that they may be older. The largest is in the southeast corner; it is a dyke 600 feet wide and traceable for half a mile north from the river, traversing the beds at a small angle to the right. Another dyke about 100 feet wide occurs in El Alamein mine. Several others a few tens of feet wide intrude rhyolite along the lower part of Lawless Creek. An outcrop of diorite occurs northwest of the Rabbitt mine. The rock is dark green in colour, and where fine grained closely resembles green Nicola volcanic rocks. The large body is much more massive than the volcanics, but the smaller bodies are more or less foliated. Two dark porphyry sills in the lower canyon of Skwum Creek may belong to this group.

Buff feldspar porphyry has been found principally on the ridge between Grasshopper and Skwum Creeks and along the adjoining segment of Lawless Creek. Innumerable sills, a few feet to a few tens of feet thick, have been injected into Nicola sedimentary and volcanic rocks. Taken as a whole, the porphyry shows a complete gradation from porphyritic granite through feldspar porphyry to aplite. Around Law's Camp on top of the ridge it is generally massive, but nearer Skwum and Lawless Creeks it is generally somewhat foliated. Several small bodies of feldspar porphyry and aplite are included in the area shown as hornblende pyroxenite on Figure 4. In a few places where the two rocks were seen directly in contact, the pyroxenite showed marked chilling against the porphyry. At one contact, fragments of aplite were found in pyroxenite. The porphyry appears somewhat more sheared and contains considerably more pyrite than the pyroxenite; it is considered to be the older.

The main Lodestone stock, a portion of which is shown in the southwest corner of Figure 4, was briefly described in the Annual Report for 1959, and will not be further discussed here. A small outlying body of hornblende pyroxenite occurs at the mouth of Skwum Creek. As already noted, it contains inclusions of feldspar porphyry and aplite. The rock is mostly coarse grained and greenish-black to black, consisting of roughly equal amounts of pyroxene and hornblende. Here and there it also contains some biotite. It is slightly magnetic. In three places it was seen to pass into a fine-grained dark brownish-grey gabbro near contacts, but on Skwum Creek coarse-grained pyroxenite is separated from Nicola greenstone by a 5-foot zone of ankerite. Veins of ankerite are also found in places inside the pyroxenite, which generally appears to be little altered against them. In an outcrop 400 feet above the mouth of Skwum Creek a little slip-fibre asbestos is present along minor shears in the pyroxenite.

Two narrow dykes of peridotite or picrite intrude Nicola rocks on Lawless Creek. One is nearly a mile above the mouth of Henning Creek, the other a quarter mile above the mouth of Grasshopper Creek. It is not known whether they belong to the Lodestone intrusions.

Two small stocks of pyroxene syenite intrude Nicola rocks on the southwest slope of Mount Rabbitt, and are exposed in cuts on the access road. The rock is identical with pyroxene syenite of the Lodestone stock on Tanglewood Hill and evidently belongs to the Lodestone intrusions. The rock consists of coarse white or pale-green feldspar and medium-grained pyroxene and amphibole. A small body of this rock occurs just below mineral occurrence No. 8, and other bodies may be present on the same slope.

The Eagle granodiorite underlies a large area to the west. A lobe of this mass extends into Lawless Creek area between Grasshopper and Skwum Creeks. As exposed just west of Law's Camp, the rock is slightly gneissic, coarse grained, and is mottled white and black by its principal minerals, quartz, feldspar, and biotite. This intrusion was assigned by Rice to the Coast intrusions, and was considered by both him and Camsell to be younger than the Lodestone intrusions.

In the northwest corner of the area a stock of red granite intrudes Nicola rocks in a hill east of Lawless Creek. Two small dykes of red granite cross the creek a little farther south. The rock is generally massive and medium grained and consists of pink to red orthoclase, green saussuritized plagioclase, quartz, and subordinate hornblende. The actual contact of the stock with Nicola rocks is exposed only along a small creek to the south, where it is irregular in detail. Near the stock, Nicola volcanics have been baked, and possibly partly silicified, to a light-green rock that rings when struck with a hammer. The red granite appears to fit Camsell's description of the Otter granite near Tulameen.

In addition to the above intrusions, the Nicola has been injected by a variety of dykes, especially along Tulameen River. Dykes of pinkish-grey syenite porphyry are sparingly but widely distributed. They are characterized by coarse feldspar phenocrysts and needles of dark-green amphibole, and closely resemble syenite porphyry dykes that intrude pyroxenite of the main Lodestone stock.

Structural Geology

Most of the Nicola rocks display a planar parting or coarse cleavage with a spacing commonly of several inches. This parting was found to be parallel to the axial planes of the few folds observed, and to bedding where recognizable beds were not folded. Breccia fragments are locally squeezed parallel to the parting. Locally on the north slope of Grasshopper Mountain, and more generally around Law's Camp, the parting becomes close-spaced, platy minerals tend to be aligned parallel to it, and the parting grades into schistosity. For this parting the general term foliation is used in this report.

The general trend of the foliation is west-northwest, but there are marked local divergences in the southern part of the area. Dips are in general to the south.

Figure 4 shows attitudes that are averages for the small areas they represent. North of the access-road crossing of Lawless Creek the strike is fairly uniform, although the dip varies. South of this bridge, however, both strike and dip vary widely. Between Skwum and Grasshopper Creeks, transitions between patches of markedly different attitude are abrupt and may represent faults.

The fold structure in the Lawless Creek area is not known. The variations in attitude noted above are believed to be related, not to the primary folding, but to later deformation. Dragfolds are scarce, small, and vary in plunge. They can rarely be tied into the lithologic pattern. The majority indicate a movement of southwest side over northeast.

Nicola rocks have been intensively faulted in some parts of the area. Three of the broadest fault zones of the area are exposed in the access-road cuts. One fault zone traverses both Nicola rocks and pyroxene syenite at the second switchback. The second, shown on Figure 4, is prominently displayed east of the second stock of pyroxene syenite. It is a zone of gouge and breccia nearly 200 feet wide, flanked by broad zones of pyritic silicified rock. A sample of this pyritic rock assayed: Gold, *nil*. The third, also shown on Figure 4, crosses the access road near its north end. Greenstone is sheared over a width of several hundred feet, but gouge and rock alteration are minor. This shear zone was inferred to continue south along a strong topographic lineament crossing the ridge between Lawless and Henning Creeks.

Lower Lawless Creek

The complexity of the Nicola rocks is illustrated by exposures along the lower part of Lawless Creek, on the east end of Grasshopper Mountain, and along the adjoining part of the Tulameen River. Figure 5 shows the distribution of the main rock types in this section. Some generalized rock units have been outlined, and are numbered from northeast to southwest. Faults are lettered. Some indirect evidence suggests that the numbered units may form an ascending sequence. Correlation with rocks farther up Lawless Creek is uncertain.

Unit 1 is predominantly massive green dacite. It forms high canyon walls along Lawless Creek. Regional foliation is indistinct or lacking. Small shear zones occur here and there. Epidote metacrysts are sprinkled through the rock in places, giving it a yellowish cast, otherwise it appears uniformly fine grained. Tiny feldspar phenocrysts can be detected in some places with the aid of a pocket lens. Interbedded sediments were not found, and fragmental bands generally are not common. Southeast of fault H however, massive dacite passes outward to fragmental dacite in which the fragments are increasingly rounded toward the greenstone contact. Elsewhere fine-grained dacite passes to fine-grained greenstone with only a darkening of colour and increase in foliation.

Unit 2 is a heterogeneous assemblage of varied andesitic volcanic rocks, including about 10 per cent of interbedded sediments. The volcanic rocks include fine-grained, calcareous, and fragmental greenstones, and the sediments include tuffaceous rock, black argillite, greywacke, and banded quartzite. The greenstone is normally medium to dark green or greyish-green. It is generally well foliated, though only on the north slope of Grasshopper Mountain is it sufficiently closely cleaved to be called phyllite or schist. Some of the greenstone effervesces with 6N hydrochloric acid; some does not. The calcite occurs partly in veinlets, partly as disseminated grains. Fragments were found in greenstone mainly in the northeast part of the unit, although faintly discernible bodies may have been missed in areas of poor exposure. The fragments range in size from half an inch to 3 inches across, and from ellipsoidal bodies just discernible on the cleanest surfaces, through

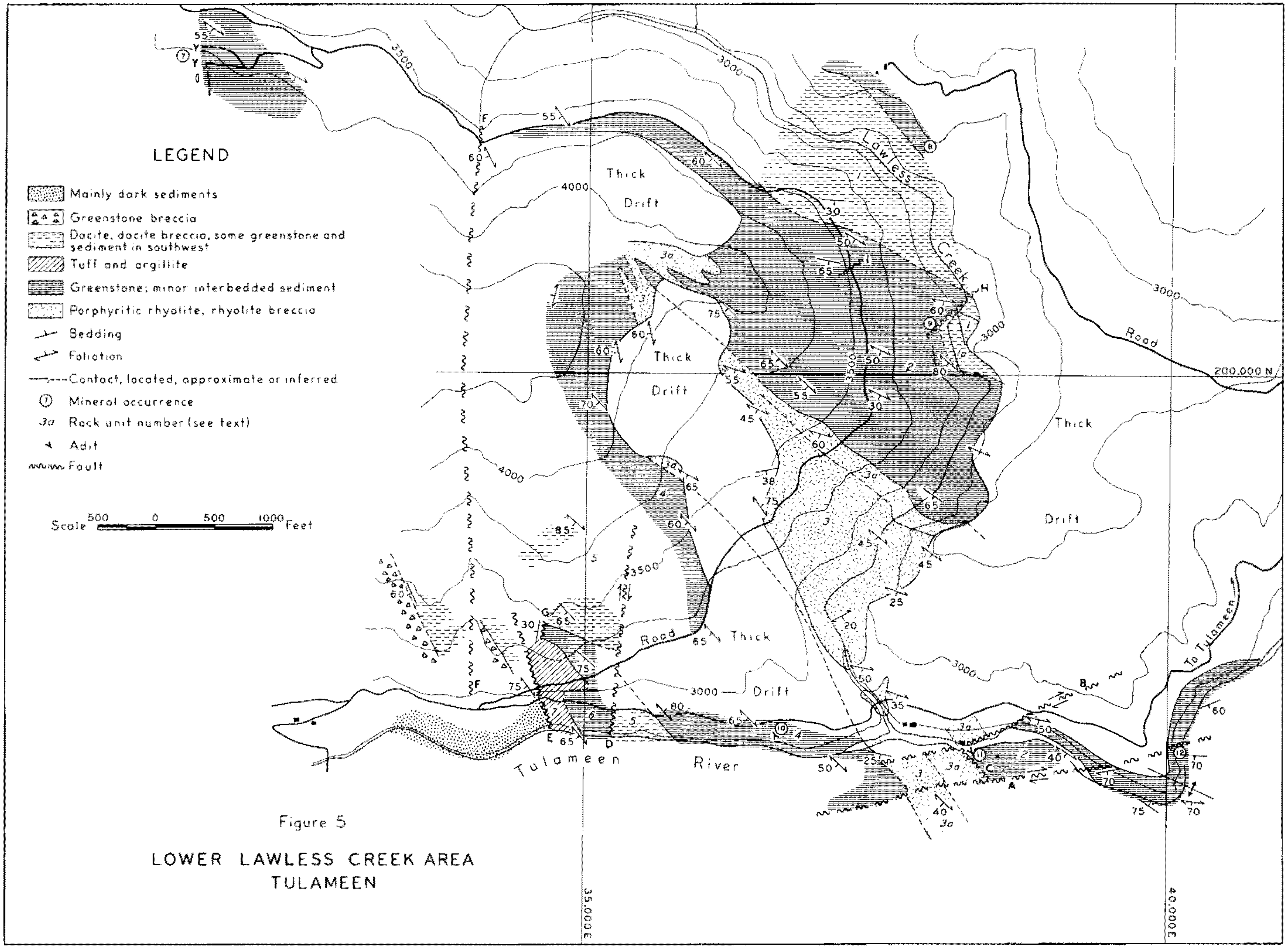


Figure 5

LOWER LAWLESS CREEK AREA
TULAMEEN

more obvious angular fragments, to sub-rounded bodies of somewhat variable colour and texture. The fainter bodies appear to be much the more common.

A fine-grained dark-green rock studded with square grains of white or pale-green feldspar, less commonly also quartz, 1 to 3 millimetres across, is closely interbedded with black argillite just north of the downstream end of fault A. It is probably a tuff or tuffaceous sediment.

Beds and narrow bands of black argillite and silty argillite are scattered through the unit and make up less than 5 per cent of it; they are more common on the Tulameen River than on Grasshopper Mountain. On the river the beds are repeated by tight folding and appear to be squeezed.

This unit exhibits most of the lithologic and structural problems encountered in mapping the Nicola group as a whole. The origins of the rocks and their relationships to each other are rarely apparent. Differing rock types occur here and there, but some lack definite contacts and most cannot be traced beyond individual outcrops. Exposures along the Tulameen River demonstrate that sediments change character markedly in short distances across folds.

Unit 3 is an irregularly lens-shaped body of well-foliated porphyritic rhyolite and porphyritic rhyolite breccia. The widest section is on Lawless Creek, where most of the rock is medium to dark brownish-grey and fine grained, with small feldspar phenocrysts. Locally, as by the bridge, the phenocrysts are ellipsoidal. To the northeast this rock grows much lighter in colour and passes to siliceous breccia consisting of pale-buff fragments, as much as 6 inches long, in a light-green matrix. This breccia is separated at the creek from greenstone of unit 2 by 8 to 10 feet of limestone containing diverse rounded fragments, but elsewhere is directly in contact with greenstone. The breccia maintains nearly uniform width to the southeast, but the rhyolite narrows sharply. Along the Tulameen River both the matrix and fragments of the breccia are generally green, but one narrow band, close to the transition to non-fragmental rhyolite, is distinguished by white fragments and matrix. The southwesterly exposures of rhyolite on the river are mostly green and foliated without discernible breccia. They do, however, contain some thin bands of white rhyolite, two thicker bands of green rhyolite breccia, and a small patch of massive grey rhyolite. The contact with greenstone of unit 4 is gradational.

Northwest of Lawless Creek the rhyolite changes character. In nearly all outcrops it is pale buff in colour, and fragments are discernible at several places in the section. At the same time, fragments are harder to recognize because there is less colour difference between them and their matrix, and for this reason the breccia band on the northeast cannot be traced with certainty. Beds of greenstone and of dark-brown or dark-grey siltstone and quartzite are intercalated in the rhyolite. The rhyolite passes under a large covered area, and where it emerges it is greatly thinned. On the crest of the east ridge of Grasshopper Mountain, rhyolite breccia intertongued with greenstone of unit 2 may represent the tails of small folds.

It is provisionally suggested that the non-fragmental rhyolite on Lawless Creek and to the southeast is the upturned edge of a very viscous flow, exposed near its outer margin. The pale fragment-bearing rhyolite northwest of Lawless Creek is interpreted as a marginal breccia. The breccia band on the northeast may be either flow-top breccia or explosive breccia.

Unit 4 is predominantly greenstone and cannot be distinguished from unit 2 where rhyolite is absent. Where best exposed, on the Tulameen River, unit 4 differs in several respects from unit 2, but it appears to grow more like unit 2 when traced onto Grasshopper Mountain. On the river it is a dense green or olive-green calcareous rock commonly containing lenses or slabs of grey calcite or limestone. It also contains several thin bands of black silty argillite and phyllite, mostly confined within a central zone 100 feet wide. The calcite or limestone lenses range from the size and shape of a dried pea to slabs an inch or two thick and several feet long, rarely to angular bodies 4 inches across. The slabs appear to be primary structures, possibly disrupted beds or pillow rinds.

Above the Grasshopper Mountain road, lenses and slabs of calcite are less common, although the greenstone remains generally calcareous, and there is considerable tuff and greywacke along the rhyolite contact. Argillite beds and greenstone fragments are uncommon.

Units 5, 6, and 7 have been mapped over a much smaller area and are less well established. Unit 5 consists primarily of dense pale-green dacite like that constituting unit 1, but on Grasshopper Mountain it has interbedded calcareous greenstone and dark sediments. Unit 6 consists of calcareous greenstone that locally grades to impure limestone; on good exposures it shows faint fragments. Unit 7 consists basically of a massive green or greenish-grey rock that may be tuff. This rock is directly in contact with the calcareous greenstone at the river, but above the main road it is interbedded with black argillite which increases toward the northeast. Unit 7 is truncated on the southwest by fault E.

Southwest of fault E no semblance of pattern could be found in the rocks. Along the river they are principally black argillite and silty argillite, much injected by granitic dykes and sills. Above the road they are principally breccia and various dacitic rocks, with two narrow bands of dark sediments. Between faults E and F the breccia includes fragments of silty black phyllite and grey limestone. The dacite is locally dark coloured and medium grained, resembling diorite, but no contacts are visible.

The true sequence of the units is not definitely known, because unquestionable evidence of stratigraphic top is lacking. Cleavage-bedding relations were not found. Dragfolds are scarce, small, and vary in plunge by about 35 degrees. It is not certain that all the dragfolds are related to the primary folding; some may have formed in a later age of the deformation. Most of the better-shaped dragfolds may, however, be related to the primary folding; they show some reversals inside the rock units, and at the sharp bend of the Tulameen River they are consistent with a small anticline in unit 2. The average plunge is gently southeast. At and near contacts of units, most of these better-shaped dragfolds indicate overriding to the northeast. This in turn suggests that units 1 to 7 form an ascending sequence.

The lower Lawless Creek section is chopped up by faults, which appear to belong to three sets characterized by the following strikes:—

(1) East-northeast to northeast—A, B, H, I.
(2) North-northeast to north—D, F, G, etc.
(3) Strike faults—C, E.

Faults of group (1) are further characterized by right-handed offset of beds, although A and B show left-handed drag. Faults A and B each offset a band of white rhyolite breccia about 300 feet. Where exposed just below El Alamein mill, fault B dips 40 degrees north. Fault A may be steeper.

Faults of group (2) are characterized by northerly strikes and near-vertical dips. Some are marked by breccia zones. Where determinable, the offset is right-handed. Fault D is inferred from truncation of beds in riverside exposures and from a vertical wall showing drag and slickensides indicating right-handed movement. Its extension across Grasshopper Mountain has not been demonstrated, but it may be partly responsible for the large shift in the southwest contact of the rhyolite. Fault F is exposed as a broad zone of mildly sheared rock in the Grasshopper Mountain road cut. It is inferred to follow a topographic lineament across Grasshopper Mountain, and may continue northward to a wide fault zone exposed on the access road. The amount and direction of movement on it are unknown. Fault G terminates unit 6 to the northwest. Along the Tulameen River, near El Alamein mine, there are three north-striking zones of fault breccia 2 to 5 feet wide. Two of these are below the mill and each offsets a quartzite-bluish greenstone contact about 30 feet to the right. Some of the fragments are well rounded and resemble pebbles.

The strike faults are by nature less conspicuous than the others. Fault E was identified because it is slightly crosscutting, gradually truncating unit 7. Fault C is host to mineralization and is exposed by El Alamein adits. It is mainly a zone of anastomosing shears in black argillite, but it has also brecciated the adjacent diorite. The Enniskillen adit exposes a gouge band 3 to 4 inches wide. Both mine faults are generally parallel to the regional foliation. The displacements are unknown.

Mineral Deposits

Mineral occurrences visited in 1960 are shown by number on Figure 4 and are mentioned below. Descriptions of some of these occurrences, and of others not mentioned here, are given in the memoirs by Camsell and Rice, in Annual Reports, and in Department of Mines Special Report No. 1937-17. None is large, most are very small, yet together they emphasize the wide distribution of mineralization.

The following production is recorded:—

	Year	Tons Shipped	Gold	Silver	Copper
			Oz.	Oz.	Lb.
Law's Camp	1916	30	30	466	869
Rabbitt mine	1939	21	88	24	......
	1940	1,361	924	524	......
	1941	50	45	36	......
Totals	......	1,432	1,057	584	......
El Alamein	1949	......	40	7	......
	1950	......	65	......	......
	1951	......	96	18	......
Totals	......	.	201	25	......
Area totals	......	......	1,288	1,075	869

1. Two small cuts have been made in the right bank of Lawless Creek 700 feet above the mouth of Henning Creek. They expose small amounts of chalcopyrite and galena in two quartz-carbonate veins striking northwest and slightly east of north.

2. On the west bank of Lawless Creek, 1,500 feet above the mouth of Skwum Creek and just above the old road to Law's Camp, galena and less chalcopyrite are irregularly disseminated in part of an inclusion of feldspar porphyry in pyroxenite. Across Lawless Creek, in the cut of the old road, there is a faint malachite stain on carbonatized pyroxenite, with one small fracture veinlet of sphalerite and chalcopyrite.

3. At a bend in Skwum Creek, just west of the pyroxenite, a north-striking gently west-dipping quartz-carbonate vein contains chalcopyrite, sphalerite, and galena with pyrite across 5 inches over an exposed length of 32 feet. A sample over this width assayed: Gold, 0.02 oz. per ton; silver, 1.1 oz. per ton; copper, 0.45 per cent; lead, 0.31 per cent; zinc, 0.5 per cent. Two small pockets of chalcopyrite and sphalerite were found farther up Skwum Creek, between the upper falls and the road to Law's Camp, in quartz-carbonate veins under minor flat-lying gouge zones.

4, 5, and 6. Law's Camp. *See* page 53.

7. *Rabbitt Mine*.—This property is on the north slope of Grasshopper Mountain at 3,700 to 3,950 feet elevation, half a mile southeast of Grasshopper Creek. It is reached by a short branch off the Grasshopper Mountain logging-road. Development and mining were carried on between 1937 and 1941. Workings include two adits, now caved, a stope broken through to surface, and extensive trenching and pitting. The workings follow two quartz-carbonate veins which strike north 10 degrees west and north 40 degrees east and intersect at the stope. Both veins were seen to contain considerable disseminated pyrite and some disseminated chalcopyrite. It is reported that native gold, a telluride, galena, and sphalerite are also present. The pattern of mining would suggest a pipe-like orebody at the intersection of the veins.

[References: Rice, H. M. A. (1947), Geology and Mineral Deposits of the Princeton Map-area, B.C., *Geol. Surv., Canada,* Mem. 243, p. 99; *B.C. Dept. of Mines,* Special Report No. 1937–17, p. 6; *Minister of Mines, B.C.,* Ann. Rept., 1940, p. 61.]

8. Copper mineralization was found in 1960 by J. W. Welden, of Tulameen, 1¼ miles east of the Rabbitt mine, across Lawless Creek and at an elevation of 3,200 feet. Trenching on the nose and north flank of a ridge has disclosed blebs and disseminated grains of chalcopyrite, together with a general malachite staining, in rubbly siliceous greenstone over a surface area of about 800 square feet. The probable size and shape of the body could not be deduced from present exposures. The rock is traversed by at least one flat-lying shear.

9. A copper showing was encountered on the west bank of Lawless Creek nearly a mile from its mouth. At the foot of a bluff and talus slope a large slump block contains a 2-inch vein of massive pyrite and chalcopyrite which assayed: Gold, 0.02 oz. per ton; silver, 6.3 oz. per ton; copper, 13.03 per cent. Directly above this block the trace of a mineralized shear zone gradually climbs the bluff northward. At its readily accessible south end this zone strikes north 80 degrees west, dips 43 degrees south, and is 2½ feet thick. It consists of a hangingwall band of barren breccia and a footwall band of sheared argillite and greenstone containing clots and disseminations of pyrite and chalcopyrite. Quartz is minor in both places.

10. *Enniskillen*.—This showing is on the north bank of the Tulameen River, 1,000 feet above the mouth of Lawless Creek. It is on the former Enniskillen No. 1 claim, which was located by W. Britton in 1939. The ground is now included in the Rambler Group, located in 1959 by Mrs. D. Petch, of Tulameen. Workings include a 10-foot adit and some caved pits and trenches. The country rock is a 30-foot band of black argillite in Nicola greenstone. The adit follows a bedded shear in the black argillite that contains some scattered grains of pyrite and chalcopyrite and small lenses of calcite.

[Reference: *Minister of Mines, B.C.,* Ann. Rept., 1949, p. 129.]

11. *El Alamein Mine*.—The mine and a pilot mill are 1,600 feet below the mouth of Lawless Creek, on the Wildcat Crown-granted mineral claim owned by V. Golden, of Vancouver. El Alamein Mines Limited in 1949–50 erected the pilot mill on the north side of the Tulameen River and drove two adits into a bluff face on the south side. The property has lain idle since 1951. N. N. MacKenzie, of Vancouver, diamond drilled two holes from surface in 1959 and one hole of 98 feet in 1960, in addition to several short holes from the upper adit. The adits trend south-southeast and are connected by a raise. The lower is about 10 feet above normal river level and is about 150 feet long. The upper is about 15 feet higher and 300 feet long. They follow a shear zone 4 to 8 feet wide in a diorite dyke. The material of the zone is largely sheared black argillite, and subordinate sheared and

brecciated diorite. The zone exhibits both anastomosing and branching shears, and is offset a few feet by several small cross-faults. Veins and veinlets of quartz and calcite are scattered through it. Pyrite, chalcopyrite, and native gold occur both in the veinlets and disseminated in sheared or brecciated diorite. The gold does not occur uniformly along the lode, but appears to be concentrated in pockets or shoots. The controls of these shoots have not been determined.

[References: *B.C. Dept. of Mines,* Special Report 1937–15; *Minister of Mines, B.C.,* Ann. Repts., 1949, pp. 124–129; 1950, p. 112; 1951, p. 128; 1959, p. 53.]

12. On the left bank of the Tulameen River, in the canyon section half a mile below the mouth of Lawless Creek, J. W. Welden, of Tulameen, in 1960 discovered pyrite, chalcopyrite, and sphalerite disseminated in a bedded quartz vein 2 to 6 inches wide. The vein is in interbedded argillite and greenstone just south of the projected position of an east-west fault.

13. In the southeast corner of the area, on the left bank of the Tulameen River directly below the foot of Logan's logging-road, copper-zinc mineralization was in 1960 exposed by bulldozing and by blasting on ground held by J. W. Welden. A bulldozed trench parallel to the river, 50 feet long, together with natural outcrops farther west, exposes granule conglomerate and 5 feet of rhyolite tuff lying above black argillite. The upper few feet of the black argillite is strongly sheared and brecciated. These rocks are thrown into a broad arch plunging about 35 degrees into the river. On the crest of the arch the tuff contains calcite stringers and stringers and ragged disseminations of sphalerite and minor chalcopyrite. No ore mineralization was seen in the black argillite, and the granule conglomerate had not been exposed on the crest of the arch. The mineralization appears to die away on the flanks.

Gold-Copper-Zinc

Law's Camp (The Consolidated Mining and Smelting Company of Canada, Limited)

The company optioned six Crown-granted claims, owned variously by The Penticton Sawmills Limited, Mrs. Ben Marcotte, and several estates; optioned thirty-five recorded claims, and holds thirteen claims by record. The principal showings are on the St. George (4), St. Lawrence (5), and Liverpool (6) Crown-granted claims, which lie in an approximate north-south line along the east brow of the ridge between Grasshopper and Skwum Creeks. The company built a short piece of road from the Skwum Creek branch of the Forestry access road to join the old Law mining-road at Skwum Creek, and rehabilitated the road up to the camp. A tent camp was established at the old camp-site. Thirteen holes were diamond drilled, aggregating about 3,000 feet. Magnetometer and E-M surveys were made, and an area around the showings was geologically mapped. All work ceased early in September. Twelve men were employed for most of the season, under the direction of D. W. Heddle.

The general geology is outlined in Figure 4 and on the preceding pages. Figure 6, a generalization of plane-table mapping by the company, indicates the main rock types in the mine area. They are dark schistose sediments and light-grey or white coarsely crystalline limestone of the Nicola group, dykes and (or) sills of feldspar porphyry, and Eagle granodiorite. The main body of granodiorite is exposed just west of the area of Figure 6, but an outlying body is exposed in the northwest part of the area, near the St. George showing. Areas shown as schist include many seams and thin bands of limestone, many dykes or sills of feldspar porphyry and aplite, and a few bodies of greenstone. Feldspar porphyry and greenstone occur

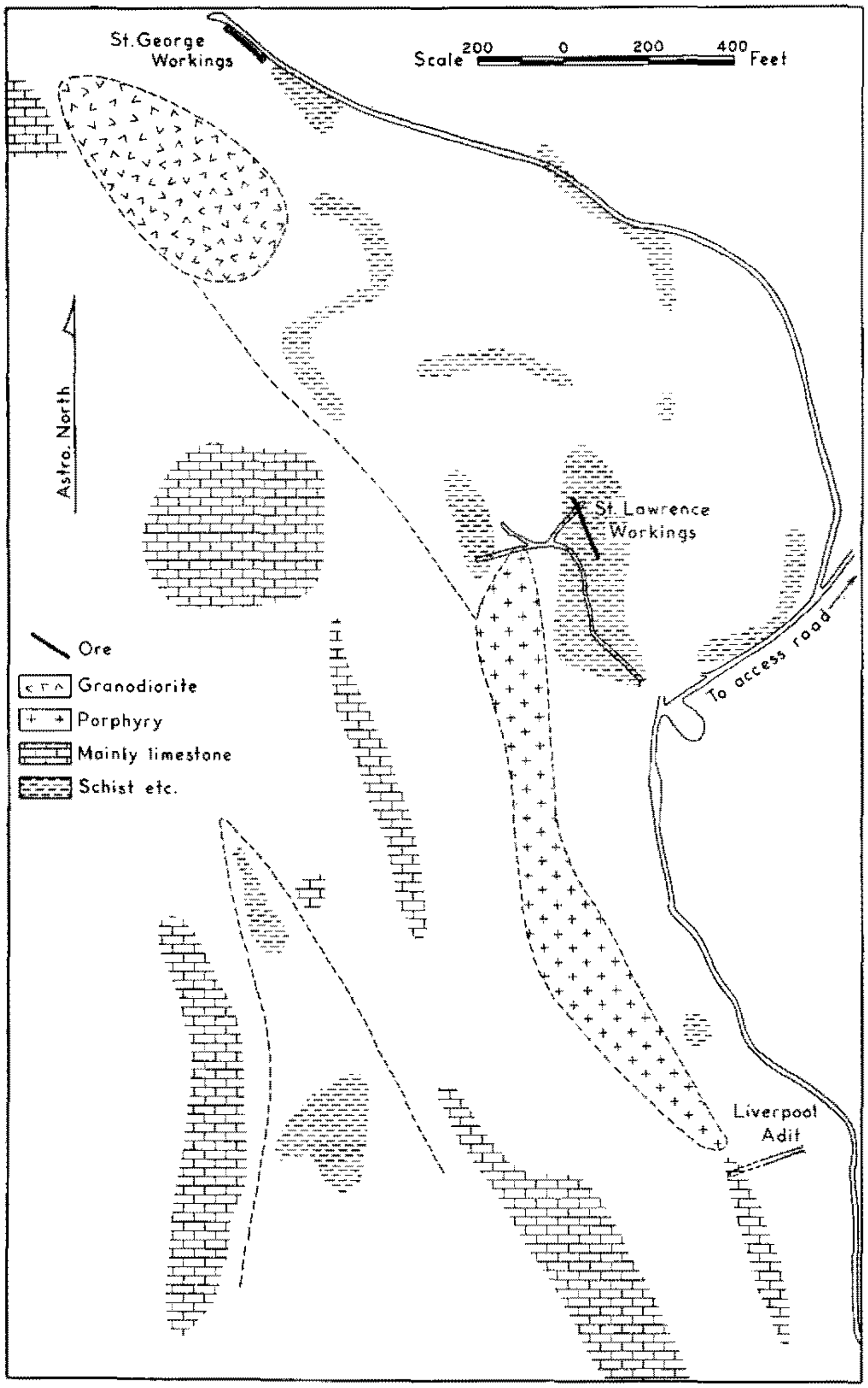


Figure 6. Law's Camp. Principal showings.

to a lesser extent in the main limestone areas. The fold structure is unknown. Bedding is indistinct in the limestone. It may be represented in the schists by the limestone seams, to which schistosity is parallel. This schistosity swings from strike north 20 degrees west, dip 35 degrees west at the St. Lawrence showings to strike north 55 degrees west, dip 50 degrees southwest at the St. George. Many small faults can be seen in the St. Lawrence adit and in some outcrops. The over-all fault pattern is not evident.

The St. Lawrence ore zone is exposed in three inclined shafts over a length of 150 feet. A trench and short adit 100 feet farther south and the main adit about 90 feet lower encountered only a breccia band at the projection of the vein, and a fourth shaft 40 feet farther north along strike was sunk in limestone. Drilling appeared to confirm that the orebody is a lens sharply limited along strike and down dip. As exposed in the south shaft, the orebody is bedded and consists of 6 feet of nearly massive sulphide lying between schist walls. Pyrite and sphalerite predominate; chalcopyrite and quartz are minor. The next two adits to the north were not accessible; fragments of ore and limestone are mingled with schist on the dumps. The relationship of this limestone to the breccia band is not known. The breccia band is 4 to 6 feet thick in the above-mentioned trench and in drill-holes, but narrows to 2.5 feet in the main adit. Two small pods of sphalerite are exposed in a drift off the main adit, but they lie some 10 feet in the hangingwall of the breccia band. A 50-foot-thick breccia band exposed along the road to the St. George showings may or may not be a continuation of the St. Lawrence breccia band. It is heavily pyritized, but no ore minerals were seen in it.

The St. George orebody is exposed in two shafts 90 feet apart, southwest of the 50-foot breccia band. The shafts are now unsafe, but the dumps indicate the ore is nearly massive pyrrhotite containing a little chalcopyrite. The walls are limestone. Here again the drilling indicated the body is a lens sharply limited along strike and down dip.

The Liverpool body was entered by an adit now inaccessible. The dump consists of black schist and massive pyrite containing a little chalcopyrite. Drill-holes on either side and down dip failed to find ore mineralization.

ASHNOLA RIVER*

Copper

Rick (Kennco Explorations (Western) Limited)

(49° 120° S.E.) Company office, 1030 West Georgia Street, Vancouver 5. The Rick group of eighty-one recorded claims is southeast of Placer Mountain near the head of McBride Creek, a tributary of the Ashnola River. Twelve miles of road was constructed. Geological, geochemical, and geophysical surveys were made, and a total of 3,000 feet of diamond drilling was done. A crew of five men was employed under the direction of C. S. Ney.

SIMILKAMEEN RIVER†

Copper

Deep Gulch (Copper Mountain Mines Ltd.)

(49° 120° S.W.) Company office, 1500 Marine Building, 355 Burrard Street, Vancouver 1. R. Collishaw, president; A. C. Skerl, consulting geologist. This company (formerly named Deep Gulch Mines Ltd.) holds about thirty claims and fractions which are mostly on the west side of the Similkameen River near the Hope–Princeton highway 15 miles south of Princeton.

* By David Smith.
† By J. M. Carr.

Work done in 1960 included geophysical surveys and about 1,000 feet of diamond drilling, of which some is reported to have intersected mineralization.

Friday Creek Development Co. Ltd.

(49° 120° S.W.) Company office, 1614 Burrard Building, 1030 West Georgia Street, Vancouver 5. D. F. Hamelin, president. This newly formed company holds twenty-two claims and fractions comprising the Ilk, Elk, and Ni groups under option from Len and Irvine Ashley, of Princeton. The property lies east of the Hope–Princeton highway about 17 miles by road south of Princeton, and adjoins the southern part of the Deep Gulch property. The showings are astride Friday Creek at about 3,200 feet elevation, and are accessible by vehicle either from the north through the Deep Gulch property or from the south by 2 miles of dirt road which joins the highway nearly 3 miles south of the Kennedy Lake turn-off.

In 1958 Phelps Dodge Corporation (Canada) Ltd. extended bulldozer trenches to north and south of Friday Creek for distances of 1,400 and 3,400 feet, respectively. Work done in 1960 by the present company includes road-building and bulldozer trenching, together with about 1,000 feet of diamond drilling and a geophysical survey. This work was concentrated near Friday Creek, in the vicinity of old workings that are now caved or destroyed and were formerly known successively as the Wheeler group and the Gladstone group.

The showings are in rocks of the Copper Mountain stock, whose western margin occurs between the southernmost trenches. In these trenches, gabbro or diorite is exposed within about 300 feet of contact metamorphosed basic volcanic rocks which strike northwestward and possess steep dips. The volcanic strata are partly sheared and pyritized. The margin of the stock is also located in trenches on the Deep Gulch property at a distance of about 1 mile north-northwest of the Friday Creek showings.

Exposures are mainly of monzonite and diorite or gabbro. Mica pyroxenite occurs on both sides of Friday Creek, and is a rock not previously recorded in the stock. It apparently forms a northerly trending body about 200 feet wide and at least 350 feet long. As seen south of the creek, the pyroxenite contains a 15-foot-wide section of gabbro and is enclosed to east and west by gabbro, or diorite, which grades rapidly to monzonite. The margins of the pyroxenite are sharp and somewhat irregular. Throughout the trenched area the plutonic rocks are traversed by varying amounts of pink pegmatite. The pegmatite consists principally of orthoclase feldspar together with biotite, plagioclase feldspar, and some quartz. It forms veins of diverse attitude, ranging in width from a fraction of an inch up to several feet. Numerous exposed sections of the plutonic rocks are virtually free of pegmatite, as also are scarce dykes of andesite porphyry which cut diorite and monzonite.

Except in pyroxenite, copper mineralization appears to be distributed in close relationship to pegmatite. Bornite and chalcopyrite occur separately or together, and are partly changed to malachite. Chalcocite is reported on the property, and pyrite was seen in small amounts in the few sections of core that were examined. The copper minerals are chiefly visible in and adjacent to pegmatite, as small pods and local disseminations where pegmatite veins intersect, or as lenses in a few of the wider veins. The most widespread mineralization is probably in the western part of the pyroxenite body, where bornite appears less restricted to the vicinity of pegmatite but in addition occurs disseminated and on hair-line fractures in the pyroxenite, together with introduced biotite. The grade of such mineralization is difficult to estimate. Platinum, palladium, gold, and silver are reported to occur in varying amounts in assayed samples of copper-rich material selected from the

Friday Creek vicinity. A sample of bornite-rich material taken from a narrow vein about 2,600 feet south of Friday Creek assayed: Gold, 0.54 oz. per ton; silver, 6.2 oz. per ton; palladium, trace; copper, 28.06 per cent. Platinum was not detected in the sample.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1929, p. 277; 1958, pp. 30–31; 1959, pp. 53–54; *Geol. Surv., Canada,* Mem. 171, 1934, pp. 47–48; Mem. 243, 1947, pp. 89–90.]

COPPER MOUNTAIN*

Copper

Copper Mountain (The Granby Mining Company Limited).—(49° 120° S.W.) Company office, 1111 West Georgia Street, Vancouver 5. L. T. Postle, president. Under a lease held by the H.G. Mining Co. Ltd., mining was carried out in the open pit. Three shipments of ore were made totalling 41 tons.

PRINCETON*

Copper

F.H. (Kennco Explorations (Western) Limited).—(49° 120° N.W.) Company office, 1030 West Georgia Street, Vancouver 5. The F.H. group of 103 recorded claims is at Jura station, 6 miles north of Princeton. Surface prospecting, some geophysical work, and some diamond drilling were carried out. A crew of three men was employed under the supervision of J. M. Anderson.

HEDLEY†

Gold

French (French Mines Ltd.) (49° 120° S.E.) Company office, 314, 718 Granville Street, Vancouver 2; mine office, Hedley. W. B. Burnett, president; J. S. Biggs, mine superintendent. The French mine is on the Oregon mineral claim on the east side of Cahill Creek, a southwesterly flowing tributary of the Similkameen River about 5 miles east of Hedley. It is at an elevation of 3,900 feet and is reached by a branch from the Nickel Plate road about 3 miles from the highway.

A short history of the property is given in the Annual Report for 1957 and descriptions in the Reports from 1950 to 1959. The geology in the vicinity is shown on Geological Survey of Canada Map 568A, Hedley.

The mine is in a salient of Triassic and later(?) sediments described (1959) as a band of limy strata up to 60 feet wide between fine-grained dark-coloured tuffs. The salient extends about a mile southwestward into younger granodiorite and is about half a mile wide. The strata in the vicinity of the mine consist of tuffs overlying 15 to 20 feet of limestone which in turn overlies cherty tuffs. Locally limestone has been completely replaced by silica. The mineralization is in a garnet-pyroxene skarn which appears to have formed in part along fractures rather than as a consistent replacement of beds. There is not, therefore, necessarily a direct relationship between the distribution of skarn and the attitude of bedding planes.

The axis of the orebody trends northwest and plunges toward the southeast. At the southwest end of the mine the orebody curves to east-west and finally swings round nearly to northwest. It is flat-lying for most of its length; the dip steepens eastward, and in the central part the orebody rolls steeply northwest between the 3,920- and 3,835-foot levels.

* By David Smith.
† By N. D. McKechnie and David Smith.

The tuffs in the ore zone show strong brecciation which is pre-silicification; there is also some healed limestone breccia. A pillar in the largest stope shows minor folds in limestone overturned flatly to the northeast, and elsewhere there are fragments of limestone in " footwall " tuffs, indicating overturned beds. Limestone-tuff contacts usually are very irregular, and blocks of tuff in limestone are not uncommon. Some of these suggest engulfment by the limestone by solid flow under great stress, such as might obtain during severe folding. Individual stopes may be flat or steep dipping; an unusual feature is the common overlapping. One stope that breaks through to surface has upper and lower branches that join to form one large chamber, the whole having the shape of a recumbent saddle. Partially completed sections in the mine files indicate that the whole structure is an overturned nappe-type fold with minor folds on the limbs, not all of them on parallel axes. Such a structure could include all of the observed features enumerated above.

If the major controlling structure at the French mine is a recumbent fold, the ore structure is quite possibly repeated elsewhere in the vicinity. A mineral deposit within such a structure might show little vertical depth but could have appreciable lateral extent, as does the French ore zone. This possibility should be considered in exploring mineral showings in the neighbourhood.

The ore zone is displaced, about 15 feet each, by several steep-dipping cross-faults, striking north-northeast to northeast. These are in the hangingwall of a northeast-striking fault dipping 40 degrees southwest which cuts off the ore zone, the Cariboo fault. If, as seems likely, the Cariboo fault is a thrust fault, the ore in its footwall should be sought to the west of the present zone.

The mine is developed from three adit levels—the 3920 level (Kelowna), the 3835 level (Granby), and the 3785 level (Cariboo). In 1960 mining and development was carried out on all three levels. The ore is mined by open stoping and is slushed to transfer raises. The operation averages 45 to 50 tons per day, the ore being trucked to the cyanide mill on the flat east of Hedley. The following is a summary of work done in 1960:—

Drifting	ft.	421
Raising	ft.	157
Crosscuts	ft.	237
Diamond drilling—		
Underground	ft.	4,920
Surface	ft.	1,688
Ore milled	tons	13,553
Gold recovered	oz.	6,420

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

KEREMEOS*

Silver-Gold

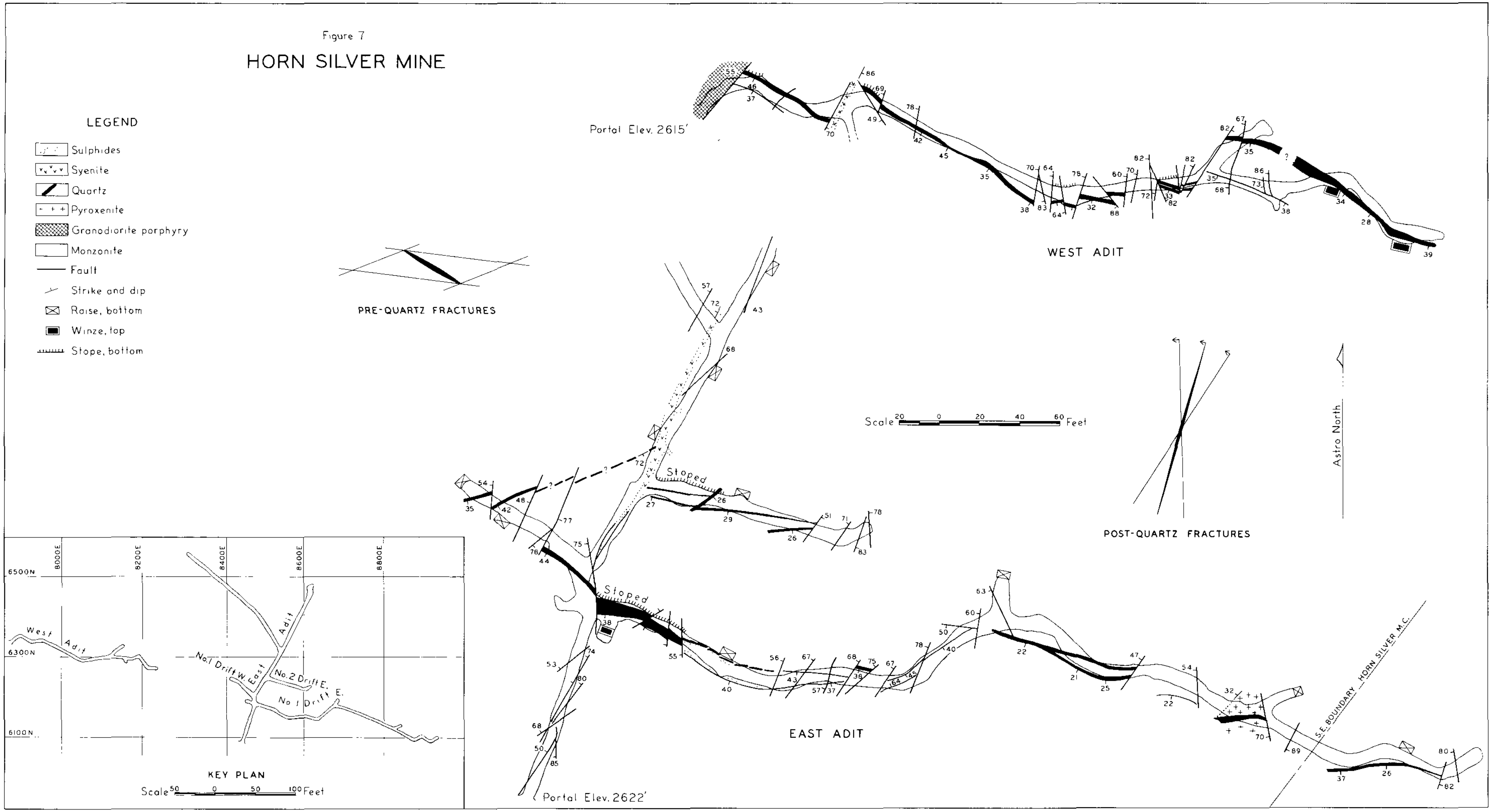
Horn Silver (Canada Radium Corporation Limited)

(49° 119° S.W.) Company office, 1024, 85 Richmond Street West, Toronto, Ont. The old Horn Silver mine is on the east slope of Richter Mountain on the east side of the Similkameen River valley, 16 miles south of Keremeos. The present property comprises the Horn Silver and Silver Bell Crown-granted mineral claims, registered owners G. F. Ramsey, Ulrich Tishhauser, and Howard Graham, all of Keremeos, and seven recorded claims, the Silver Bell 1 to 5 and Silver Bell 7 and 8, in the name of Canada Radium Corporation

* By N. D. McKechnie.

Figure 7

HORN SILVER MINE



Limited. A jeep-road, now in need of repair, leads from the Keremeos–Chopaka highway, past the old loading-platform at 1,300 feet elevation, to the east portal at 2,622 feet elevation in a distance of about 1 mile. A good foot-path connects the east portal with the west portal.

The Horn Silver claim was Crown-granted in 1909 and the property was under development every year from 1914 to 1922. In 1925 Horn Silver Mining Corporation built a small mill, rated at 22 tons per day capacity, near the site of the present loading-platform. The mill operated in 1926 only, when it treated 700 tons. The company reorganized in 1927 as Big Horn Mines Limited, under Dominion charter, and confined its work to underground development. Further development was done during 1929, but in 1930 the property was closed. The mine and milling equipment had been removed by 1933. In April, 1958, Canada Radium Corporation began a programme of drifting, crosscutting, raising, and diamond drilling which continued until September, 1959. No work was in progress in 1960.

The total production, chiefly shipping ore, is 5,878 tons containing 682 ounces gold (0.116 ounce per ton); 249,090 ounces silver (42.4 ounces per ton); 131 pounds copper; 1,471 pounds lead; 85 pounds zinc. Tests of a composite sample by Horn Silver Mining Corporation in 1925 showed *nil* in bismuth, antimony, and nickel.

The property is described or mentioned in the Annual Reports for 1915 to 1930, inclusive, 1933, 1958, and 1959. The general geology of the area is shown on Geological Survey of Canada Map 341A, Keremeos.

The Horn Silver mine lies in the Kruger syenite, which forms a band about 1 mile wide trending east to southeast for 4 miles from the Similkameen Valley, then turns due south and widens to about 3 miles at the International Boundary. It is bordered on the north and east by the older Kobau group of quartzites, schists, and greenstones, and on the south and west by a large mass of younger granodiorite. Two to 3 miles east of the mine the syenite-granodiorite contact is offset to the left on two northeastward-striking faults.

The Horn Silver deposit (Fig. 7) consists of quartz veins, mineralized with sulphides, in a shear zone in a monzonite phase of the syenite.

The monzonite is a medium-grained dark-grey rock with a pinkish cast, which locally may be quite pronounced, given by the potash feldspar. The rock shows little alteration, involving scattered grains of calcite, a little sericite, and some conversion of pyroxene to hornblende.

The monzonite is cut by dykes of granodiorite porphyry, pyroxenite, and syenite. None was found in contact with any other, so their age relationships are not known for certain.

The granodiorite porphyry is a fresh-appearing rock composed essentially of elongated phenocrysts of feldspar and dark-green hornblende. In thin-sections the phenocrysts are seen to be microcline with chipped and crushed edges. The groundmass is microcline, muscovite, hornblende, minor plagioclase, and a few grains of quartz. Most of the feldspars are fractured, and sericite has formed in the streaks and small patches of finely crushed material. The only exposure of this rock in the mine workings is a large dyke at the portal of the West adit. It is presumed to be allied to the main mass of granodiorite.

The pyroxenite is exposed only in one place in the workings, in No. 1 East drift about 320 feet east of the main crosscut. It is composed essentially of pleochroic clinopyroxene in part converted to amphibole, biotite, and about 10 per cent or less of microcline and perthite. Secondary alteration is confined to a little talc.

Syenite is exposed in both the West and East adits. It is a coarse-grained pink rock composed chiefly of microcline and perthite, hornblende, biotite, plagioclase, and quartz. A little talc borders some of the hornblende, and the feldspars are sericitized along cleavages. Structural relationships indicate the syenite to be the youngest of the three dyke rocks.

The controlling structure of the Horn Silver mine is a shear zone some 80 feet wide which strikes north 85 degrees west and dips 40 degrees south. A subsidiary shearing, visible within the main shear zone and also in minor vein directions elsewhere, strikes north 70 degrees east and dips 55 degrees southeast. Lenticular quartz veins striking north 60 degrees west and dipping 35 degrees southwest occupy tension fractures in the north 85 degrees west shear zone and are in echelon to the left. Oreshoots controlled by this shear system would have a flat westerly plunge of about 10 degrees.

The pre-mineral shear zone is faulted by a later system consisting of two shear faults: strike north, dip 55 degrees west and strike north 35 degrees east, dip 65 degrees northwest. Tension fractures, occupied by syenite dykes, strike north 15 degrees east and dip 70 degrees west. Displacement on the north-south faults is to the right; that on the north 35 degrees east faults to the left. Observed displacements are of a few inches to a few feet only, but break the veins into short lengths.

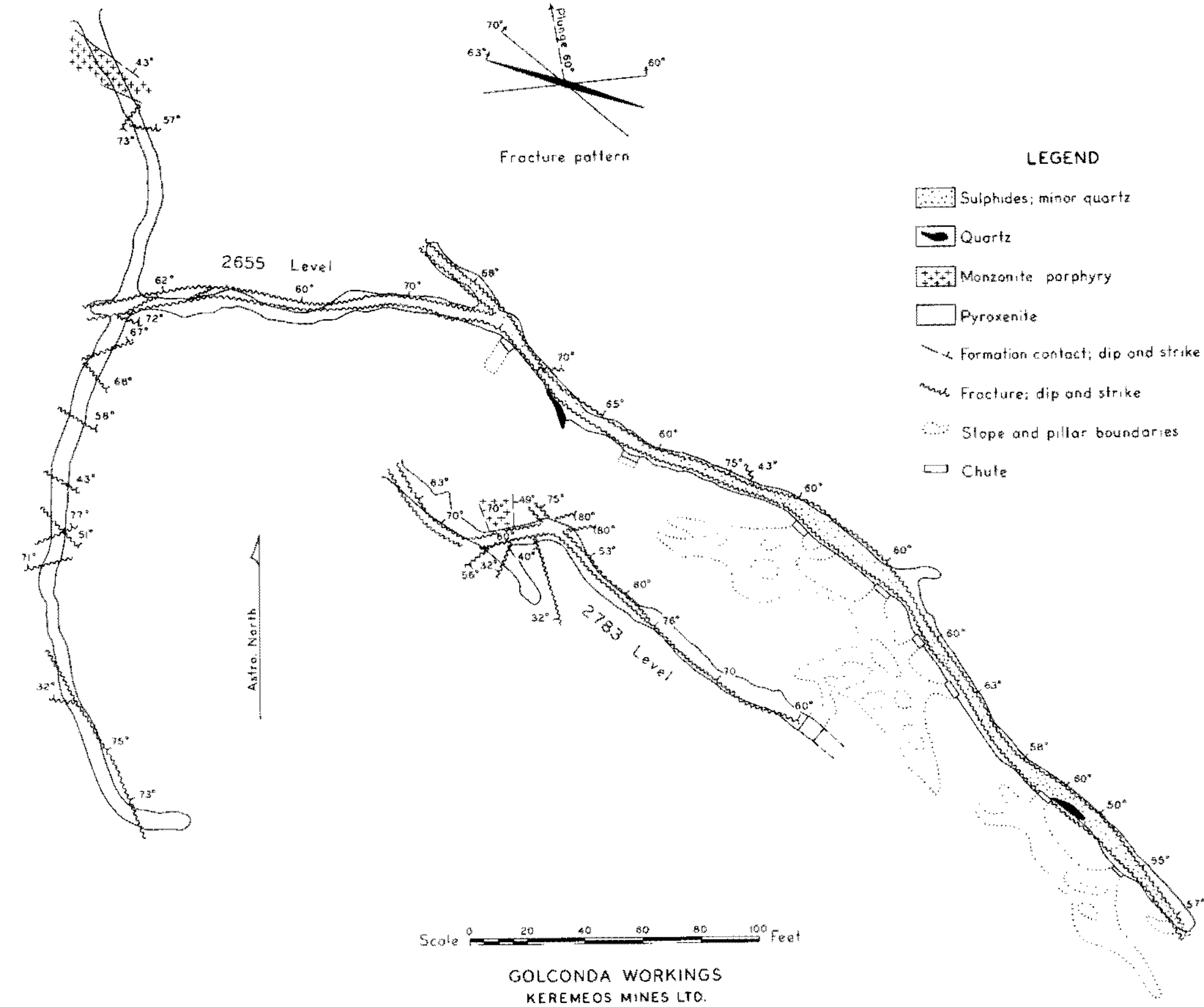
The quartz veins are up to 5 feet wide, and are often sheeted. They are mineralized with galena, argentite, tetrahedrite, pyrite, and chalcopyrite. Native silver, cerargyrite, and pyrargyrite are reported but were not seen by the writer. The metallic minerals commonly occur in bands in the quartz, usually near the walls. The 1958 Annual Report notes that gold assays appear to vary directly with the proportion of pyrite present.

Quartz veins terminate against syenite in the East adit except at the junction with No. 2 East drift (Fig. 7), where discontinuous stringers of quartz pass from the vein through the syenite. This suggests at least two ages of quartz, the later post-syenite. The syenite also contains a little pyrite.

Earlier Annual Reports refer to other workings, but at present two adits are accessible. The present workings (Fig. 7) consist of the West adit, driven on a faulted quartz vein, and the East adit, a north-trending crosscut with two drifts, No. 1 and No. 2, and a long exploratory drive to the northwest. Raises and small stopes were driven on the veins from the drifts. Raises also were driven from the crosscut north of the drifts to intersect the flat-lying veins, and some stoping was done from them.

The quartz veins pass southeastward from the footwall side of the shear zone to the hangingwall side as successive lenses in echelon to the left. Faulting has obscured the relationships, but the longer continuous veins illustrate the pattern. The quartz in the west adit possibly represents two veins; the westerly one is repeatedly faulted to the north. No. 1 West and East drifts in the East adit are on one vein in the hangingwall side of the zone as far as the sharp northward swing of No. 1 East drift. The working becomes a crosscut and picks up an extension of the vein in the footwall side of the zone exposed by No. 2 East drift. This pattern of quartz veining should repeat both horizontally and vertically as far as the shear zone persists. Raises toward the east end of No. 1 East drift show quartz which may represent veins lying above those in the workings rather than faulted segments of these veins.

The shear zone is not everywhere well defined. Much of the movement seems to have been taken up by opening of the tension fractures which now contain quartz. In places shearing is very weak between quartz lenses. In such places the zone might not be recognizable in drill core.



GOLCONDA WORKINGS
KEREMEOS MINES LTD.

Figure 8

Copper-Molybdenum

Golconda (Keremeos Mines Ltd.) (49° 119° S.W.) Registered office, c/o Hamilton, Reid and Patterson, 725 Rogers Building, Vancouver; mine office, Olalla. W. W. Geminder, manager. The property is on the south fork of Olalla Creek, a southeastward-flowing tributary of Keremeos Creek, about 1½ miles by road west of the settlement of Olalla. It includes the Copper King Crown-granted mineral claim and, by agreement with Lind J. Lievre, the Trout Fractional, Wright Fractional, and North Star Fractional recorded mineral claims.

Mentions of the property are in Annual Reports from 1899, the most descriptive in 1910, 1917, 1918, 1922, 1923, 1927, and 1946. The geology of the region is shown at 1 mile to the inch on Geological Survey of Canada Map 628A, Olalla.

The deposit is in a pyroxenite stock intruding sedimentary and pyroclastic rocks of the Triassic(?) Shoemaker formation. The pyroxenite in turn is intruded by dioritic rocks and, in the mine workings, by monzonite porphyry.

The deposit is a shear zone up to 5 feet wide striking north 51 degrees west and dipping 70 degrees northeast. The shear zone is mineralized with quartz in the form of stringers and large lenses containing pyrite, chalcopyrite, and molybdenite.

The shear zone is composed of the following elements: Two shear plane directions, one striking north 85 degrees east and dipping 60 degrees to the north, the other striking north 51 degrees west and dipping 70 degrees northeast; tension fractures striking north 73 degrees west and dipping 63 degrees northeast. The dominant shear strikes northwestward and controls the over-all direction of the mineralized zone. The subsidiary shear and the tension fractures are evident in abrupt changes of direction along the mineralized zone and, particularly the tension fractures, in the orientation of some large quartz lenses. A plunge of 60 degrees in the direction north 10 degrees west is indicated by the pattern.

The workings (Fig. 8) consist of two adits 128 feet apart vertically, the 2655 level and the 2783 level. As shown, the 2655 level encountered a north 85 degrees east striking shear at about 100 feet from the portal. A drift eastward along this shear, which is sparsely mineralized, encountered the main shear zone at about 120 feet from the crosscut. From there the zone was followed for a short distance northwest and for some 330 feet to the southeast. The shape and position of stopes are shown; the plunge of the oreshoots is indefinite, although some similarity to the postulated plunge direction is indicated.

A 45-tons-per-day mill produces both a copper and a molybdenum concentrate.

FAIRVIEW CAMP*

Silica-Gold

Fairview (The Consolidated Mining and Smelting Company of Canada, Limited) (49° 119° S.W.) Head office, Trail; mine office, P.O. Box 337, Oliver. G. S. Ogilvie, property superintendent. This property consists of thirty-six Crown-granted claims. The mine lies about 5 miles to the west of Oliver. Quartz is mined and shipped to Trail for use as flux. All production has been from No. 3 level. Operations were continuous throughout the year, and 24,573 tons of quartz was shipped. Development work included 40 feet of raising and 169 feet of diamond drilling. A crew of six men was employed.

* By David Smith.

Gold

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

(49° 119° S.W.) Head office, Trail. This property consists of four Crown-granted claims as follows: Morning Star, Lot 443; Evening Star, Lot 543; Silver Crown, Lot 442; August, Lot 1050. The claims lie about 5 miles west of Oliver. The underground workings on the Morning Star were dewatered and geologically mapped. Surface diamond drilling totalling 1,409 feet in six holes was done on the Morning Star, August, and Evening Star. Four trenches were bulldozed on the Silver Crown. A crew of six men was employed under the supervision of G. S. Ogilvie.

CAMP McKINNEY

Gold

Cariboo-Amelia (McKinney Gold Mines Limited)*

(49° 119° S.E.) Mine office, Rock Creek. Hill, Starck and Associates, consulting mining engineers; A. G. Ditto, general superintendent. This property consists of the following Crown-granted claims held under option: Cariboo, Alice, Emma, Maple Leaf, Waterloo, Wiarton, Sawtooth, Okanagan, and Amelia. Early in the year the shaft was completed to No. 5 level. Except for a small tonnage (700 tons) obtained from the old workings on No. 3 and No. 5 levels, production for 1960 has come from new workings on No. 5 level east. Two 150-foot holes were diamond drilled on No. 4 level, and three holes at 45 degrees were diamond drilled on No. 5 level.

Production in 1960 totalled 4,370 tons of ore, which was trucked 16 miles to Rock Creek and shipped to the Trail smelter. It had an average content of 1.2 ounces gold and 1.7 ounces silver per ton, and 65 per cent silica. A crew of nineteen included fourteen men underground and five men on the surface.

Gold-Silver

Old England†

(49° 119° S.E.) This property on Jolly Creek 2 miles east of the Cariboo-Amelia mine consists of three Crown-granted claims—the Old England (Lot 658), Victoria (Lot 218), and Snowdon (Lot 583)—surrounded by twenty-four recorded claims owned by R. W. Wylie, of Vancouver. The claims are reached by following a local road called the Jolly Creek trail for about 1 mile from the point where it leaves the road to the Cariboo-Amelia, some 2 miles from the mine. On the Old England several workings were driven and small shipments of ore were made before 1900, and at least one adit was driven about 1930. The showings are in calcareous greenstones containing lenses of black argillite. They are shear zones and quartz veins locally containing gold in association with pyrite, galena, and sphalerite. In the summer of 1960 three holes were diamond drilled on the bench east of Jolly Creek, about half a mile downstream from the point where the Jolly Creek trail crosses the creek.

BEAVERDELL*

Silver-Lead-Zinc-Cadmium

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; R. Ross, mill superintendent; B. Goetting, mine engineer. The property consists of thirty-two Crown-granted claims and four claims held by record.

* By David Smith.
† By J. T. Fyles.

Production for 1960 was obtained from the 2800, 2900, and 3000 levels, the main haulage being the 2900 adit. The winze to the 2800 level was completed in 1959, and stoping has now commenced from this new area. In 1960 the normal production of 70 to 75 tons per day was maintained. Some exploration work was carried out on the Sally property.

The following is a summary of operations for 1960: Drifting and crosscutting, 859 feet; raising, 559 feet; diamond drilling 5,294 feet; ore mined, 18,204 tons. An average crew of forty men was employed, of whom twenty-five worked underground.

Silver-Lead-Zinc

Bounty Fraction (Sheritt Lee Mines Ltd.) (49° 119° S.E.) Company office, 530, 470 Granville Street, Vancouver 2. K. E. Wickstrom, president. This property consists of seven Crown-granted claims and fractions—the Standard, Black Diamond, Bounty, Logan, Reco, Black Bess, and the Bounty Fraction. At the point at which the lower adit on the Bounty Fraction is connected with the bottom of the shaft, two drifts have been driven to the east and west. Work on the east drift was continuous throughout 1960. Some underground diamond drilling was done on the Bounty Fraction and some in the old workings on the Bounty claim. An underground and surface survey was carried out as part of the 1960 programme. An average crew of six men was employed. Supervision of the property was assumed by D. Sheck in the latter part of the year.

Silver-Lead

Silver Scandie (49° 119° S.E.) Mine office, Beaverdell. D. Hood, president and manager. This property consists of seventeen claims held by record—the Scandie, Scandie 1 to 3 and 5 to 17, inclusive. It is on the slope of Mount Wallace south of Dry Creek, 3 miles south of Beaverdell. The upper adit was driven an additional 90 feet to a total length of 190 feet. A new adit, at a lower level just off the valley floor, was driven 155 feet. A combination machine-shop, warehouse, and compressor-house was built in a cleared area east of the lower portal. An average crew of three men was employed.

GREENWOOD

Copper

West-Coast Resources Ltd.* (49° 118° S.W.) Company office, 569 Howe Street, Vancouver 1. Hamlin B. Hatch, president. This company owns and controls a great many mineral claims in the general Greenwood-Grand Forks area. In 1959 an air-borne geophysical survey was made by Lundberg Explorations Limited of an area of about 1,600 square miles, extending from Grand Forks to about 7 miles west of Midway, and from the International Boundary for 12 miles north. The survey combined magnetic intensity readings with the two-plane rotary-field electromagnetic method.

In 1960 Tombac Exploration Ltd. obtained a short-term examining option on eight groups of claims, each of which covered one or two anomalies determined by the Lundberg survey. Stripping or trenching, ground geophysical work, and diamond drilling were variously done. Some of the anomalies were found to be due to graphite. Large quartz veins were indicated on the Mona group.

* By M. S. Hedley.

The following is a brief statement of the groups, their locations, and the amount of work done on each:—

Group	Location	Work Done					
		E.M.	Magnetom.	Geochem.	Prospecting	Stripping	Diamond Drill
Fab	Fisherman Creek, 7 miles north of Grand Forks	×	×	×	×	—	—
Mona	Gibbs Creek	×	—	×	×	×	3 holes
Snow	Wright Mountain	×	—	—	×	—	—
Frank-Barry	3 miles south of Greenwood	×	—	—	×	×	—
Fall	4½ miles north of Greenwood, east of Boundary Creek	×	—	×	×	—	—
Mar	2 miles southwest of Greenwood	×	—	×	×	×	—
King Solomon	Copper Camp, 5½ miles northwest of Greenwood	×	—	×	×	—	2 holes
Baseline	Lee Creek, 10 miles northwest of Midway	×	×	—	×	—	—

The work was done by a small crew under the direction of Joseph Sullivan. The option terminated in August.

Copper-Gold-Silver

Mother Lode (Consolidated Woodgreen Mines Limited)*

(49° 118° S.W.) Company office, 204, 569 Howe Street, Vancouver 1; mine office, Greenwood. R. A. Brossard, president; C. W. S. Tremaine, manager; G. F. Groves, chief engineer. The property, in existence since 1891, comprises the Mother Lode, Primrose, Crown Silver, Florence, C.O.D., Sunset, and Sunflower Crown-granted mineral claims. The Mother Lode mine was opened by the B.C. Copper Co. Ltd. in 1896 and was one of the principal copper producers of the Boundary District until the close of operations in 1918. The present company began work in 1956 with the erection of a 1,000-ton mill. Work ceased in August, 1957, but was resumed after a reorganization of the company in 1959, at a milling rate of 500 tons per day.

The Mother Lode and adjacent orebodies lie in the " Deadwood mineral zone " at and near the contact of the Brooklyn formation with the underlying Knob Hill. The exact nature and relationships of some of the rocks are in question, and consequently the stratigraphy and geologic structure of the area are in doubt.

The description of the Mother Lode orebody in Memoir 19, now long out of print, is quoted as follows: " The zone consists essentially of actinolite, garnet, epidote, calcite, and quartz in which metallic minerals chalcopyrite, pyrite, and magnetite have been deposited in certain favourable areas, so concentrated as to form irregular orebodies of considerable size. The gangue rock is tough, compact, and usually dark green from the prevalence of actinolite. Where garnet and epidote predominate, the rock is harder, denser, and yellowish green or pale brown in colour. The rock is generally massive, but also occurs roughly banded from alternating layers of the several gangue minerals."

The present property includes the Mother Lode and Sunset orebodies, lying about 1,800 feet apart on a northwest-southeast line about parallel to Deadwood Creek. The Mother Lode is on the northwest.

The Mother Lode orebody lies between crystalline limestone on the northwest and a fault, strike north 15 degrees east, dip 80 degrees east, on the southeast. The

* By N. D. McKechnie.

orebody strikes north 30 degrees east, curving eastward at the northeast end, and the dip is described in Memoir 19 as steepening from 45 to 70 degrees southeast and steepening to nearly vertical in the lower part. The limestone widens northward. Near the northwest corner of the pit, drill cores show that the limestone arches over mineralized skarn.

On the northwest side of the present Mother Lode pit a dragfold is exposed having a plunge of approximately 25 degrees to the southwest. The localization of the orebody may be related in some way to dragfolding of this sort.

At the Sunset there are two orebodies, flat lying and of irregular shape. They have been mined partially in two main pits, an east pit and a west pit, and in some smaller pits covering a distance from northwest to southeast of about 400 feet. Bedding on the west side of the east pit strikes north-south and dips about 50 degrees east; on the east side of the west pit the strike is north-south and the dip 35 degrees west. Diamond-drill holes to the underlying Knob Hill formation show that the dip flattens toward the east side of the east pit. The rock immediately underlying the ore is siliceous breccia, similar to that at the Mother Lode. The only limestone observed was a faulted block at the north side of the west pit.

Mining of ore and removal of waste has been carried out primarily on the Mother Lode with some stripping and ore removal at the Sunset A total of 201,497 tons of ore was mined and milled in 1960. Milling, at near rated capacity of 650 tons per day, was continuous throughout the year. A crew of thirty-six men was employed.

[References: *Geol. Surv., Canada,* Mem. 19, Mother Lode and Sunset Mines, Boundary District, B.C., 1913; Mem. 21, Geology and Ore Deposits of Phoenix, Boundary District, 1912; Paper 45-20, Greenwood-Phoenix Area, B.C.; Seraphim, R. H., Geology and Copper Deposits of the Boundary District, *C.I.M.,* Trans., Vol. LIX, 1956.]

PHOENIX*

Copper-Gold-Silver

Phoenix Copper Company Limited (49° 118° S.W.) Company office, 1111 West Georgia Street, Vancouver 5; mine office, Phoenix. L. T. Postle, president; J. H. Parliament, manager. This property consists of sixty-three claims as follows: Twenty-nine Crown-granted, twenty-seven held by location, and seven leased. The mine and concentrator were operated continuously throughout 1960. Shipment of the 3,000 tons of concentrate stockpiled at the mine due to the strike at the Tacoma smelter was completed in May.

In January, 1960, a third ball-mill unit was put into production, increasing the mill capacity to 1,000 tons per day. The average tonnage milled during the year was 950 tons per day. A small amount of ore from the Stemwinder mine was milled on a custom basis.

Production of ore for the most part was from the Old Ironsides pit. A third shovel shift was started in June and continued throughout the remainder of the year to increase the removal of waste and to improve the operation's flexibility. No work was done in the Snowshoe pit. A small amount of ore was mined on the Rawhide claim by agreement with the owners. The Idaho claim, northwest of the Ironsides, was acquired and a small open pit started. No diamond drilling or underground mining was done. During 1960, 576,731 tons of waste was removed and 340,112 tons of ore transferred to the mill. A total of 346,638 tons was milled.

A total crew of fifty-eight men was employed as follows: Surface, nineteen; open pit, twenty; and crusher and concentrator, nineteen.

* By David Smith.

Copper-Gold-Silver

Stemwinder (Continental Consolidated Mines Ltd.).—(49° 118° S.W.) Company office, 201, 535 Howe Street, Vancouver 1; mine office, Greenwood. Activity on this property was limited to transporting the stockpile of ore to the nearby Phoenix Copper mill for concentration. A watchman was at the mine throughout the year.

ROSSLAND*

Gold-Copper

Velvet (Mid-West Copper & Uranium Mines Ltd.) (49° 117° S.W.) On May 16th, 1960, this property was leased by Mid-West Copper & Uranium Mines Ltd. to the Velvet Mine Leasers—R. Lefevre, H. W. Lefevre, J. C. Urquhart, B. W. Price. Company office, P.O. Box 389, Rossland. The property is on the western slope of Sophie Mountain, 11 miles from Rossland on the Rossland–Christina Lake highway.

All mining was done on No. 7 level, where 239 feet of drifting and 152 feet of raising were completed. The ore is trammed to the coarse-ore bin on the surface at No. 7 level, where it is crushed and carried to the fine-ore bin. From the fine-ore bin it is transported by a gravity tram to the 150-ton mill in the bottom of Sheep Creek valley. The mill operated part time in milling 4,264 tons, producing 308 tons of concentrate, which was shipped to the Tacoma smelter. The concentrates contained: Gold, 355 oz.; silver, 1,066 oz.; copper, 146,171 lb. In the period May 15th to December 31st, seven men were employed, including the four lessees.

TRAIL*

Gold

W.D. (W.D. Mining Company Ltd.) (49° 117° S.W.) This property is owned and operated by W.D. Mining Company Ltd. The company consists of five men with equal shares. F. Donelly, of Trail, president. Mine office, 1360 McLean Street, Trail. All work on the property is done by the five partners on a part-time basis. The property is on the west side of the Columbia River, 5 miles south of the Trail bridge along the Casino road. In 1960, 35 feet of diamond drilling was done from surface. A small amount of mining was done, 30 tons of ore shipped to the Trail smelter containing 21 ounces of gold. A major breakdown of the compressor prevented further mining.

NELSON*

Silver-Lead-Zinc

Big Mac (49° 117° S.E.) This property consists of fifteen recorded claims owned by R. Pond and R. McCandlish, of Nelson. An additional eight claims located south of the Big Mac group are called the Jumbo group. The property is east of the Great Northern Railroad tracks, 3 miles south of Nelson. The first showing is at an elevation of 3,150 feet, which is 500 feet above the railroad.

The mineralization occurs in a shear zone in volcanic rocks and follows a general strike of north 25 degrees west, veering to north at the north end and dipping 75 to 80 degrees east. The vein is 4 to 5 feet wide where observed. On the south end the zone is cut off by a granite contact. There is some impure limestone in the volcanics, and it appears that the limestone is more extensive at the north end of the property. Mineralization is mainly zinc with some lead and silver.

* By J. D. McDonald.

The Big Mac group was optioned to Sheep Creek Mines Limited in July, 1960. Five diamond-drill holes were completed, with a total footage of 791 feet. The option was dropped in December, 1960.

Gold-Silver-Lead-Zinc

Hummingbird (49° 117° S.E.) This property consists of eight recorded claims owned by F. Arnot and E. Arnot, of Nelson. It is at the summit between Apex and Selous Creeks. The property is accessible by a jeep-road from a point 7 miles south of Nelson on the Nelson–Salmo highway.

A lease was given to L. DeCoch to mill the dump ore from the old workings. A portable jaw crusher, jig, and sluice-boxes were set up and some trial runs were made, with good gold recovery being reported.

There are a number of showings on the property. The old workings are in a quartz vein 6 to 24 inches wide containing good gold values. Above these workings are two veins containing lead and zinc values, and below are some outcrops of lead-zinc mineralization with zinc predominant. All veins appear to be blanket veins following the bedding of the sediments. The general strike is northeast and the beds dip approximately 45 degrees southeast. A granite contact lies a short distance to the east.

Gold-Silver

White (Kenville Gold Mines Limited) (49° 117° S.E.) D. Norcross, of Nelson, has three claims under lease from Kenville Gold Mines Limited. These include Lot 2556 and are known as the White mineral claims. The property is accessible by road one-half mile past the Kenville mill on the old Eureka mine road. The vein is in a shear zone in granodiorite. Development consisted of sinking a 48-foot shaft and 51 feet of drifting along the vein from the shaft bottom. Twelve tons of ore was shipped to the Trail smelter, with returns of 1.59 ounces of gold per ton and 8.6 ounces of silver per ton. All work was done by Mr. Norcross, except for a three-week period when one man was employed.

YMIR*

Gold

Yankee Dundee (Yankee Dundee Mines Limited) (49° 117° S.E.) Company office, 404, 510 West Hastings Street, Vancouver 2; mine office, Ymir. R. Sostad, president. Capital: 4,000,000 shares, 50 cents par value. This company diamond drilled the Bonus vein, reporting a 3.2-foot intersection of ore above the 2000 level. In August, 1960, the property was optioned to Newmont Mining Corporation of Canada Limited. Two diamond-drill holes were drilled by Newmont to check the extension of the Bonus vein between the 2000 level and the intersection obtained by Yankee Dundee Mines Limited. The option was dropped in December.

Gold-Silver

Goodenough (Hyrock Goodenough Mines Ltd.) (49° 117° S.E.) Registered office, 507 Stock Exchange Building, Vancouver 1. Capital: 50,000 shares (N.P.L.). This property was under the sole management of E. W. Nilson, who died suddenly of a heart attack. A shipment of 11 tons was made to the Trail smelter. This assayed 0.385 ounce of gold per ton. Operations were suspended in October.

* By J. D. McDonald.

Silver-Lead-Zinc

Ruby (Universal Minerals Ltd.)

(49° 117° S.E.) Company office, 575 Howe Street, Vancouver 1. J. E. LaFleur, president. Capital: 5,000,000 shares, 50 cents par value. This property is under option to Universal Minerals Ltd. from E. Haukedahl, of Ymir, and A. Erdahl, of Nelson. It consists of fourteen recorded claims and two fractions. It is 4½ miles southeast of Ymir, at an elevation of from 3,000 to 5,000 feet, and is accessible by road. It is adjacent to the southwest boundary of the Jackpot property. Mineralization occurs in a dolomitic limestone band. In November and December five holes were drilled, with a total length of 1,290 feet.

SALMO*

Sheep Creek (49° 117° S.E.)

Gold

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

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. J. C. MacLean, property superintendent; J. M. B. Scarborough, mine superintendent; N. Doyle, 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 zinc-lead replacement in dolomite. There are five zones, known as No. 1 or east orebody, No. 2 or west orebody, two flat-lying orebodies named X-1 and X-2, and No. 4 orebody which lies between X-1 and X-2.

Mining in No. 1 and No. 2 orebodies is by blast-holes and slusher drifts, the drilling being done from sublevels on the hangingwall and footwall. Holes are drilled with 2⅛-inch tungsten carbide bits. Hoists used in the slusher drifts are 50- and 60-horsepower electric slusher hoists. Production from blast-hole stoping accounted for 77 per cent of the total production. The total long-hole footage for the year was 128,809 feet. The first of the large pillars in No. 1 orebody was blasted in July, breaking 116,000 tons of ore with 30,000 pounds of powder. This is a powder factor of 0.26 pound per ton.

In the other ore zones, open stoping was done, slashing and benching with jacklegs using a panel system of pillars and stopes. Production from these stopes was 15 per cent of the total production. During the year primary development was done in 81 block in No. 1 ore zone. Secondary development in the other areas continued as scheduled. Development: Total, 7,419 feet; drifting and crosscutting, 525 feet; sublevels, 3,877 feet; raising, 3,017 feet.

Main haulage is on the 2800 level, with diesel locomotive and 6-ton Granby cars. Ore is hauled from ore-passes underground to the coarse-ore bin on surface. Other levels are the 3200, 3300, and 3500. These are served by internal shaft, with the hoistroom at the 3500 level.

The mine is ventilated with a 70,000-cubic-feet-per-minute fan located adjacent to the old Oxide mine workings. The fan exhausts to surface, and the main intakes are the 2800 and 3500 adits.

* By J. D. McDonald.

Underground diamond drilling was 18,957 feet, and surface diamond drilling was 3,296 feet.

The Garnet zone, which lies west of the other zones, and outcrops at surface above the 2800 adit level, was outlined during the year.

The milling rate averaged 38,700 tons per month, with a total production of 464,408 tons. This was the highest in the West Kootenay area. The average number of men employed was 120, fifty-four of whom were employed underground.

The mine-rescue team trained regularly and competed in the West Kootenay competition. There were two lost-time accidents during 1960.

Boy (The Consolidated Mining and Smelting Company of Canada, Limited).—Company office, Trail. This group of four recorded claims adjoins the H.B. mine to the south, on the southern side of Sheep Creek. In May and June 3,500 feet of road was constructed, starting at the east end of the first bridge beyond the old H.B. mine road and trending southwest up the hillside. Two holes were drilled with a total length of 1,062 feet.

Lead-Zinc-Silver-Molybdenite

Double " B " Group

This property of ten recorded claims is owned by F. W. Cartwright and W. Cartwright, of Nelson. It is on Hedgehog Creek, east of the H.B. mine. Approximately 1 mile of road leads to the present workings. In 1960 stripping and trenching were done in the limestone adjacent to the granite contact. Showings of sphalerite and molybdenite were exposed by the stripping.

IRON MOUNTAIN (49° 117° S.E.)

Lead-Zinc

Jersey (Canadian Exploration Limited)

Head office, 700 Burrard Building, Vancouver; mine office, Salmo. G. A. Gordon, general manager; J. D. Little, assistant general manager; C. M. McGowan, general superintendent; R. G. Weber, mine superintendent; H. A. Steane, general mill superintendent; E. A. Erickson, mill superintendent. This company is a wholly owned subsidiary of Placer Development Limited. Operations have been confined to the Jersey mine since July 31st, 1958. The property is reached by two roads which leave the Nelson–Nelway highway 4 and 5½ miles respectively south of Salmo, the north road being the main access road. The lead-zinc concentrator is alongside the Nelson–Nelway highway and is served from the mine by a conveyor system. The mine and main camp are located on the summit between Sheep Creek and Lost Creek.

All production came from the Jersey lead-zinc mine. The ore zones occur in dolomitized limestone along folds which plunge gently to the south. Seven ore zones are now recognized. From west to east they are: A, B, C, D, E, F, and G. Two types of mining are being done—trackless mining in A, D, E, F, and G zones and conventional track mining in A, C, and D zones.

The main haulage for the trackless mine is via the 4200 Dodger and 4200 Jersey adits to the ore-pass to the underground crusher on the Emerald 3800 level. Haulage is by 8-ton Dumptors, both overhead and front-end loaders being used for loading. Seventy per cent of loading is done with front-end loaders. Drill jumbos mounted on caterpillar tracks are used for drilling. A giraffe mounted on a truck is employed full time for barring and checking backs. Some of the stopes in the trackless mine are being mined by conventional open stoping, with jacklegs and slushers, and trackless haulage for transportation of the ore. These are classed as low head-room stopes and account for 50 per cent of the trackless production.

The main haulage in the track mine is on the 4000 level, hauling to an ore-pass system leading to the underground crusher. Locomotives are diesel-electric, using a 37-horsepower diesel M.G. set on a standard battery-locomotive chassis. Mining is by conventional open stopes with jacklegs and slushers. Work is being done below the 4000 level, using the south "A" winze inclined at 32 degrees.

In the fall of 1960 a pillar-recovery programme was started in " D " zone in the track mine. Main pillar recovery will be in "A" zone of the trackless mine. The Alimak raise machine will be used for drilling off the pillars, which range up to 90 feet in height. The track for the raise machine will be bolted to the pillar wall. Drilling will be done from a bar mounted on the platform and chained to the pillar wall, using liners, 1-inch steel, and 2-inch tungsten carbide bits. The platform and cage have been modified with a frame to allow it to rest on a truck deck for transportation. The last two rows of holes at the back will be loaded with a special type of powder to give a smooth and safer back. The ore, when blasted, will be scraped to a loading point, and there will be no necessity for going under the back in a blasted area.

Total development was 10,052 feet, consisting of 1,348 feet of 16- by 16-foot drifting, 7,265 feet of subdrifting, and 1,439 feet of raising.

Ventilation is maintained with three reversible fans which normally blow into the mine. Two 48-inch 60-horsepower fans rated at 60,000 cubic feet per minute at a 4½-inch water-gauge draw air from the Dodger 4400 level, and one 50-horsepower fan rated at 72,000 cubic feet per minute at a 3½-inch water-gauge draws air from the old Emerald 4600 level. Auxiliary ventilation of headings and stopes is with 30-inch 20-horsepower Axivane fans rated at 12,000 cubic feet per minute at an 8-inch water-gauge and 36-inch 50-horsepower Axivane fans rated at 23,000 cubic feet per minute at a 10-inch water-gauge. Vent-pipe is 30-inch neoprene, nylon impregnated collapsible pipe.

The concentrator treated 364,424 tons of ore during 1960, an average of 30,369 tons per month. The track mine produced 30 per cent of the total and the trackless 70 per cent, of which 50 per cent was low head-room stoping. Concentrates were shipped to the Bunker Hill smelter at Kellogg, Idaho, for the first ten months of the year; zinc concentrates were shipped to the Trail smelter in November and December. Tailings were impounded in the tailings pond adjacent to the Salmo River. During 1960 the sides of the pond were raised. Experimentation with growth of various types of plants, grasses, and trees on the tailings pond are being carried out to determine the best effective cover.

A mine-rescue team practises regularly in the mine, and competed in the West Kootenay Mine Rescue Competition. The property maintained the excellent safety record of the past two years, having only one lost-time accident over six days during 1960. This performance won for the mine the Regional John T. Ryan Safety Trophy for 1960. The average number of men employed was 160, with eighty-five working underground.

Tungsten King

This property, comprising eighteen Crown-granted mineral claims and fractions, is adjoined on the north by the Emerald and Jersey holdings of Canadian Exploration Limited and on the south by the Truman holdings of American Zinc, Lead and Smelting Company. The claims are owned by L. R. Clubine, of Salmo, and R. O. and E. Oscarson, of Spokane, Wash. The property is 2 miles from the Nelson–Nelway highway by way of the Lost Creek road. Stripping and trenching were done during the summer on new showings exposed in 1959. Mr. Clubine has reported that an option on the property was taken by American Zinc, Lead and Smelting Company.

NELWAY*

Silver-Lead-Zinc

Reeves MacDonald Mines Limited (49° 117° S.E.) Company office, 413 Granville Street, Vancouver 2; mine office, Remac. L. M. Kinney, Metaline Falls, Wash., general manager; F. R. Thompson, manager; W. Pollock, mine superintendent; F. Irwin, mill superintendent. Capital: 3,000,000 shares, $1 par value. This company owns the Reeves MacDonald mine on the Pend d'Oreille River, on the Nelway–Waneta road 4 miles west of Nelway. Lead-zinc replacement orebodies in limestone have been developed from the 1900 level. Four orebodies are being mined—the Reeves, B.L., O'Donnell, and No. 4 bodies.

Mining above the 1900 level in the Reeves and O'Donnell orebodies has been completed. The No. 4 and B.L. orebodies are developed and producing. These four orebodies are faulted segments of a single ore zone.

The major development is now in the Reeves, below the 1900 level. This section is serviced by No. 2 and No. 3 shafts. The No. 2 shaft is used as a service shaft for hoisting men and supplies. It is located in the footwall of the Reeves orebody, inclined at 52 degrees, with the hoistroom on the 1900 level. The No. 3 shaft, which is inclined at 55 degrees, is the production shaft. The main ore-pockets for the shaft are located below the 1320 level. The hoistroom is on the 1900 level.

Extension of No. 3 shaft below the present bottom 1100 level started in July. Sinking is being done on a one-shift basis using a Cryderman mucker and a crew of three men. One muck skip was altered so that mucking could be done directly into it with the Cryderman, and it would remain satisfactory for hoisting ore from the 1320 ore-pockets. The Cryderman mucker is mounted in the other compartment with wood stringers along the bottom and top of the frame. Sinking to the 980 level, a distance of 146 feet, has been completed. The 980 level station has been cut out. Further sinking will be done with a sinking hoist on the 1100 level, allowing full use of the No. 3 shaft above the 1100 level for production.

Mining is done with long-hole machines, drilling down-holes from horizontal slots slashed to the ore outline. These slots are located at 50-foot intervals and are mined with jacklegs and slushers. A vertical slot is cut along one pillar and a series of down-holes are drilled and blasted at regular intervals, retreating to the opposite pillar. Drilling was previously all done with 2⅛-inch tungsten carbide bits, with holes at 6- by 7-foot spacing. Change is now being made to 3-inch tungsten carbide bits on 1¼-inch carburized hexagonal steel in 5-foot sections, with holes at 10- by 12-foot spacing. At the year-end 50 per cent of the holes drilled were 3-inch.

Development of the B.L. zone and the 1100, 1320, 1460, and 1520 levels of the Reeves zone continued throughout the year. Drifting and crosscutting totalled 524 feet; sublevels, 1,796 feet; raising, 1,987 feet.

The mill operated continuously at an average rate of 34,273 tons per month, with a total production of 411,282 tons. Zinc concentrates were shipped to the Trail smelter. Lead concentrates amounting to 2,550 tons were shipped to the smelter at Kellogg, Idaho. The remainder was stockpiled. The number of men employed was 103, of whom fifty-eight worked underground.

* By J. D. McDonald.

NORTH KOOTENAY LAKE*

Riondel (49° 116° N.W.)

Silver-Lead-Zinc

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

Company office, Trail; mine office, Riondel. D. S. Campbell, property superintendent; J. B. Donald, mine superintendent; T. F. Walton, mill superintendent. This property is at Riondel, on a small peninsula 1½ miles long, on the east shore of Kootenay Lake, 6 miles by road north from the southern trans-Provincial highway at Kootenay Bay ferry landing. The ore deposits are sulphide replacements in a limestone band ranging from 100 to 150 feet in stratigraphic thickness, striking north and dipping 35 to 38 degrees to the west, under the lake. There are three separate ore zones—the Kootenay Chief at the south end, Bluebell in the centre, and Comfort to the north. Main production is from the Kootenay Chief zone.

The mine is serviced by No. 1 shaft, inclined at 35 degrees, on the north side of the Kootenay Chief zone. It is completely timbered for its entire length of 1,625 feet. The levels are at intervals of 150 vertical feet, with No. 2 level and No. 5 level extended north to the Bluebell and Comfort zones.

Due to a heavy inflow of thermal water with large quantities of carbon dioxide gas in No. 1 shaft below No. 8 level, it was necessary to seal the shaft below No. 8 level. In 1959 a development programme was started to drain off the thermal water below No. 8 level from No. 9A level, pump it to surface, and then raise No. 1 shaft to No. 8 level. It was planned to sink an internal vertical winze from No. 8 level (elevation 960 feet) to No. 9A level (elevation 735 feet) in the footwall rock, then drift out to limestone and establish a drill station for drilling 4-inch drainage holes to tap the thermal water. In 1960 the sinking was completed, sumps and pump station were excavated, and the drift to the limestone was extended close to the limestone footwall. A water-tight door, designed to withstand a pressure of 250 pounds per square inch, is being installed in this drift.

Development work was confined mainly to the Kootenay Chief and Comfort ore zones. The raising from No. 5 level to No. 2 level in the Comfort zone was completed. Stoping above No. 3 level along the footwall is now being done. In the Kootenay Chief zone No. 8 level was extended south and stope development was started. Other development was mainly stope development on No. 5 and No. 6 levels of the Kootenay Chief. Development work in 1960 was as follows: 1,126 feet of drifting, 5,907 feet of crosscutting, 3,884 feet of raising, and 106 feet of shaft sinking. Diamond drilling consisted of 21,545 feet of exploratory drilling.

Mining methods are open stoping, cut-and-fill stoping with deslimed tailings, and minor shrinkage stoping. Several longitudinal pillars were recovered in the upper levels. Old shrinkage stopes at the Comfort have been filled with deslimed tailings in preparation for recovery of the pillars. A total of 65,590 cubic yards of deslimed tailings was placed in cut-and-fill and open stopes for pillar recovery. The use of plastic pipe for transportation of the deslimed tailings has proven very successful.

Present pumping is at the rate of 3,600 imperial gallons per minute, of which 1,600 imperial gallons per minute is thermal water. Main pump stations are on No. 5 and No. 8 levels, and a major pump station is being installed on No. 9A level. The pumps are all centrifugal, with capacities from 300 to 1,000 imperial gallons per minute and motor power ranging from 40 to 300 horsepower. The No. 8 level

* By J. D. McDonald.

pump station has 550 installed horsepower in pumps capable of pumping 3,600 imperial gallons per minute against a dynamic head of 325 feet. There are also two 300-horsepower high head pumps capable of handling 1,400 imperial gallons per minute to surface against a dynamic head of 1,020 feet. The No. 5 level pump station has seven pumps with an installed 1,350 horsepower capable of pumping 4,500 imperial gallons per minute against a dynamic head of 680 feet. All pumps run at 3,600 r.p.m., except three 1,000-imperial-gallons-per-minute pumps which operate at 1,800 r.p.m. These slow-speed pumps have shown little tendency to cavitate or seize up due to deposits on wear rings and impellers. Considerable maintenance is required on the high-speed pumps. The No. 9A level will have an installed capacity of 4,600 imperial gallons per minute with 700 horsepower. To minimize pump corrosion from thermal water, three of the 1,000-imperial-gallons-per-minute pumps will be all bronze and one stainless steel. Total installed horsepower in all main and secondary pump stations will be 3,132 horsepower, and the capacity to pump water out of the mine will be about 6,800 imperial gallons per minute. Discharge lines presently consist of two 12-inch-diameter pipe-lines extended up the manway of No. 1 shaft.

Main ventilation is induced by three units in parallel of 48-inch dual-duty aerofoil fans which are flameproof and waterproof. Each unit has two 30-horsepower 550-volt 3-phase 60-cycle counter-rotation motors with automatic butterfly dampers. Each of these units is rated at 50,000 cubic feet per minute at a 7.6-inch water-gauge. Ventilation is maintained at all times due to the critical carbon dioxide gas problem. A separate auxiliary stand-by diesel unit supplies power in the event of power outages.

In July, 1960, a seismic survey was made on the bottom of Kootenay Lake adjacent to the Bluebell mine to determine the position of bedrock. The survey was made for the company by Hunting Survey Corporation Limited, of Toronto.

The equipment used was the "Sparker," a continuous seismic underwater profiling instrument. With this equipment a high-voltage power supply is triggered at regular intervals, producing vibrations of audio frequency. The pulses of sound energy so formed travel through the water and are partially reflected from the bottom and some strata beneath. The reflected pulses are picked up by a hydrophone, and a continuous record is made on elecrically sensitive paper. The survey showed that the lake bottom is relatively flat. A line surveyed across the lake indicates the bedrock valley bottom to be more than 1,100 feet below the surface of the lake, covered by at least 700 feet of sediments, which probably are largely silt. It should be pointed out that the maximum depth of valley bottom is not of direct concern to the operation.

Mine-rescue and first-aid classes were held. Mine-rescue teams practised regularly underground. Two teams competed in the West Kootenay competition at Trail. The team captained by P. Rowan won the West Kootenay competition and competed in the Provincial competition in Cranbrook. The average number of men employed was 289, of whom 173 were employed underground.

The concentrator treated 255,571 tons of ore, or 700 tons per calendar day.

AINSWORTH (49° 116° N.W.)

Silver-Lead-Zinc

Highlander, etc. (Yale Lead & Zinc Mines Limited) Company office, 525 Seymour Street, Vancouver 2; mine office, Ainsworth. H. M. Turner, of Western Mines Limited, property manager; C. Anderson, mill superintendent. Capital: 5,000,000 shares, $1 par value. This company controls most of the mineral claims lying between Coffee and Cedar

Creeks. The property was closed in December, 1958, and since then has been worked by lessees. The mill operated part time during 1960 and milled ore for lessees of the Highlander, Crow Fledgling, and Krao mines, and Western Mines Limited. This is the only mill available for milling ore in the Kaslo-Ainsworth area. A three-man crew was employed part time.

	Milled in 1960	Silver	Lead	Zinc
	Tons	Oz.	Lb.	Lb.
Crow Fledgling	125	199	11,568	6,017
Highlander	4,300	7,653	517,057	148,834
Yale Lead & Zinc Mines Limited (mill clean-up)	367	1,038	48,916	32,761
Krao	60	135	4,960	1,954
Western Mines Limited (includes thickener clean-up)	590	7,083	401,098	208,393
Totals	5,442	16,108	983,599	397,959

P. Gilchrist and C. Hartland, leasing the Banker orebody, hand-sorted ore and shipped it to the Trail smelter. Leasing operations ceased in the fall of 1960. Production: Ore shipped, 57 tons. Gross content: Silver, 1,134 oz.; lead, 67,685 lb.; zinc, 3,861 lb.

In the Highlander mine, T. G. Laughton and three partners, working mainly above the 1900 level, removed pillars and did development to reach new ore below the two worked stopes. Production: 4,300 tons mill feed; 25 tons ore shipped to Trail smelter. Gross content: Silver, 925 oz.; lead, 36,661 lb.; zinc, 1,575 lb.

Kootenay Florence, Lakeshore (Western Mines Limited) Company office, 850 West Hastings Street, Vancouver 1; mine office, Ainsworth. H. M. Wright, president; H. M. Turner, superintendent. Capital: 3,000,000 shares, $1 par value. This company owns a large group of mineral claims lying south of Lendrum Creek and astride Princess Creek. The mine plant and mill are on the Nelson–Kaslo highway 2 miles north of Ainsworth. M. B. Sirak and partner mined in the Kootenay Florence during the early part of the year. Mining ceased in June, and a clean-up of the dump and thickener in the mill was made during the summer. There was no production for the remainder of the year. The ore was trucked to the Yale Lead & Zinc mill and the concentrates were shipped to the Trail smelter. Production: Ore milled, 590 tons.

WOODBURY CREEK*

Gold-Silver-Lead-Zinc

Scranton (Scranton Mines Limited) (49° 117° N.E.) Company office, 1519 Marine Building, 355 Burrard Street, Vancouver 1. A. A. Loeb, president; C. J. Bailer, general manager; C. E. Lind, mine manager. Capital: 3,000,000 shares, $1 par value. This company owns the Scranton group of claims in Kokanee Glacier Park, astride Pontiac Creek, a tributary of Woodbury Creek. The mine camp is on Pontiac Creek, at an elevation of 5,600 feet, and is reached by 11½ miles of road from a point on the Nelson–Kaslo highway 8 miles south of Kaslo.

A limited amount of development and exploration work was done during the period May to September, 1960. A total of 93 feet of drifting and crosscutting was done on the lower Pontiac vein at an elevation of 5,800 feet. About 300 feet of surface stripping with a bulldozer was completed. Total underground diamond

* By J. D. McDonald.

drilling was 143 feet. The operation closed on September 28th. Three men were employed for a total of 135 man-shifts for the season.

PADDY PEAK*

Silver-Lead-Zinc

Utica (Lajo Mines Limited) (49° 117° N.E.) Company office, 717 West Pender Street, Vancouver 1; mine office, Kaslo. R. Mintz, president; J. A. Cooper, manager. This company holds a long-term lease on the Utica mine from Utica Mines (1937) Limited. The mine is at the head of Twelve Mile Creek, about 15 miles from Kaslo. A new section of road was completed in 1960, which by-passes the rock bluffs in the lower stretch of the road. It is now possible to haul concentrates from the mine with big trucks.

In the spring of 1960, stope development was completed on the vein above No. 5 level. These stopes were mined by shrinkage stoping. After stoping was completed, the ore was pulled from chutes on No. 5 level and hand-trammed to the ore-pass. The main haulage is No. 7 adit level (elevation 5,950 feet), on which a diesel locomotive and 2-ton side-dump cars haul to the coarse-ore bin on surface.

In the 50-ton mill, graphite in the flotation circuit gave considerable trouble in separation of the lead and zinc concentrates. The concentrates were shipped to the Trail smelter. An average of nine men was employed when the mine was operating. In the first week in October the mine closed down for the winter.

Production: Ore milled, about 4,000 tons. Gross content: Silver, 34,872 oz.; lead, 68,376 lb.; zinc, 123,858 lb.

KASLO*

Lead-Zinc-Silver

Empire (49° 117° N.E.) This property consists of eight recorded claims owned by E. Muller, of Helix, Ore. Mine office, Kaslo. E. Augustine, mine manager. It is 3 miles by road north of the highway, from a point about 10 miles west of Kaslo on the Kaslo–New Denver highway. Two men were employed for three months extending the drift along the vein. The vein is vertical and appears to be along an argillite contact with a maximum width of 5 feet. A total of 35 tons of development ore was shipped to the Trail smelter. Gross content: Gold, 1 oz.; silver, 300 oz.; lead, 9,725 lb.; zinc, 9,655 lb.

Black Fox (New Ainsworth Base Metals Ltd.) (49° 117° N.E.) Company office, 623, 470 Granville Street, Vancouver 2; mine office, Kaslo. W. Inverarity, president; J. Donovan, manager. Capital: 4,000,000 shares, no par value. This property is 10½ miles by road from Kaslo on Keene Creek, one-half mile past the Cork Province mine. Mining started in December, 1960, and approximately 250 tons of ore was shipped to the Yale Lead & Zinc mill at Ainsworth.

RETALLACK-THREE FORKS*

Silver-Lead-Zinc

Texas, Fourth of July (July Silver Mines Ltd.) (50° 117° S.E.) This property, formerly known as Lucky Edd Mines Limited, was incorporated on September 19th, 1960, as July Silver Mines Ltd.; mine office, Kaslo. V. J. Dresser, president; L. N. Garland, manager. This company has optioned a group of Crown-granted mineral claims at the headwaters of Robb Creek, a tributary of Kaslo River.

* By J. D. McDonald.

The property is reached by 6 miles of road which leaves the Kaslo–New Denver highway at Retallack and follows the west side of Robb Creek in a southerly direction. Two miles of road was constructed in 1960 to the Texas and Fourth of July claims, to complete the road to the property.

SANDON*

Silver-Lead-Zinc

Silversmith, 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 forty-six Crown-granted and six recorded claims and fractions which include the Silversmith, Slocan Star, Richmond-Eureka, Ruth-Hope, and Slocan King mines on Sandon Creek, south of Sandon.

In the Ruth-Hope mine the main adit was retimbered. No mining was done on any of the mines in this group.

The concentrator, employing a crew of three men, milled 6,842 tons of ore, of which 6,227 tons was from the Victor mine and 615 tons from the Lone Bachelor.

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. Capital: 5,000,000 shares, $1 par value. In July, 1960, the controlling interest in Violamac Mines Limited was bought by New Dickenson Mines when they obtained 1,484,700 shares. The Victor mine is 2½ miles by road northwest of Sandon, or 2½ miles by road southeast of Three Forks.

Pillar recovery continued during the year, and some additional development found new pockets of ore. The main haulage is maintained on No. 7 level. On the 4150 sublevel, 100 feet above No. 7 level, new development opened up a narrow vein in 754 stope. The main production came from stopes operating above and below No. 5 level.

The average number of men employed up to September 30th was twenty. The crew was reduced to ten men for the remainder of the year. Production was 6,227 tons, which was milled in the Carnegie mill, producing 481 tons of lead concentrates and 1,030 tons of zinc concentrates.

Lone Bachelor (Lone Bachelor Mines Limited)

(49° 117° N.E.) This company is controlled by Violamac Mines Limited, which owns the adjoining Victor property. The property was leased in 1959 to E. Perepolkin, L. Fried, and E. DeRosa, who continued working in 1960. Mining was above No. 4 level. Production was 615 tons of mill feed, which produced 93 tons of lead concentrates and 120 tons of zinc concentrates; 83 tons of ore was shipped to the Trail smelter.

SPRINGER CREEK*

Silver

Anna (Silver King Mines Limited)

(49° 117° N.E.) This group of five claims was optioned by Silver King Mines Limited; mine office, Silverton. B. Marasek, president and manager. The property is on the northern side of Springer Creek, adjoining the Ottawa mine on the east. It is accessible by 5 miles of good road from Slocan City.

* By J. D. McDonald.

On the Anna, two shear zones in granite parallel each other, striking north 10 degrees east and dipping 35 degrees to the east. These appear to parallel the shears in the Ottawa and Arlington mines. The ore in the shear zones occurs in siliceous stringers and lenses. The only metal of value in the ore is silver, which occurs as native silver, argentite, stephanite, and tetrahedrite. The ore-bearing vein is normally 6 to 12 inches wide where observed, but widens out in some places related to rolls in the vein. Samples taken from a 6-inch vein in the old workings in No. 3 tunnel assayed 190 and 160 ounces of silver per ton.

All previous stoping was done above No. 3 level at an elevation of 4,760 feet. The last recorded work done on the property was in 1927. In July, 1960, a new level called No. 4 level was started in the west vein, 90 feet below No. 3 level, at an elevation of 4,670 feet. In 1960, 565 feet of drifting was done, 35 feet short of a point from which a raise is driven to No. 3 level for access and ventilation. An average crew of six men was employed from July to December. One mile of road was built from the Ottawa mine road to No. 4 adit. Four tons of ore was shipped to the Trail smelter.

Ottawa (Skylane Mines Limited)

(49° 117° N.E.) Company and mine office, Slocan City. A. Semeniuk, president and manager. This company, formerly the Yukon Western Mining and Prospecting Co. Ltd., was reorganized as the Skylane Mines Limited. The company holds an option on the Ottawa mine on the north side of Springer Creek, 5 miles by road from Slocan City. Stoping was done intermittently on No. 8 level, a small amount of high-grade ore being shipped to the Trail smelter. When operating, four men were employed.

BURTON*

Silver-Lead-Gold

Millie Mack

(49° 117° N.W.) This property is owned by Mrs. N. W. Forster, and is optioned by W. Isaacs, of Burton. It is on the south slope of Silver Mountain, which lies on the north side of Caribou Creek, 14 miles from Burton. A logging-mining road leaves the main highway at Burton and follows Caribou Creek up the north side for 10 miles. From this point a new road was constructed during the summer, climbing from an elevation of 3,100 feet at Blue Grouse Creek to the property at 5,800 feet, a distance of 3½ miles. The top one-half mile will require more work to make it passable for four-wheel-drive vehicles.

Some stripping was done, and about 14 tons of ore was shipped to the Trail smelter. The ore exposed by stripping shows mineralized pieces of quartz in a flat-lying bed of graphitic argillites and schists. It is overlain by argillites and underlain by andesite. There are considerable old workings, which are all caved. Three men were employed for three months constructing the road and stripping.

NORTH LARDEAU

Ferguson (50° 117° N.E.)*

Silver-Lead-Zinc

Black Warrior, Elsmere.—This property, owned by J. Main, of Ferguson, is at the headwaters of Ferguson Creek, 10 miles by trail from Ferguson. The trail was cleaned out and repairs made to a bridge.

* By J. D. McDonald.

HALL CREEK (50° 117° N.E.)*

Silver-Lead-Zinc

Bannockburn The Bannockburn property is on the south side of the headwaters of Hall Creek, a tributary of the Duncan River. It comprises two groups of Crown-granted claims, one owned by J. Gallo, of Howser, and the other by Sheep Creek Mines Limited. The property is reached by 17 miles of road from a point on the Lardeau–Gerrard road about 3 miles south of Gerrard. The road follows Healy Creek, crosses a pass to the head of Hall Creek, and in 1959 was extended about 3 miles down the southeast side of Hall Creek to Bannockburn Creek. In August, 1960, the road was continued southward up Bannockburn Creek to the old Bannockburn adit, a distance of almost 1½ miles.

The property was discovered many years ago, and most exploration was done before 1920. In the early work several open pits, a short shaft, and an adit were made on showings of high-grade galena in limestone called the Bannockburn vein. These old workings are at an elevation of about 6,000 feet on the lower slope of a spectacular ridge of limestone northwest of Mount Abbott, which forms part of the Lime Dyke (*see* Walker, Bancroft, and Gunning, 1929). A second series of showings which constitute the Shelagh vein are about 600 feet to the southwest and for the most part several hundred feet above the Bannockburn vein. The Shelagh vein, though discovered many years ago, has attracted attention only recently. In 1955 The Granby Mining Company Limited, then The Granby Consolidated Mining Smelting and Power Company Limited, in addition to some exploration work on the Bannockburn vein, mapped and sampled and made trenches and short packsack diamond-drill holes on the Shelagh vein. In September, 1960, Sheep Creek Mines Limited drilled four holes, totalling 1,049 feet, one at the end of the new road below the Bannockburn vein and three to explore the Shelagh vein.

The showings are in quartzite and limestone near the top of the Hamill group of rocks, a thick quartzitic sequence below the Badshot limestone. The uppermost quartzite of the Hamill group is a light-grey to brown blocky rock containing visible rounded white and opalescent quartz grains in a calcareous cement. On the Bannockburn property this quartzite contains galena and is known as the Shelagh vein. It is as much as 40 feet thick. White finely crystalline limestone which weathers to a cream colour overlies the quartzite. This limestone, which contains the Bannockburn vein, varies greatly in thickness and is commonly more than 100 feet thick. A few hundred feet of grey and green phyllite overlies the limestone and underlies the Badshot limestone, which forms Mount Abbott and the Lime Dyke.

Near the showings the rocks dip steeply to the northeast and form a tight overturned anticline with low plunge. The axial plane dips steeply to the northeast and lies between the Shelagh and the Bannockburn veins. The anticline is clearly outlined in cliffs northwest of Hall Creek and on the property causes a repetition of the quartzite, limestone, and phyllite just described.

The Shelagh vein contains very fine-grained sulphides, mainly galena, disseminated in calcareous quartzite. Minor pyrite and sphalerite are present, and small amounts of chalcopyrite and tetrahedrite are reported. Although most of the galena is disseminated, some relatively coarse galena is contained in quartz veinlets within the quartzite. Pyrite grains are locally rusty, but in general the mineralized zone is not marked by a conspicuous gossan. The mineralized quartzite is exposed at intervals for about 3,500 feet along the strike. Most commonly it is 4 to 10 feet thick, and at one place is as much as 40 feet thick. Samples taken by the writer indicate

* By J. T. Fyles.

an average grade across the 40-foot width of: Gold, *nil;* silver, 0.5 oz. per ton; lead, 4.02 per cent; zinc, 1.3 per cent. About 1,000 feet to the southeast where the mineralized quartzite is 10 feet thick, a sample assayed: Gold, *nil;* silver, 0.03 oz. per ton; lead, 1.97 per cent; and zinc, 0.2 per cent. A few hundred feet farther to the southeast the mineralized zone assayed: Gold, *nil;* silver, 1.1 oz. per ton; lead, 5.59 per cent; and zinc, 0.5 per cent, across a width of 12 feet. Three holes were drilled by the Sheep Creek company in 1960 to intersect the mineralized quartzite a few hundred feet below the outcrop. One hole is reported to have encountered mineralization like that on surface. Northwest of Hall Creek, more than a mile from the showings on the Bannockburn property, similar mineralization is found in the same quartzite near the crest and down the southwest limb of the same anticline found on the property. Exposures in Hall Creek suggest that mineralization becomes scattered or dies out down the dip of the quartzite.

In the Shelagh vein the sulphides have formed by replacement of the carbonate cement between the quartz grains in the quartzite. Replacement is thought to have been controlled by the structure. Dragfolds, locally with sheared limbs, are common near the mineralized quartzite. They have a low plunge and a shape that suggests they have not formed by interbed slippage during the formation of the large anticline, but are superimposed on the anticline. Probably these dragfolds and related shears on the southwest limb and near the crest of the anticline have provided a favourable structure for mineralization, and it is suggested that the long axis of the deposit has a low plunge parallel to the plunge of the dragfolds.

The Bannockburn vein consists of lenses of massive galena with more or less sphalerite, pyrite, and minor chalcopyrite in limestone. At least three lenses are exposed in old trenches and in a shaft, above the caved portal of an old adit at the end of the new road. The lenses are one above the other and are up to a few feet wide and a few feet high. They appear to plunge at a low angle to the southeast and have been found in the old workings a few hundred feet along the plunge. The old adit driven southwestward beneath the showings did not encounter mineralization like that on surface, and a hole drilled down to the southwest at 45 degrees from a point about 100 feet northeast of the adit portal also did not encounter mineralization. It passed through the limestone into the underlying quartzite. The suggestion obtained from surface exposures of the sulphide lenses is that they are pencil-like replacements of the limestone that have formed at intersections of relatively gently dipping beds and a steeply dipping cleavage.

[References: Walker, J. F., Bancroft, M. F., and Gunning, H. C., Lardeau Map-area, British Columbia, *Geol. Surv., Canada,* Mem. 161, 1929, p. 77.]

SOUTH LARDEAU*

Lead-Zinc

Duncan (The Consolidated Mining and Smelting Company of Canada, Limited) (50° 116° S.W.) Company office, Trail. J. J. McKay, development superintendent until September, when R. Douglas was in charge for the last three months of operation. This company has an option from J. Gallo and associates, of Howser, on a group of forty-nine mineral claims held by record, one Crown-granted mineral claim named the Grizzly, and eight claims held by retention lease. This group of claims has in recent years been called the J.G. and is now referred to by the company as the Duncan. The claims cover a band of calcareous rocks mineralized with galena and sphalerite, which strike north 20 degrees west and dip steeply to the east.

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

A development programme which was started in June, 1959, was completed in October, 1960. This programme was concentrated on the north end of the peninsula, where extensive underground work was done. The mine and camp-site are on the shoreline of Duncan Lake on the west side of the peninsula, about 2 miles from the northern tip. The mine is 4 miles by boat north of Howser or 12 miles by good road. The road follows the shoreline on the east side of the lake, crossing over to the west side of the peninsula.

In October the mine was closed for an indefinite period, until such time as the mining of lead ore is more attractive to the company. Total development in 1960 was 4,096 feet, made up of drifting and crosscutting, 3,623 feet, and raising, 473 feet. The total for the entire programme was 6,565 feet, including an adit at an elevation of 1,800 feet, 35 feet above lake level, that was driven 990 feet to the mineralized zone; drifts were extended north and south along the strike; crosscuts were driven to the west at regular intervals for diamond drilling; a vertical raise was driven from the 1800 level to surface, a distance of 346 feet.

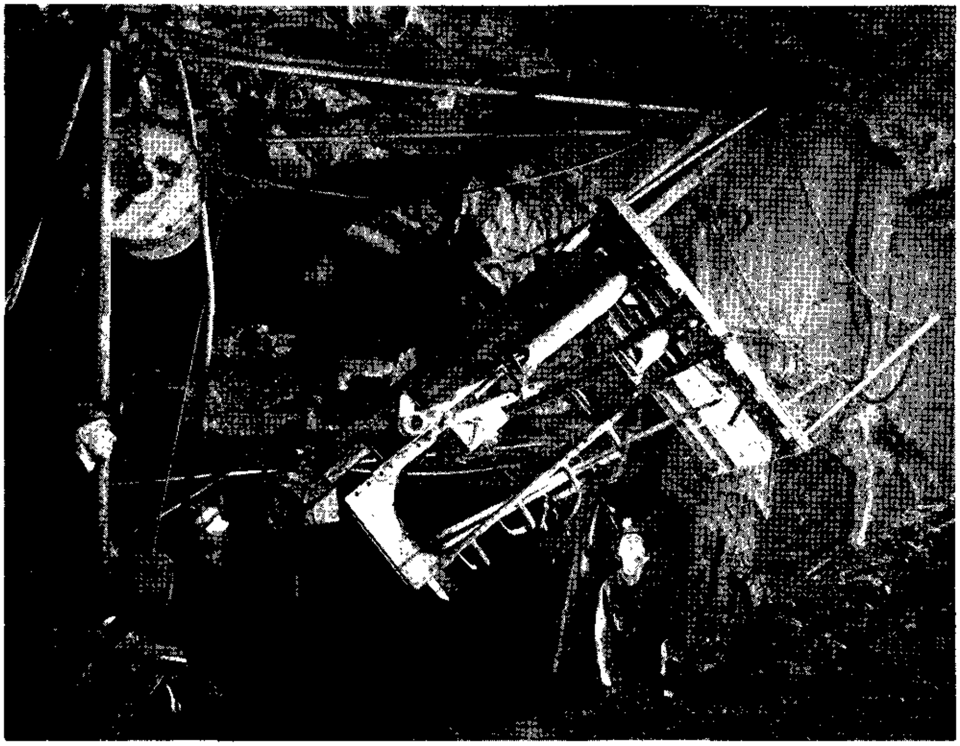
The underground work was directed mainly to exploring and developing mineralization in zones known as the No. 5, No. 6, No. 7, and No. 8. The crosscut passed through No. 6 zone, and the drift followed No. 7 and No. 8 zones. No. 5 zone is beneath the present level. The zones in general form a series of lenses in echelon with long axes plunging at low angles to the north. In cross-section they dip steeply to the east and are a few tens of feet thick and more than 100 feet high. Parallel to the plunge, the zones are several thousand feet long, though the full length of any one zone has not been determined. Mineralization exposed underground consists of very fine-grained galena, sphalerite, pyrite, and minor pyrrhotite disseminated in dolomite. The long axes of the mineralized zones plunge parallel to the axes of major and minor folds in the area, and the deposit appears to be a structurally controlled replacement of the dolomite.

An interesting feature of underground operations was the use of a raise climber in driving 310 feet of vertical raise. This is the second time that a machine of this type has been used in British Columbia. The machine was used to drive the centre compartment of a three-compartment vertical shaft. The size of this pilot raise was 7½ by 6 feet. The plan was to raise the pilot shaft to surface from the 1800 level, a distance of 346 feet, and slash the shaft to full size, 7½ by 20 feet, as the timber was installed from the surface downward. Before installing the raise machine, a cut-out for the machine was made, and 36 feet of raise was driven by conventional methods. The machine was installed and ready for operation in fourteen man shifts.

The crew for the raise consisted of a shift leader, raise miner, and a third miner assisting during the mucking cycle for two hours. The crew did their own tramming. The average cycle consisted of: two hours for mucking; one and one-half to two hours to travel to the face in the raise machine and to bar down and install one 6½-foot section of track; two hours to drill off a twenty-six-hole 8-foot round using 1⅜-inch tungsten carbide bits for the square and 1½-inch bits for the cut holes; one and one-half to two hours to load and blast the round using 1⅛- by 8-inch 75 per cent Forcite powder primed with electric blasting-caps, series 0–11.

A total of 310 feet of raise was driven in seventeen days, or fifty-one shifts, for an average advance of 6.1 feet per shift. The productivity, including the third man, was 2.46 feet per man shift. One shift was required for geological mapping, and one shift for plumbing raise. The raise was completely stripped of rail and all equipment in twenty-four man shifts.

Regulations laid down by the Chief Inspector of Mines and District Inspector of Mines governed the operation of the machine with regard to safety. Several additional safety features were employed by the management. A steel plate was



(Cominco photo.)

The Consolidated Mining and Smelting Company of Canada, Limited. Raise machine in hinged position at bottom of vertical raise in Duncan mine.

(Cominco photo.)

Raise machine in position for drilling.

installed so that it could be swung into a position covering the bottom of the raise during mucking. A second feature, used in stripping the raise, was a pipe scaffold with a plank covering to protect the men on the platform. Ventilation of the raise was good at all times.

The cost of raising with this equipment was considerably less than that of conventional raising. The rate of advance was greatly increased, and there were no accidents.

An extensive diamond-drilling programme was completed in 1960. Underground drilling to check the downward extension of the ore zone totalled 19,710 feet. Surface diamond drilling amounted to 9,250 feet, of which 4,014 feet was drilled in five holes on No. 7 zone on the peninsula and 5,236 feet in twelve holes on No. 3 zone on the Hinck ranch.

Until the time of shut-down twenty-five men were employed at the mine, of whom seventeen were employed underground. In addition, an average of six men was employed on the surface diamond drilling.

[Reference: *Minister of Mines, B.C.*, Ann. Rept., 1959, p. 71.]

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

(50° 116° S.W.) Company office, Trail. This property consists of nineteen recorded claims situated south of Glacier Creek, at an elevation of about 5,000 feet. A portion of the property covers claims previously known as the Bonaventure group on the south side of Glacier Creek, and the Al and High Hope on the north side of Hamill Creek. A road was completed to the property in June. It leaves the Howser–Argenta road about 2 miles south of the Glacier Creek bridge and climbs 3.1 miles up the west slope of Lavina Mountain from an elevation of 1,825 to 5,190 feet. Exploration work done in the period July to November consisted of geological mapping, 500 cubic yards of trenching, and 3,323 feet of diamond drilling in eleven holes. Nine men were employed under the supervision of company geologist T. W. Muraro.

Showings on the property are in calcareous rocks of the Badshot formation on the western limb of a large isoclinal anticline, which plunges to the north at about 10 degrees and is overturned toward the west. Quartzites and phyllites in the core of the anticline are overlain by limestone and dolomite, and these rocks in turn are overlain by dark-grey phyllite. The calcareous rocks are a few hundred feet thick, but, because of a peculiar dragfold which plunges to the north more or less parallel to the slope of the hill, they outcrop extensively on the claims. The showings have been exposed at intervals by bulldozer trenches and road cuts over a distance along the strike of the calcareous rocks of more than a mile and over a vertical range of about 2,000 feet. They consist of zones of gossan locally containing galena and sphalerite in more or less weathered dolomite. Diamond drilling encountered sulphides at no great depth but was hampered by broken ground and by an abnormally low eastward dip of the dolomite.

KIMBERLEY*

Silver-Lead-Zinc

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

(49° 115° N.W.) Company office, 215 St. James Street West, Montreal; western headquarters, Trail. W. S. Kirkpatrick, Montreal, president; R. D. Perry, Trail, vice-president and general manager. Sullivan mine office, Kimberley. J. R. Giegerich, general superintendent; R. M. Porter, mine superintendent; H. J. Chalmers, Chapman Camp, superintendent, Sullivan concentrator. The Sullivan mine is on Mark Creek,

* By D. R. Morgan.

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 1960 the mine produced and the concentrator treated about 2,522,000 tons of ore; seventy-six per cent of which was produced from the section above 3900 level and twenty-four per cent from below 3900 level.

"The total development footage was 51,755 feet. This included drifting on the new 2600 and 2700 levels, driving a conveyor gallery 1,500 feet, and other related development for the new 2500 level crushing chamber. The installation of the steel shaft sets between 2850 and 2400 levels was completed and this section of No. 1 shaft was put into operation.

"The total backfill placed was 617,336 cubic yards. This consisted of 293,424 cubic yards (48%) of planned cave, 194,337 cubic yards (31%) of float rock with five per cent iron sulphides added, placed in ten stopes below 3900 level, 124,143 cubic yards (20%) of gravel, and a minor amount of development work.

"The ventilation system supplied fresh air and exhausted 900,000 c.f.m. of contaminated air. A new exhaust ventilation shaft (No. 40) was completed in the south section of the mine; this replaces No. 9 shaft. The total number of primary fans in operation was thirteen. Their power requirement was 1,425 horsepower.

"The accident frequency and severity rates were slightly above last year's all-time low. The mine had 26 lost-time accidents, the same as in 1959, and 1,665 days lost, resulting in a frequency rate of 15.1 and a severity rate of 965 per million man-hours worked. The concentrator had 10 lost-time accidents with a total time loss of 400 days, a frequency rate of 13.0 and a severity rate of 518 per million man-hours worked.

"No. 1 shaft section, employing about 120 men, completed the year without a lost-time accident. There were no fatalities at either the mine or the concentrator in 1960.

"Seventeen Sullivan mine and concentrator employees obtained their Industrial First Aid Certificates. Eight First Aid classes were held and 137 employees passed the St. John's First Aid examinations.

"Eight men were trained in Mine Rescue work and obtained Department of Mines Certificates. Total trained since 1930 has been 263. Team refresher training was given to 25 active Mine Rescue men.

"The concentrator operated 254 days during 1960 at an average of 9,930 tons per day. Employees at the year end totalled 839 at the mine and 390 at the concentrator."

WINDERMERE*

Toby Creek (50° 116° S.E.)

Silver-Lead-Zinc

Mineral King (Sheep Creek Mines Limited) Company office, 6, 490 Baker Street, Nelson; mine office, Toby Creek. H. E. Doelle, managing director; J. B. Magee, resident manager. The mine is at Toby Creek, 28 miles by road southwest of Athalmer. It is on the ridge between Jumbo and Toby Creeks, and is entered by three adit levels driven from the mountainside north of Toby Creek. No. 7, the lowest or main haulage level, is at an elevation of 4,775 feet, No. 3 level at 5,460 feet, and No. 2 level at 5,595 feet. Three intermediate levels have been driven from an inclined shaft in the workings but do not extend to the surface. The mine is operated by the open-stope method, and the workings are in four parallel orebodies known as

* By D. R. Morgan.

the " A," " B," " C," and " D." A full description of the deposit is included in the 1959 Annual Report.

The mine produced 194,507 tons of lead-zinc ore during 1960, most of the ore coming from the workings above No. 4 level. The ore was developed and mined from all levels between No. 2 and No. 6 levels, and its extraction extended across the " A," " C," and " D " zones. No. 7 level was extended 1,150 feet in a northerly direction for future development, and it is expected to enter the limestone horizon in the near future. Total development work at the mine included 3,458 feet of drifting and crosscutting, 1,793 feet of raising, and 17,116 feet of diamond drilling. There were no major changes to the operation, and the ore reserves remained fairly constant. It is pleasing to report the operation produced its one-millionth ton of ore during 1960 since the commencement of operations in March, 1954.

The production of barite during 1960 averaged 500 tons per month. It was mined from the " C " and " D " zones above No. 3 level, and was transported from the mine via No. 3 level and the surface incline. Further deliveries of barite from the area will be limited as the major reserves are now between No. 3 and No. 4 levels. The barite is shipped in a crude state, and is trucked to Invermere for shipment by rail.

The mine was ventilated by both mechanical and natural means. Approximately 29,000 cubic feet of air per minute was exhausted from the workings, and of this quantity 18,000 cubic feet per minute was supplied by a 15-horsepower electrically driven fan which is located on the No. 2 intake airway. The remainder was natural ventilation. This quantity was found to be sufficient for the requirements of the workings.

The concentrator operated at 90 per cent capacity throughout the year and produced 14,873 tons of zinc and 7,155 tons of lead concentrates. The concentrates were trucked to Invermere for shipment by rail. New construction and alterations made on the surface during 1960 were limited to the building of a duplex family dwelling at the mine camp, an employees' laundry-room, and an addition to the camp kitchen. One mile of access road was built up Jumbo Creek, and three surface diamond-drill holes were drilled to obtain knowledge of the geological structure on a number of claims owned by the company on the north side of the mine workings. Some 200,000 board feet of mine timber was cut on the claims.

The average number of men employed was ninety-nine, of whom fifty-four were engaged underground.

Paradise (Sheep Creek Mines Limited)

Company office, 6, 490 Baker Street, Nelson; mine office, Toby Creek. H. E. Doelle, managing director; J. B. Magee, resident manager. This property is at the headwaters of Springs Creek, a tributary of Toby Creek. The mine is at an elevation of 7,800 feet, and is 20 miles by road west of Athalmer. The mine has been inactive since 1955.

Commencing in May, 1960, the road leading from Jack Pine Flat on Toby Creek to the mine was repaired, and a crew of nine men rehabilitated the surface buildings and 7800 adit level. No. 2 winze, collared from the 7800 level, was dewatered and a diamond-drill hole was started from the 7700 level. Approximately 1,100 tons of ore was mined from above the 7800 level and was trucked to the Mineral King concentrator. Average grade of ore: Silver, 5.5 oz. per ton; lead, 4.8 per cent; zinc, 8.2 per cent. Operations were suspended for the winter late in November, with the exception of the diamond drilling. A fatal accident involving the death of one of the workmen occurred underground in August.

HORSETHIEF CREEK (50° 116° N.E.)

Silver-Copper

Ptarmigan (The Selkirk Ptarmigan Mines Limited)

Heinz K. F. Seel, president, Edgewater. This mine is located at the headwaters of Red Line Creek, a tributary of McDonald Creek, which in turn is a tributary of Horsethief Creek. It is at an elevation of 8,600 feet and is accessible by means of a 29-mile road leading from Wilmer. The mine is an old operation that was abandoned for many years. The present company was formed in 1958 to continue operations after the owner, Mr. Seel, had removed a large quantity of ice from the workings. There are over 3,000 feet of development tunnels in the old workings, and production during the past three years has been obtained from small cut-and-fill stopes on two of the levels.

A crew of three men, including a geologist, worked at the mine for a period of two weeks in the summer getting a number of samples from various parts of the workings. There was no production in 1960.

BOBBIE BURNS (50° 116° N.W.)

Copper

St. Andrew Mining Co. Ltd.

Head office, 1501, 1030 West Georgia Street, Vancouver 5. This company holds 234 mineral claims in the Warren Creek area, 30 miles northwest of Spillimacheen. The claims extend from the headwaters of Rocky Point Creek to Warren Creek, and down both sides of the latter creek for a distance of 3 miles. Access is by means of a logging-road, 14 miles long, from Parson to the confluence of Warren Creek and Bobbie Burns Creek, and about 10 miles of road along Warren Creek. A report on a previous prospect in the area is included in the 1920 Annual Report.

A reconnaissance has been made of the property, and most of the 1960 activities were directed to diamond drilling and the building of access roads. The drilling was done by contract, and a number of holes totalling 2,250 feet had been completed by October. Approximately 14½ miles of roads was constructed. The total number of men employed, including the drilling crews, was ten. Exploration was suspended for the winter in November.

McCULLOCH CREEK*

Gold

Argo Exploration & Mining Company Limited

(51° 118° S.E.) Registered office, 201, 1027 West Broadway, Vancouver 9; mine office, 1202 First Street West, Revelstoke. H. B. Zavitz, president; A. E. Horne, managing director. Capital: 10,000 shares, no par value. This company holds twenty-seven mineral claims and four placer leases on the headwaters of Graham Creek, a tributary of French Creek. The property is accessible by road from Mile 57 on the Big Bend highway. The road follows the north side of the Goldstream River for a distance of 5 miles, then turns and follows McCulloch Creek to the summit at 6,000 feet between McCulloch Creek and Graham Creek, a distance of 13½ miles, then 1 mile of road switchbacks down to Graham Creek, a drop in elevation of 1,000 feet.

The rocks in the area are mainly mica and chloritic schists, striking northwest and dipping flatly to the northeast. A general fracture system in the area strikes north 10 degrees east and dips steeply to the west. Quartz veins follow the fracture system, ranging in width up to 8 feet. Some veins are heavily mineralized with pyrite and some are unmineralized.

The McCulloch Creek road was extended from the Stanmack property 6 miles over the McCulloch Creek summit. A camp was established on Graham Creek at

* By J. D. McDonald

an elevation of 5,050 feet. Two small prefabricated buildings were erected, 1,000 feet of 18- to 10-inch pipe was hauled in and installed, and two No. 4 monitors, pressure-box, and 132 feet of 3- by 3-foot sluice-boxes, which were prefabricated in Revelstoke, were set up. Six to eight men were employed during the summer.

REVELSTOKE*

Silver-Lead-Zinc

Mastodon (Mastodon Zinc Mines Limited)

(51° 118° S.E.) Head office, 502, 1200 West Pender Street, Vancouver 1; mine office, Revelstoke. K. J. Springer, president; J. M. Parker, mine manager; R. F. Lambert, mine superintendent; R. G. Gould, mill superintendent. This company holds about fifty Crown-granted claims crossing the ridge between LaForme and Carnes Creeks about 17 miles north of Revelstoke. The main camp and mill are on the north side of LaForme Creek at an elevation of about 3,400 feet, 4½ miles by road from Mile 17 on the Big Bend Highway. The mine is on the divide between LaForme and Carnes Creeks at an elevation of 5,000 feet. It is serviced from the main camp by an incline and about 1 mile of level haulage from the top of the incline to the mine. In the summer of 1960 a road was constructed a distance of 3.3 miles, connecting the mine to the mill.

The mine, which had been idle since October, 1953, was reopened in 1960. Rehabilitation of buildings, machinery, and mine started in April and production began in June.

The Mastodon orebodies are replacements of calcareous rocks, principally by sphalerite. A complete geological description of the property is given in the Annual Report for 1959.

There are four main levels—the 5500, 5300, 5100, and 5000. The 5100 level is the main haulage level, using a small battery locomotive and 2-ton V-cars for hauling and dumping into a coarse-ore bin on surface. Open stoping was done with jacklegs and slushers. Development: 290 feet of crosscutting and drifting, 350 feet of raising. Some underground diamond drilling was done. No work was done on the 5000 level. Ore was hauled from the coarse-ore bin at the mine to the coarse-ore bin at the top of the incline, over about 1 mile of narrow-gauge railroad, using 48-horsepower diesel locomotive and 2-ton V-cars. The ore was transferred to the mill by 3-ton skips via the incline. A new road built from the mill to the mine was completed in September to enable ore haulage by truck and thus eliminate the incline and extra handling of the ore.

The 200-tons-per-day mill treated 15,532 tons of ore in the operating period, averaging 0.2 ounce of silver per ton, 0.5 per cent lead, and 9.5 per cent zinc. The ore contained zinc oxides which were not recoverable. Concentrates were trucked to Revelstoke and thence by rail to the Trail smelter.

All mining ceased on October 16th, and the property was closed on November 15th. During the period of operation the average number of men employed was seventy, of whom forty-five were employed underground.

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

(51° 118° S.E.) Head office, Trail. This property consists of fourteen recorded claims. It is on the north side of Akolkolex River, which empties into the Columbia River at a point about 14 miles south of Revelstoke. The property is accessible by road which leaves the Revelstoke–Arrowhead highway 10½ miles south of Revelstoke, and follows a southeasterly direction for 5 miles to Akolkolex River then turns and goes

* By J. D. McDonald.

north up the river for 5 miles. Approximately 5 miles of road was cleared, and some geological mapping was done on the property. Mineralization occurs in quartzites adjacent to a limestone bed which is believed to be part of the Badshot formation.

SKAGIT RIVER*

Copper

A.M. (Canam Copper Company, Ltd.) (49° 121° S.E.) Company office, c/o Room 609, 850 West Hastings Street, Vancouver 1. W. M. Sharp, resident engineer. This property, comprising eight Crown-granted and fifty recorded claims, is astride the divide on the west boundary of Manning Park, about 4 to 6 miles by road from the Hope–Princeton highway, 26 miles east of Hope. Detailed descriptions of this property have appeared in the Annual Reports for 1938, 1949, 1954, and 1959.

In September a contract was commenced by Intermountain Construction Ltd. to extend the 8- by 8-foot No. 15 level or 4300 adit a distance of approximately 1,300 feet. Commencing at the adit face, a distance of 4,350 feet from the portal, a crew of twenty men completed 1,168 feet of crosscutting. This work was done to investigate the possible extension below No. 10 level of the main ore zone.

Copper-Lead-Zinc

Gold Coin (Earlcrest Resources Ltd.) (49° 121° S.E.) Company office, 212, 678 Howe Street, Vancouver 1. This property, comprising twenty-seven recorded claims, is on Shawatum (Ten Mile) Creek, a tributary of Skagit River, 25 miles southeast of Hope. It was reported that between mid-July and mid-November a crew of nine men, working under the direction of R. Stokes, was employed in magnetometer surveying, geological mapping, and trenching on a large low-grade zone containing copper, lead, and zinc with minor amounts of silver and gold.

HOPE*

Nickel-Copper

Pride of Emory (Giant Nickel Mines Limited) (49° 121° S.W.) Company office, 844 West Hastings Street, Vancouver 1; mine office, Hope. W. Clarke Gibson, president; R. E. C. Richards, mine superintendent; C. Major, mill 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. A branch road from this point gives access to the 3550 adit portal. The adit numbers designate elevations above sea-level.

The Pride of Emory showing was found in 1923 by Carl Zofka, and since that time development and production have been carried on by several different companies. A short summary of earlier development is given in the 1959 Annual Report. In 1959 Giant Mascot Mines Limited acquired Newmont Mining Corporation's interest in Western Nickel Mines Limited and on May 26th joined with Pacific Nickel Mines Limited to form a new company, Giant Nickel Mines Limited. The mine was immediately prepared for production, which was begun on July 5th, 1959. Apart from occasional temporary stoppages, production has been continuous since that time.

* By J. E. Merrett.

The ore occurs in a number of separate orebodies, the principal ones being the Pride of Emory, the Brunswick Nos. 1, 2, and 5, and the 2663, which was mined out in 1958. The first four orebodies mentioned are mainly above the 3550 level. The orebodies are steeply plunging pipe-like deposits and occur in an irregular stock-like intrusion of ultrabasic rocks approximately 1½ square miles in area. They comprise disseminated and massive sulphides, of which pyrrhotite, pentlandite, and chalcopyrite are the most common. The ore reserves at the end of 1960 are estimated as approximately 700,000 tons with an average nickel content of 1.18 per cent. The mine is developed from two adit levels—the 3550 level, with portals on both west and east sides of the mine, and the 2600 level, which is the main haulage level. An ore-pass and an internal inclined shaft join the two levels.

Mining in 1960 was confined to the Pride of Emory and Brunswick No. 1 orebodies, the former being the main source of mill feed. Development of the A and B zones of the Pride of Emory was completed and development of the C zone was in progress at the year-end. The A zone was mined out to the 4075 level by conventional underground longhole methods. The ore from the 4075 level to the surface (100,000 tons) was mined by open-pit methods employing caterpillar tractors and air tracks. Longholing of the B zone was in progress at the end of the year. The ore from this area is drawn from the stopes by 50- and 60-horsepower slushers to the main Pride of Emory ore-pass and dropped to the 3550 level. The Brunswick No. 1 orebody was mined to the surface, and work is now in progress to explore and develop the Brunswick Nos. 2 and 5 orebodies above the 3550 level. The following is a summary of development work done in 1960:—

	Feet
Drifting and crosscutting	1,211
Raising	2,013
Diamond drilling	11,363
Longhole footage	134,278

The milling process was changed from selective to bulk flotation in March on the completion of the current contract with Sherritt-Gordon Mines Limited. The new three-year contract with the Sumitomo Metal Mining Company calls for a bulk nickel concentrate. The concentrates are trucked from the property to Vancouver Wharves bulk-loading plant at North Vancouver by two Mack truck-trailer units.

In 1960 a total of 250,261 tons of ore was milled. A total of 19,995 tons of concentrates, containing 4,295,316 pounds of nickel and 1,578,312 pounds of copper, was shipped.

The crew in December comprised 132 men, of whom seventy-five were employed underground. The accident rate at Giant Nickel mine in 1960 was not good. There was a total of fifty-one lost-time injuries, giving an accident rate per million man-hours of 162.0. This compares with a rate of 28.0 for all lode mines in the Province. Accidents in many categories of underground work were high, but the largest single cause was in the transportation and handling of materials. It is to be hoped that now the mine is entering on its third year of operation, a really determined effort will be made to reduce this accident rate.

[References: *Minister of Mines, B.C.*, Ann. Rept., 1954, pp. 161–163; *Geol. Surv., Canada*, Mem. 190, 1936.]

HOWE SOUND*

Copper-Zinc

Britannia (Howe Sound Company (Britannia Division)) (49° 123° N.E.) Head office, 500 Fifth Avenue, New York, N.Y.; mine office, Britannia Beach. William M. Weaver, Jr., president; Frederick A. McGonigle, vice-president; D. W. Pringle, manager; A. MacCutcheon, general superintendent. Shrinkage, cut-and-fill, filled square-set, sublevel caving, and blast-hole mining methods were used to remove ore from remnant pillars and from broken but hitherto unrecovered ore reserves in the Victoria and No. 8 orebody areas. The largest portion of the ore produced was obtained from the No. 8 shaft area. Rehabilitation work was done on two levels off No. 7 shaft, in the lower Bluff orebody. No. 8 shaft was reconditioned below the 5100 level to the bottom or 5700 level, 1,200 feet below sea-level.

Exploration development was done locally in many areas, but most of it was done in the Victoria mine on the extension of 41-234 drift, easterly along the Britannia shear zone, in an investigation of this area below the Fairwest mine workings, the most easterly ore occurrence in the Britannia deposit. This drift was extended 3,883 feet to a total length of 5,106 feet. Diamond drilling was done at regular intervals without additional ore being disclosed. In the No. 8 shaft area a crosscut was driven toward the shear zone 317 feet on the 5700 level. Development work done included 9,493 feet of drifting, 2,035 feet of crosscutting, 7,695 feet of raising, 11 feet of winze sinking, and 20,982 feet of diamond drilling.

In 1960, 409,751 tons of ore was milled to produce 28,818 tons of copper concentrate, 10,121 tons of zinc concentrate, and 31,418 tons of pyrite concentrate. The copper and zinc concentrates were shipped to the Tacoma and Anaconda smelters, respectively, and, except for a small shipment of pyrite concentrate to Nichols Chemical Company Limited at Barnet, the pyrite was stockpiled for future sale. Some metallic copper was recovered by precipitation, by passing mine drainage water over iron shavings. In addition, part of the mill tailing was sold to Lafarge Cement company and to Construction Aggregates Ltd.

During the year twenty-two employees were successful in passing a mine-rescue training course, thirty-four a first-aid training course, and thirteen the shiftboss examination. Four employess obtained shiftboss certificates.

The average number of men employed was 364, of whom 246 were employed underground.

TEXADA ISLAND*

Iron-Copper

Texada Mines Ltd. (49° 124° N.W.) Registered office, 626 West Pender Street, Vancouver 2; mine office, Box 35, Vananda. A. D. Christensen, San Francisco, president; B. L. Alexander, general manager; J. Kenneth Halley, chief engineer; J. Yuill, mine superintendent; L. D. Smillie, mill superintendent. This property, comprising eight Crown-granted and twelve recorded mineral claims, is at Welcome Bay, 3 miles northwest of the mine camp at Gillies Bay on the southwest coast of Texada Island.

Open-pit mining methods were used to remove ore and waste. Eight drills were used to drill holes 3, 4, and 6 inches in diameter. Blasting was done with 40 per cent Forcite, 75 per cent Giant Gelatin, Hydromex, ammonium nitrate and diesel-oil mixture, and Primacord, using electric detonators. Loading and transportation equipment included six 2½-cubic-yard-capacity diesel-driven shovels, one Michigan front-end loader, two D-8 Caterpillar tractors, five 22-ton-capacity and six 27-ton-capacity trucks.

* By J. E. Merrett.

The waste stripping programme, commenced in 1959, was continued on the Boulder Nest, Paxton, Prescott, and Yellow Kid pits, a total of 1,600,219 solid cubic yards of rock being removed in 1960. Of this total, 97 per cent was removed from the Prescott and Yellow Kid pits, more than half of it from the Yellow Kid pit.

Underground, 225 feet of raising and 405 feet of sublevel drifting were completed beneath the Paxton and Yellow Kid pits.

Diamond-drill exploration was done continuously throughout the year, 11,672 feet having been drilled on the surface and 12,180 feet underground.

An aircraft landing strip more than 2,000 feet long, for the use of small aircraft, was under construction close to the mine.

Additions to the camp included two thirty-two-man bunk-houses and a community hall.

The mill produced magnetite concentrate by a wet magnetic separation process, and the chalcopyrite was recovered by flotation. The concentrates were shipped to Japan.

Production: Ore mined, 869,673 tons; ore milled, 867,736 tons; iron concentrate, 419,651 tons; copper concentrate, 7,927 tons. The average number of men employed was 216.

BUTE INLET*

Copper

Colossus (Phelps Dodge Corporation of Canada, Limited)

(50° 125° N.E.) Company office, 904, 1030 West Georgia Street, Vancouver 5. W. A. Hutchison, Toronto, general manager; D. C. Malcolm, Vancouver, resident geologist. This company holds options on four Crown-granted and forty-one recorded mineral claims and fractions in the vicinity of Buker Creek on the north side of Estero Basin of Frederick Arm, west of the south end of Bute Inlet.

A crew of three men was employed reopening 2 miles of trail from Estero Basin to the old mine workings, which consist of four adits between elevations of 1,055 and 1,300 feet. The adits were reopened and geological mapping was done on the surface and underground.

In addition, prospecting was done in the Coast Range, using a helicopter based at Estero Basin and at Jervis Inlet.

VANCOUVER ISLAND

Benson Lake (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. The mine is operated by Mannix Company Ltd. (company office, 546 Howe Street, Vancouver 1), which has a 60-per-cent interest in Empire Development. A. Ostgard is project manager. The remaining interest in Empire Development is held by Quatsino Copper-Gold Mines Limited, who are the original owners of the ground which now includes the present operation.

The property consists of a block of forty-five Crown-granted claims on which the operating pits are situated. There are also another eleven Crown-granted claims and at least seven recorded claims in the area. A reciprocal agreement exists involving exploration rights to iron mineralization by Empire Development on the

* By J. E. Merrett.
† By W. G. Jeffery.

northerly adjoining Coast Copper property, and to copper mineralization by The Consolidated Mining and Smelting Company of Canada, Limited, on Empire Development property.

The Empire mine lies 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 flank of Merry Widow Mountain. The concentrator and mine camp are in the valley at an elevation of 800 feet. Access to the open pits is by tote-road about 4 miles in length, and ore is brought down the hillside by tramline. Access to the mine camp is by a 25-mile gravel road from Port McNeill on the east coast of Vancouver Island. Details of the mining, milling, and shipping processes may be found in the Annual Report for 1959.

Magnetite occurrences have been known in the area from 1897, but the initial development was of copper mineralization, and the present magnetite orebodies have been developed from showings originally considered to be of lesser interest. After some exploration work, Quatsino Copper-Gold Mines Limited suspended operations in 1931, but diamond drilling of the magnetite showings was commenced in 1950. Further work in 1951 and 1952 proved the existence of magnetite orebodies on the Merry Widow No. 5 (Lot 1533) and the Kingfisher Fraction (Lot 1532) Crown-granted claims. Empire Development Company Limited was formed in 1956, and production commenced in 1957. To the present time, production has been as follows:—

Year	Ore (Tons)	Concentrate (Tons)
1957	121,423	82,668
1958	572,404	272,495
1959	863,176	393,558
1960	1,046,989	463,240

In 1960 the number of men employed averaged 142. A total of 11,675 feet of diamond drilling was completed during the year.

Acknowledgments.—The writer, with one assistant, used the mine as a base for mapping the surrounding area during the summer of 1960, and wishes to express his appreciation to the staff of Empire Development Company Limited for their co-operation. The following preliminary notes on the regional geology are based on the writer's observations, and the detailed geology of the mine is developed partly from the writer's work and partly from the observations and ideas of John Lamb, company geologist, to whom in particular the writer wishes to express his thanks.

The mine is in an area of fairly rugged topography with an over-all relief of about 2,500 feet. Apart from summits above about 3,500 feet elevation, the country is wholly wooded, in places with heavy underbrush. The amount of outcrop varies greatly, but the better exposures are usually found in the creeks, which are normally difficult and slow for travel. Annual rainfall is over 100 inches. Precipitation during the field season of 1960 from May to September amounted to approximately 10 inches, and there were dry sunny spells of considerable duration through the summer months.

Regional Geology

The region is underlain by rocks of the Vancouver group, similar to those described in the Zeballos-Nimpkish area by Hoadley (1953). These rocks consist of a series of interbedded volcanic and sedimentary rocks. The lowermost unit is the Karmutsen group of unknown thickness. The upper horizons are of Upper Triassic age. Upper Karmutsen rocks underlie large areas to the north and east of the Empire mine, and consist of thick green and purplish amygdaloidal flows with very little sedimentary material.

The Quatsino limestone formation rests conformably on top of the Karmutsen group. The unit is a crystalline limestone, ranging in colour from white and grey to blue. In places it is well bedded, usually in beds ranging from 6 inches to about 4 feet thick, but elsewhere it is very massive rock with little indication of bedding. The Quatsino limestone is of the order of 4,000 feet thick. The major part is unfossiliferous, but a few fossils collected in the upper horizons have been tentatively identified as Upper Triassic by W. R. Danner (personal communication). Exposures occur across a broad belt of relatively low-lying country northwest of the mine along the valley of the Benson River, south of Benson Lake, east of the mine, and extending southeast in the general direction of Zeballos. Areas underlain by limestone are generally characterized by sink-hole topography, and a noticeable feature is that undergrowth is less dense than over areas underlain by other rock types.

Rocks of the Bonanza group lie above the limestone. Exposures of the Bonanza group occur to the northwest, west, and south of the mine. In places these rocks can be subdivided into a sedimentary part and a dominantly volcanic part. The sedimentary rocks comprise the lowermost part of the Bonanza group and have an approximate thickness of 300 to 400 feet where they are exposed south of the mine. The Quatsino limestone grades rapidly into thin-bedded impure carbonaceous limestones, black calcareous argillites, argillites, and tuffaceous argillites. This lower sedimentary unit of the Bonanza group is not present in all parts of the area. Overlying the sediments is a thick series of pyroclastic rocks, the top of which is not exposed in the area. The division between the sedimentary and volcanic units of the Bonanza group is somewhat arbitrary as the contact appears gradational, although no complete exposures were seen in the field. The predominance of volcanic or normal sedimentary rocks is the basis for separation. The volcanic unit is composed of tuffs and agglomerates with some lava flows. Tuffs are predominantly brown, green and greenish-grey, or purple; minor amounts are creamy grey with a cherty texture. Agglomerates are abundant, some of the fragments ranging in size up to a foot across. Flow rocks occur in limited amounts. There are some exposures of a distinctive feldspar porphyry flow rock which contains amygdules. At the base of the volcanic sequence a coarse limy agglomerate was observed, very similar to that described in a similar stratigraphic position in the Zeballos area by Hoadley (1953).

Throughout the Vancouver group, and especially in the volcanic units, numerous fine-grained green rocks occur as dykes, sills, and irregular intrusive bodies. In most places they are similar to the rocks which they invade, and field identification in limited exposures is difficult.

To the west of the Empire mine the Vancouver group rocks are intruded by a large crystalline igneous mass. Exposures show contacts with the Quatsino formation and the Bonanza group, but there are no surface contacts with the Karmutsen group rocks. In other reports this intrusive mass has been referred to as the Coast Copper stock from its proximity to the orebodies in the Old Sport mine (Coast Copper Company Limited), which lie about 2 miles to the north of the Empire mine. The Coast Copper stock is similar to the igneous rocks of the Coast Range.

Recent mapping has shown that the Coast Copper stock is composed of diorite and monzonite. The more easterly part, nearest to the Empire mine, is a narrow elongated mass extending north and south. Contacts dip steeply outward, ranging from near vertical to about 50 degrees east at the mine. The rock ranges in colour from white to grey, and the more basic parts are dark greenish-grey. The composition changes from place to place, but in general the rock is a diorite with gabbroic phases. Remnants of metamorphosed volcanic rocks of the Bonanza group are included within the stock.

Lying farther to the west and partly separated from the diorite-gabbro by a large mass of Bonanza group volcanics is another intrusive phase of the Coast Copper stock. This rock is pink or pinkish-brown monzonite occurring as an elongated mass trending northwest. Contacts with the diorite-gabbro show rapid gradation but have not revealed a clear age relationship. The only evidence suggesting a later age for the pink monzonite is that it contains abundant inclusions, some of which appear to be dioritic in composition.

The Vancouver group rocks within the region form a monoclinal sequence with an over-all northwest strike and a dip of about 30 degrees southwest. Apart from minor rolls and undulations indicated by variations in strike and dip, there are no major fold structures within the area. The Coast Copper stock has caused some local folding and bending in adjacent bedded rocks.

Faults can be divided into two groups. The major displacements occur on faults striking north at a small angle to the strike of the beds. These are apparently normal faults, and within the district they produce repetition of the Quatsino limestone at the surface. Faults of the other set range in strike from east to northeast and have been recognized in detailed work in the vicinity of the orebodies. They are not as persistent as the northerly striking faults, and displacements have been small. In some cases they have caused the development of deep gullies and ravines in the drainage pattern, but otherwise such faults are not readily detected.

Local Geology

The geological setting of the magnetite orebodies of Empire Development Company Limited is similar to that of many other magnetite showings along the British Columbia coast. Magnetite is present in limestone and volcanic rocks where they both occur close to the margins of the Coast Copper stock. The distribution of these rocks and the magnetite exposures are shown on the accompanying geological map (*see* Fig 9).

Bedded Quatsino limestone strikes generally west of north and dips southwest, with moderate variations in strike and dip. The most prominent change is a northeast strike around a bulge of the Coast Copper diorite-gabbro protruding to the east, in the vicinity of the Merry Widow and Kingfisher orebodies. The orebodies are emplaced where the bedding strike tends to coincide with the northeast strike of steep southeasterly dipping faults. There are other magnetite exposures in the area, but investigation has shown so far that they are small and sporadic. Superimposed on the over-all attitude of the limestone are rolls and gentle folds with dip variations of the order of 10 to 15 degrees. Limited exposure in the Merry Widow pit and evidence from diamond drilling suggests that the limestone is locally more severely folded. To the north, in the vicinity of the Shamrock (Lot 1492) and Blackjack (Lot 1498) showings, there are very steep dips where the limestone is adjacent to the intrusive.

Bonanza group rocks overlie the limestone and occur as a discontinuous rim around the edge of the Coast Copper stock. These rocks consist of metamorphosed volcanic agglomerates, tuffs, and flows. Other than in exposures of agglomerate with clear textural features, the rocks are dense, fine grained, and green, with little evidence of structure, and are hard to distinguish from abundant intrusive rocks in the area. The few bedding attitudes observed conform to the general structure, with

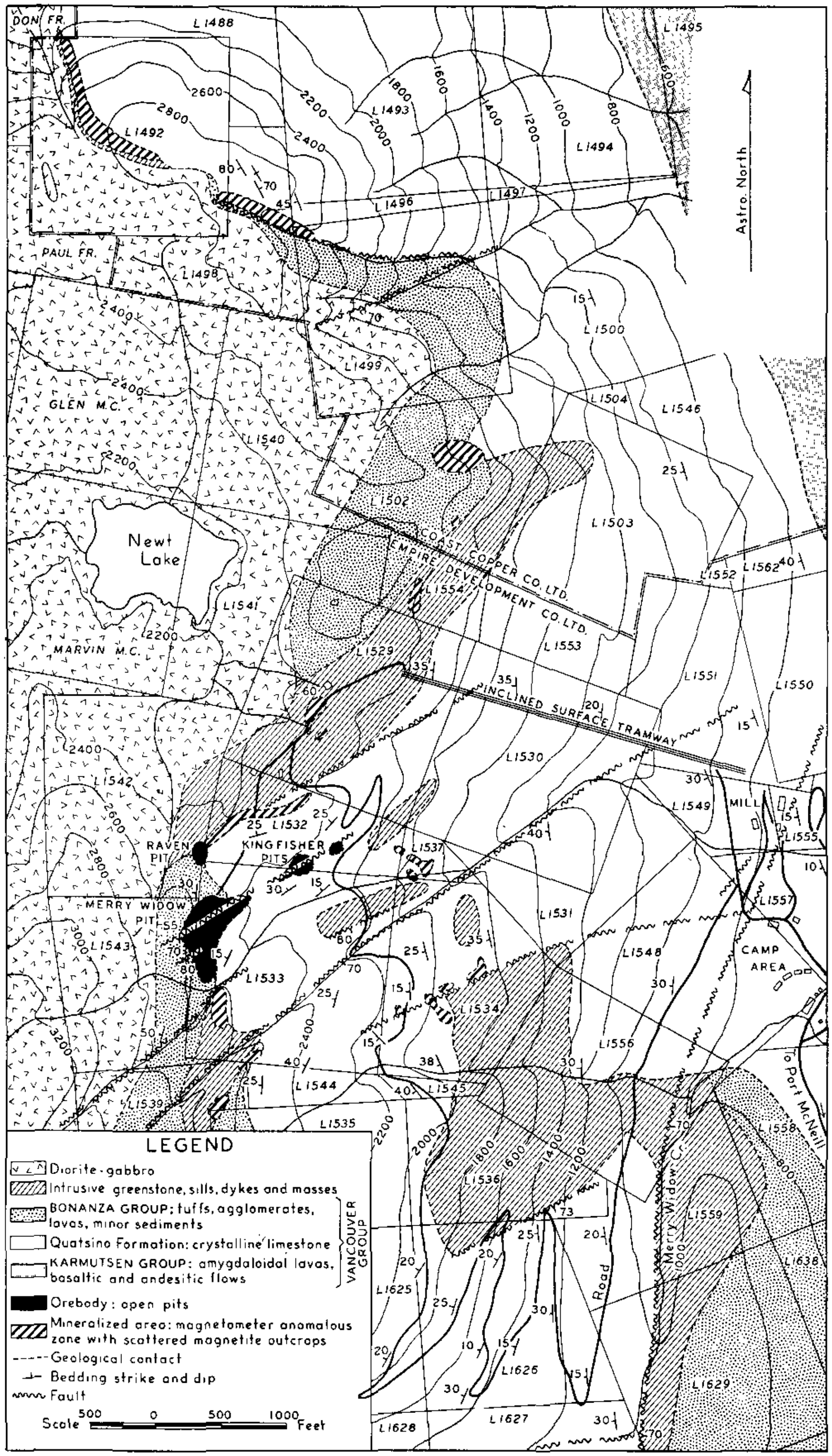


Figure 9. Empire Development Company Limited. Geology in the general vicinity of the mine workings.

moderate dips to the west. The headwall of the Merry Widow pit exposes Bonanza rocks with a uniformly massive character and commonly no trace of bedding, that could well be considered as intrusive were it not for the fact that development occasionally reveals relict bedding, mainly as a colour banding ranging from dark green to cream. Where these rocks occur close to the diorite intrusive, they are altered to a pyroxene-plagioclase gneiss. Under the microscope the green host rock adjacent to the Merry Widow orebody exhibits a fluid texture, with laths of plagioclase feldspar in places flowing round a rare feldspar phenocryst.

The Coast Copper stock intrudes the limestone and volcanic rocks, along a contact that trends roughly northward close to the mine orebodies. In composition this intrusion is essentially diorite, but in places there are dark gabbroic phases. In most places the dip of the contact is steep, ranging from 90 to 70 degrees outward to the east. However, where the contact lies west of the Merry Widow pit, diamond drilling and recent development show that the contact dips 55 degrees east. Close to areas of magnetite mineralization the margins of the intrusive stock contain magnetite grains disseminated through the crystalline fabric. Contact metamorphic effects on the limestone appear to be almost wholly those of recrystallization, and such limestone has a coarse sugary grain and is friable where weathered. The fresh rock is a white marble. Close to the diorite the volcanic rocks are metamorphosed, the main effect being an obliteration of bedding features. Intrusion of the diorite stock appears to have caused some minor folding in the limestone along the margins, but no broad-scale disruption of the beds has been observed.

In part, the intrusive green volcanic rocks (greenstones) are thought to represent an intrusive phase of the vulcanism which deposited the Bonanza group pyroclastics. The larger bodies are shown in Figure 9, but there are numerous dykes and sills, often with crosscutting relationships, throughout the Quatsino limestone and Bonanza volcanic rocks. These rocks are dense, fine grained, vary in colour from light greyish-green to dark green, and have a variety of compositions. On the tote-road, exposures of a large body of greenstone are of andesitic rocks composed of a felted mass of plagioclase and ragged amphibole.

North of the pits the road close to the mine warehouse exposes a number of fine- and medium-grained intrusive rocks. Greyish-green andesite is cut and brecciated by a very fine-grained rock which is composed almost wholly of equigranular quartz and potash feldspar, and which may be termed alaskite. This produces a very distinctive texture, as the edges of all the brecciated fragments are bleached white by the alaskite, but the only mineralogical change seen microscopically is a reduction in the amount of opaque iron minerals. The alaskite also cuts a diabase porphyry rock, and is in turn cut by fine-grained basaltic trap dykes and another basaltic porphyry which is very similar in appearance to the diabase. Close to these exposures the green intrusives are cut by granodiorite, which has been termed microdiorite in the field, and which is almost certainly an apophysis of the diorite-gabbro stock. The mine workings have exposed granitic and quartz diorite dykes with a typical aplitic sugary texture.

Within the magnetite orebodies, some dyke rocks were seen with inconclusive post-ore relationships. An example is an altered diabase in the Raven pit. Other dykes definitely post-ore in age were observed. In the Merry Widow pit, a fine-grained basaltic dyke with abundant chlorite cuts massive magnetite with smooth polished walls. In the Kingfisher pit a very fine-grained banded dark-green post-ore dyke is composed of chlorite with some sericite, epidote, and calcite.

Faults are numerous in the vicinity of the mine. Two sets are described above. A north-striking fault follows the bed of Merry Widow Creek for part of its course, and has caused repetition of the Quatsino limestone to the east. Along and in the vicinity of this fault, small showings of copper and iron sulphides and cobalt bloom have been observed, but the fault is remote from the present orebodies and from many other showings, and appears to have no structural connection with them.

The east- to northeast-trending faults are numerous in the vicinity of the orebodies. All have steep southerly dips. Movements on them have been negligible or small, and, unless exposed by creeks which tend to form deep gullies along them, their surface expression as seen in the open pits is not very extensive. One fault crosses the tote-road south of the Kingfisher pits and forms a steep-sided gully. Individual limestone beds on either side of the fault can be matched. Farther down the creek the movement has been of the order of some tens of feet. There is field evidence that at least part of the movement on these faults took place after emplacement of the diorite-gabbro stock. Exposures in a creek within the diorite in the northern part of the map-area show a brown sheared and fractured zone about 9 inches wide containing lenses and stringers of quartz.

In addition to the steeply dipping faults, the Kingfisher pit reveals evidence of movement along the bedding planes in the limestone. The plane of movement lies along the base of a sill, which dips 20 to 25 degrees west, and contains green clayey gouge and slickensides, indicating an overthrust of the hangingwall to the northeast. In the hangingwall, breccia, containing matching fragments of skarny green sill rock with selvedges of magnetite and chlorite, is healed by coarsely crystalline calcite. Other pods of coarse crystalline calcite with associated magnetite occur in the footwall of the thrust. Excavation has revealed that magnetite occurs down dip under this horizon, proving that either the thrust or the sill was a structure controlling ore emplacement.

Other evidence of movement, not fully revealed by the texture of the limestone, includes boudinage structures seen in some sills, and fragments of dyke rocks separated by gaps of 6 inches to several feet. Close examination shows flow structures in the limestone which fills such breaks.

Orebodies

The Merry Widow and Kingfisher orebodies have been the major source of ore, with the Raven pit providing minor amounts in 1960. The Kingfisher orebodies are now worked out, and all production is from the Merry Widow pit.

In the Merry Widow orebody, magnetite ore occurs as sheets or lenses, with irregularities, which lie within Bonanza volcanic rocks adjacent to the limestone contact. The attitude of these magnetite layers is parallel to the intrusive contact, dipping approximately 55 degrees east.

There are two Kingfisher orebodies, on which are the Kingfisher Central and Kingfisher East pits. The terminology was derived from the initial magnetometric work which outlined an elongated anomalous zone with three wider parts. Orebodies were found under the central and easterly of these three bulges, but no ore was found to underlie the western end of the anomaly. Both orebodies are wholly contained within the limestone, and are very steeply plunging pipes of magnetite, nearly circular in cross-section. The central pit is between 150 and 200 feet in diameter, and the east pit is approximately 100 feet in diameter. They have been worked to depths of about 300 feet, as access has been possible from the side of the steep slope on which they are situated. They now have been abandoned, as economic limits controlled by access, drainage, and waste-to-ore ratio have been reached. Diamond drilling has shown that the two orebodies merge below the present floors and then fade, so that there remains only a relatively small tonnage of magnetite. These pits have provided 419,460 tons of ore.

The Raven orebody is a part of an elongated mineralized zone of disseminated magnetite that probably lies along a fault. The ore opened up at the western end is fine-grained massive magnetite which is about 70 feet wide and appears to extend in a northerly direction.

In the ore zones, magnetite varies from massive to disseminated. Where enclosed in limestone, the ore tends to be massive, with sharp clean contacts with the host rock, whereas contacts with both extrusive and intrusive volcanic rocks are gradational in character. Due to this fact, the exposures in the Kingfisher pits have revealed more distinct relationships of ore with host rock than in the Merry Widow pit.

Bedding structures can, in places, be traced into the magnetite, and the ore has been observed to pass outward into stringers which lie along bedding planes and follow dykes and sills in the limestone. A number of minor showings in the region consist of thin selvedges of magnetite along intrusive volcanic rock contacts.

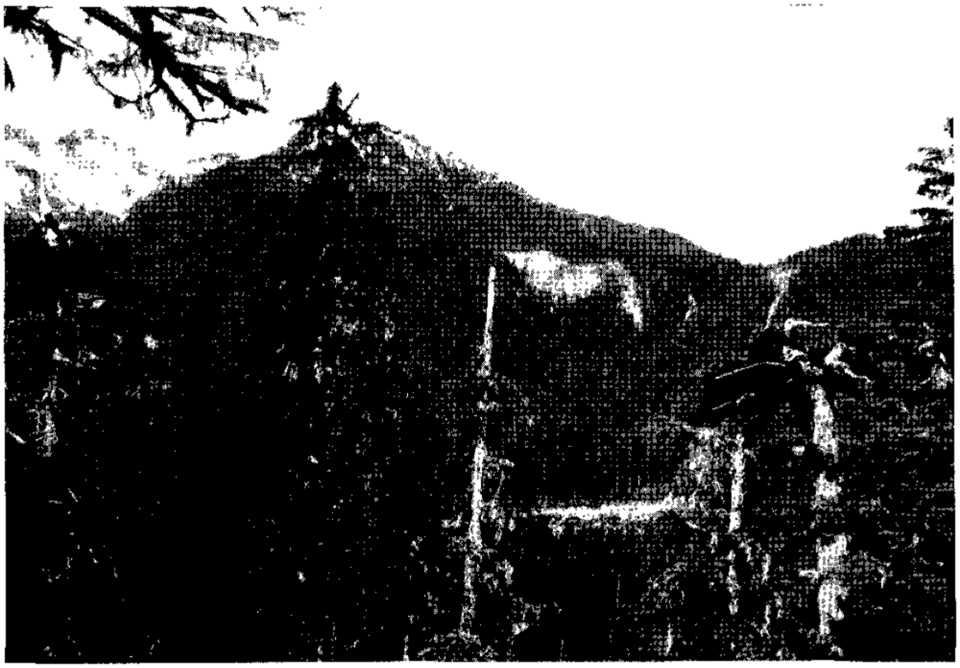
Magnetite with a coarse mammillary texture has been found amongst broken ore in the Kingfisher pits, and also in broken ore in the Merry Widow orebody where it is enclosed by limestone. The nodules exhibit smoothly " crackled " intersecting faces. Sections through the nodules show a radiating structure and a concentric banding. The bands appear to be related to grain size as the outer layers are thin, fine grained, and dense, whereas at the centre of any one nodule the magnetite is coarser and the banding is wider and less prominent. The hollows between the nodules are commonly filled with coarsely crystalline friable magnetite. The writer has not seen examples of such mammillary structure in place.

Mammillary surfaces and associated radiating and concentric banded structures are termed colloform textures. The curved surfaces are thought to be the result of surface tension effects and therefore represent a colloidal or gel origin. The curvature is convex toward the younger or free surface. The finer grain near the surface indicates that crystallization proceeded from the free surface inward. Colloform textures are thought to indicate deposition at low temperatures and low pressures, and rapid precipitation is known to promote gel formation.

Colloform texture is known in many minerals, and frequently the deposits are in limestone, but, to the writer's knowledge, colloform magnetite has not been described previously. The texture implies that the formation of magnetite took place in open space fillings at low pressures. Colloform magnetite has only been found where the host rock is limestone. The solubility of limestone may have allowed the rapid enlargement of openings, and thus allowed an equally rapid deposition of iron oxides. Alternatively, the effect of the limestone may have been to neutralize acid solutions, although if that were so one would expect colloform magnetite to be more widespread in distribution.

Banded ore, showing as variations in the size of magnetite grains and the amounts of dark-green chlorite and white calcite associated with the magnetite, was observed in parts of the orebodies.

Minor amounts of pyrite, chalcopyrite, and pyrrhotite are distributed throughout the orebodies, in places accompanied by quartz. As has been noted in other accounts of the Coastal " contact metamorphic " deposits, the sulphides appear to be later in age than the magnetite mineralization. Development of the Raven pit disclosed a substantial body of sulphides on the east side of the magnetite zone. The dominant mineral is pyrrhotite with lesser chalcopyrite and pyrite. Veins of crystalline sphalerite and calcite cut across the massive pyrrhotite. Small amounts of crystalline arsenopyrite have been found in the Merry Widow orebody, with calcite, pyrrhotite, and chalcopyrite.



Empire Development Company Limited. Open pits at 2,500 feet elevation connected by tramline (partly hidden on right) with mine camp in Benson River valley. Merry Widow Peak, 4,600 feet elevation, on far left.

Quatsino limestone conformably overlying amygdaloidal flows of the Karmutsen group.

Brown garnet, epidote, actinolite, and chlorite are the skarn minerals which, together with calcite and small amounts of pinkish-red microcline, are found throughout the magnetite masses, at the margins of orebodies, as isolated masses, and as selvedges along the margins of dykes and sills. The skarn mineralization and masses of unreplaced host rock form the gangue of the ore zones. Crosscutting relationships shown by veinlets indicate that magnetite, together with calcite and some epidote, is later in age than the massive garnet and epidote skarn.

Bluish-green actinolite crystals, largely converted to calcite, in many places occur with the late crystalline calcite. Rarely, open vugs containing clear calcite were found.

The Merry Widow orebody is a contact metasomatic magnetite deposit and appears to be the result of successive mineralizing periods of silicates, oxides, sulphides, and carbonate, which have replaced volcanic rocks immediately adjoining both the Coast Copper stock and limestone. The orebodies are developed where the intrusive contact has the lowest dip in the locality, and also where a bulge in the intrusive has caused a change in the strike of the bedded rocks. These appear to be the dominant structural controls, but formation of the deposit may have been assisted by a local concentration of faults with northeasterly strikes and southerly dips.

The structural effect of the intrusive stock on the Kingfisher deposits is less clear. The most important control appears to be the northeasterly striking fault which extends along strike from the Merry Widow pit, but the reason for the location along this fault plane remains unknown. The shape of the ore zones and their fusion at depth implies that mineralizing solutions ascended from an underlying source.

Areas with anomalous magnetometer readings and small magnetite exposures are shown on Figure 9. Investigation by Empire Development company has shown that most do not constitute ore.

Two of the larger anomalous areas (Blackjack, Lot 1498, and Shamrock, Lot 1492) were investigated with a diamond drill during the end of 1960. Scattered magnetite outcrops in coarsely crystalline friable limestone and accompanying anomalous magnetometer readings were distributed over two narrow zones about 100 feet wide and about 800 feet and 1,200 feet long.

These magnetite showings lie on the north side of the large bulge in the Coast Copper stock, and they are separated by a smaller bulge in the outline of the intrusive. Steep dips in nearby limestone outcrops suggest local severe folding. The position and attitude of some of the magnetite outcrops indicate that structural control of ore location involves the attitude of the intrusive, fold structures and bedding in the limestone.

An interesting specimen was collected from an outcrop in the Shamrock showing which exposes magnetite 3 feet thick interbedded in coarse crystalline limestone dipping 20 degrees west, and exposed over a distance of about 25 feet. Part of this outcrop showed a finely banded texture with uniform layers of magnetite one thirty-secondth of an inch wide separated on the weathered surface by gaps about half this wide, possibly where thin layers of carbonate had weathered out. This layering exhibits apparent fold structures a few inches in size. The layers tend to fuse on some parts of the folds. No similar thin layering was observable in the surrounding limestone. The unbroken and consistent nature of the magnetite lamellæ indicates that the magnetite replaced a fossil algal structure, or, less likely, a slump structure in a finely bedded sediment, but there is no evidence of rocks with either of these features in the vicinity. If such structures had existed in the limestone and had been obliterated by contact metamorphism, that would imply that magnetite formation occurred prior to emplacement of the intrusive rock. There remains the possibility that these magnetite laminations may be a form of colloform texture.

[References: Gunning, H. C., *Geol. Surv., Canada,* Sum. Rept., 1929, Pt. A, p. 94; Bacon, W. R., *Minister of Mines, B.C.,* Ann. Rept., 1952, p. A 228; Hoadley, J. W., *Geol. Surv. Canada,* Mem. 272, 1953.]

Copper

Old Sport (Coast Copper Company, Limited)

Company office, Tadanac; mine office, Port McNeill. H. G. Barker, property superintendent. This property consists of forty-eight Crown-granted claims, situated on the southern shore of Benson Lake and southward along the valley of the Benson River. After a long history of development, work commenced in 1960 to bring the mine into production. As no information has been published since 1931 apart from the recording of 5,456 feet of diamond drilling in 1956, the following will serve as a brief résumé of the history and geological setting of this copper deposit.

The claims were developed from 1911 onward, and control changed hands several times. In 1916 The Consolidated Mining and Smelting Company of Canada, Limited, assumed control and organized the present company. Apart from a period of inactivity in 1921 and 1922, development continued until 1931, when economic conditions forced the closure of operations. At that time, development included about 5 miles of underground workings and many thousands of feet of diamond drilling. There was an established camp, a hydro-electric generating system on the Raging River that provided all power, including that required for underground haulage, and a good road and water connection to Jeune Landing at tidewater on the west coast of Vancouver Island. Following 1931 these assets fell into decay.

The decision to reopen the mine has been aided by the recent demand for minerals by Japan, and by the existence of a good 25-mile road running from Port McNeill to the workings of Empire Development, lying approximately 2 miles to the south of the Coast Copper deposit. Rehabilitation of the camp and the building of 1½ miles of road to the mine-site were completed in the second half of 1960. At the end of the year fifteen men were employed.

Local relief is of the order of 2,500 feet and annual rainfall is over 100 inches.

In the vicinity of the Old Sport mine a thick series of basic volcanic rocks (Karmutsen group) is overlain by Upper Triassic limestone (Quatsino formation), and these rocks are covered by a sequence of dominantly pyroclastic rocks (Bonanza group). The whole is usually referred to as the Vancouver group. These rocks are intruded by an irregular body of igneous rock which varies in composition from gabbro to quartz diorite. Because of its similarity to the Coast Range batholiths, this is usually classified as a Coast Range intrusion, and has been termed the Coast Copper stock.

The bedded rocks occur as a monoclinal sequence, striking west of north and dipping about 30 degrees southwest. Over a much larger region there is evidence that the rocks are part of a broad fold structure, and that the Old Sport mine is on one limb of a large open fold. Within the local monoclinal sequence, local variations in dip and strike signify gentle rolls and undulations in any one horizon. Faults are widespread and can be divided into two groups. Those showing most displacement strike north at a slight angle to the strike of the beds. They are apparently normal faults and have caused repetition of beds in the outcrops. Faults of the other set have a strike ranging from east through northeast and generally do not appear to have caused much displacement. The intrusive contact has a dip ranging between near vertical and about 50 degrees to the east (outward). In the vicinity of the mine, interpolation between the surface and a drill-hole to the intrusive from the workings shows an over-all dip of 72 degrees outward over a vertical range of 3,200 feet.

The orebodies at the Old Sport mine occur at the contact of the limestone with the underlying volcanic rocks. The zone dips about 37 degrees southwest toward the easterly dipping intrusive contact. The mineralized zone is divided in many places into a hangingwall and a footwall section by a dark volcanic rock which has previously been termed the " included diorite." To date there is no proof as to whether this is a flow rock or intrusive. The hangingwall section of the ore, lying above the included diorite, is not present everywhere. The main mineralization occurs between the " included diorite " and andesite flows of the volcanic rocks, but replacement in the mineralized zone has proceeded to such an extent that it is difficult to establish how much of the host rock was limestone and how much was volcanic.

Faulting is widespread throughout the mine, but displacements do not amount to more than a few feet in most places, and there are long stretches where there is little or no important faulting.

The ore zone consists mainly of garnet, epidote, magnetite, and calcite, with chalcopyrite and bornite occurring as veins, lenses, and disseminations in the silicates and magnetite. There are also lesser amounts of amphibole, chlorite, quartz, pyrrhotite, and pyrite.

The mine has been developed on the fifth, seventh, eighth, tenth, twelfth, fourteenth, and sixteenth levels, with a level interval of 200 feet except for Nos. 7 and 8 levels, which are 100 feet apart. Nos. 5 and 8 levels are connected to the surface by adits, and the other levels are served by internal inclined shafts. No. 5 level is about 800 feet above sea-level, and the maximum extent of development along strike is of the order of 6,000 feet.

[References: Dolmage, V., *Geol. Surv., Canada,* Sum. Rept., 1918, Pt. B; Gunning, H. C., *Geol. Surv., Canada,* Sum. Rept., 1929, Pt. A; *Minister of Mines, B.C.,* Ann. Repts., 1911 to 1931, 1956.]

NIMPKISH LAKE (50° 126° S.W.)*

Iron

Nimpkish, Klaanch, etc. (Nimpkish Iron Mines Ltd.) Company office, 205, 850 West Hastings Street, Vancouver 1; mine office, Camp A, Beaver Cove. S. V. Wines, project manager; D. Burns, mine superintendent; R. Bick, mill superintendent. Mining and ore-treatment operations are described in the Annual Report for 1959, page 134. Statistics for 1960: Ore mined, 480,000 tons; waste stripped, 163,265 solid cubic yards; concentrate shipped, 283,000 tons. The average number of men employed was fifty-five.

Magnetite was discovered in the area in 1897, and the deposits were reported on by E. Lindeman in 1910, who drew a magnetic map which fairly accurately indicates the orebodies now being mined on the Iron Crown claim (Lot 126).

The Iron Crown claim lies about 5 miles south of the southern end of Nimpkish Lake on the southwest bank of the Nimpkish River, and south of the junction of the river and Mukwilla Creek. On the opposite side of the Nimpkish River a creek flows from a small lake into the river.

* By W. G. Jeffery.

The regional geology has been described by Gunning (1930–1933) and Hoadley (1953). In the vicinity of Nimpkish Iron Mines, basic volcanic rocks underlie crystalline limestone, and the contact between them trends northwest through the Iron Crown claim. The volcanic rocks have been intruded by rocks ranging in composition from monzonite to gabbro. The magnetite deposits lie within an embayment of the intrusive rock with tongues extending across the river to the north and south of the workings.

The valley of the Nimpkish River is less than 500 feet above sea-level, and is extensively covered with drift material, so that natural outcrops are very scarce, apart from those occurring along the river banks. Before the present operations began, magnetite was observed on the southwest river bank over a length of 180 feet, forming cliffs 25 to 30 feet high. Smaller outcrops of magnetite were mapped at distances of 100 feet and 600 feet southwest from the river bank.

Diamond drilling and subsequent excavation have proved the presence of four orebodies, which have been named the East, South, Road, and River. The developments have proved that the South and Road orebodies are connected by a neck of magnetite, and this entity constitutes the major source of ore. The East orebody is small. The River orebody is an extension of the river-bank exposure. The three large orebodies (River, Road, and South) are shaped like elongated basins with their long axes lying roughly parallel to the surface trace of the limestone-volcanic rock contact. Ore depths are as great as 200 feet, and the walls dip inward at angles of the order of 70 degrees.

The headwall of the main pit exposes massive crystalline limestone with no definite indication of bedding. Fracturing is noticeable in limestone adjacent to magnetite, and there is also much fractured, polished, and slickensided intrusive greenstone, some of which is basaltic.

The major part of the ore is enclosed within and intimately associated with greenstones, some of which are dykes and sills and some are rocks of the regional volcanic assemblage. Feldspar porphyry is abundant, with phenocrysts constituting from 5 to 20 per cent of the rock. In places there are a few amygdules, most of which contain calcite, but some are filled with epidote. A specimen taken from the river bank below the River orebody is composed of fine-grained hornblende with sericite, chlorite, and epidote distributed heterogeneously through the rock. A similar rock was taken from a drill-hole below the River orebody, but these rocks are so close to the ore deposit and the intrusive contact that metamorphism and alteration have been extensive.

Exposures of granitic rock occur in the river both up and downstream from the ore zone, and also within the ore zone itself. Upstream from the mine the intrusive is quartz monzonite, a coarse-grained rock with large anhedral quartz grains, andesine, potash feldspar, and green hornblende largely altered to biotite and chlorite.

Within the ore zone, diorite occurs as a plug between the South and Road orebodies, and there are small exposures in the River open pit. Downstream, steep walls of diorite are exposed where the intrusive extends across the river. The attitude of the diorite contact in the vicinity of the iron deposits is not known, but the intrusive plug in the ore zone must have steeply dipping contacts.

The ore is composed of magnetite with minor copper and iron sulphides, skarn minerals such as calcite, chlorite, epidote, and garnet, and included fragments of country rock. Skarn is mostly developed in the greenstone areas of the pits. Close to the limestone-magnetite contact, masses of coarsely crystalline pyroxene intergrown with magnetite were picked up from the broken ore, although this material was not seen in place. The small East orebody is mostly enclosed with limestone, and contacts are sharp and well defined. Crystalline garnet, in places up to one-half inch across, is disseminated through the limestone close to the magnetite, and also in steeply dipping bands traceable for distances of 1 to 2 feet.

The magnetite is dense and fine grained, and small amounts of pyrite, pyrrhotite, and chalcopyrite are found as irregular masses throughout the ore. All these sulphides have been found forming a lamellar pattern within magnetite, in occurrences close to the limestone contact. In one specimen, lamellar pyrrhotite and chalcopyrite were cut by a veinlet of pyrite, indicating that some of the pyrite is probably a part of later mineralization.

Magnetite in the River orebody forms an intrusive relationship with greenstone rocks, in places developing a brecciated greenstone cemented by iron ore. This in turn is cut by calcite veins, and where calcite is abundant it cements angular fragments of both greenstone and magnetite. Parts of the River orebody contain magnetite fragments with rims of pyrite surrounded by coarsely crystalline calcite. Much of the late calcite is associated with euhedral cubes of pyrite. Brown sphalerite set in calcite was also observed by the writer.

A structural feature in the ore is the intersection of the magnetite by numerous slip planes, commonly well polished and often with chlorite developed along them. The slip planes are randomly oriented and movements were probably small, but they are indicative of some post-ore disturbances. Additional evidence of post-ore activity is indicated by the occurrence of dykes cutting through the magnetite. One rock exposure with somewhat debatable relationships is composed of fine-grained quartz, mica, and chlorite with scattered grains of pyrite, and may be termed an alaskite dyke. Another observation was of a dyke cutting cleanly through massive magnetite in the River orebody and exposing smooth, polished, and slickensided walls. The rock is a feldspar porphyry with a basaltic matrix now extensively altered.

Exposures to date have revealed that this deposit is in a similar environment to other magnetite deposits along the west coast. It appears to be genetically related to the diorite intrusion, adjacent limestone and volcanic rocks, and possibly to faulting.

[References: Lindeman, E., Iron Ore Deposits of Vancouver and Texada Islands, B.C., *Canada Dept. of Mines,* 1910; Gunning, H. C., *Geol. Surv., Canada,* Sum. Rept., 1929, 1931, 1932; Hoadley, J. W., *Geol. Surv., Canada,* Mem. 272, 1953.]

ZEBALLOS (50° 126° S.W.)*

Iron

F.L. (Zeballos Iron Mines Limited) Company office, Room 504, 850 West Hastings Street, Vancouver 1; mine office, Zeballos. A. H. Upton, president; F. E. Worthington, engineer-in-charge. This company, a subsidiary of International Iron Mines Limited, owns seven recorded claims and holds thirteen Crown-granted claims under lease from Ventures Limited and eighteen recorded claims under option from various owners, on the west side of Zeballos River on the west coast of Vancouver Island. The claims extend from the river mouth to a point 3 miles upstream to Blacksand Creek, astride which is an occurrence of magnetite.

The geology of the property is described in British Columbia Department of Mines Bulletin No. 27, page 125; in the Annual Report for 1952, page 231; and in Geological Survey of Canada Memoir 272, as the Ford Magnetite Deposit, page 66. The most complete published map accompanies Memoir 272 and is on a scale of 150 feet to the inch. In brief summary, the deposit occurs on a narrow southwest-

* By N. D. McKechnie and J. E. Merrett.

ward-striking lobe of sedimentary and volcanic rocks of the Quatsino and Bonanza formations that protrudes nearly across the Zeballos batholith. The magnetite bodies replace tuff beds and andesitic flows along their contact with a thick bed of underlying limestone. The magnetite is both massive and disseminated in a skarn derived mostly from the volcanic rocks. The structure is described as a southeastward plunging anticline, and the deposits are thought to be at or near the crest. Diamond drilling has shown that the large bodies of magnetite exposed at surface have limited extensions in depth.

In 1959 and 1960 an additional nineteen diamond-drill holes were drilled from surface; of these, ten drilled in 1960 totalled 2,765 feet. The distribution of the holes is shown on Figure 10. A section (Fig. 10) is drawn showing the distribution of magnetite in the 1959–60 holes and an interpretation of the intersections. The shallow depth of the magnetite as shown is confirmed by an old hole drilled just north of this section, diamond drill hole No. 6. It is shown on a section in the 1952 Annual Report.

A possible structural interpretation of the occurrence is offered. An association such as this of heterogeneous and comparatively thin-bedded volcanic rocks with a thick bed of limestone in a folded structure may produce dragfolds in the volcanic rocks. Fracture zones associated with the dragfolds could provide the channelways for the mineralizers to enter the formations and from which replacement by magnetite could take place. The magnetite bodies would be restricted to friable zones within the dragfolds. There would be possibilities of repetitions within a zone of dragfolding.

Since June, 1960, the construction contractors, Hunstone and Wood Limited, completed 3½ miles of truck-road from the Zeballos River road to the main magnetite outcrop at an elevation of 2,500 feet and completed 1,300 feet of gravel fill at the river mouth preparatory to constructing a road to the loading-dock site.

A right-of-way was cleared for an inclined surface tram extending from the main outcrop to the mill-site near the river.

SAYWARD (50° 125° S.W.)*

Iron

Iron Mike Office, c/o Caldwell and Hartt, R.R. 1, Campbell River. The Iron Mike group consists of seventeen claims held by record. It is about 4 miles southwest of Sayward and 3 miles west of the junction of the White and Salmon Rivers.

Work done on the claims at the time of the writer's visit in June consisted of stripping of magnetite showings on the Iron Tom, Iron Dick, Iron Mac, Iron Dan, and Iron Mike claims and a number of dip-needle traverses by R. B. Hartt, discoverer of the magnetite. Outcrops are scarce.

The rocks are limestones, basalts, and tuffs intruded by granitic rocks and gabbro. Magnetite occurs principally with the tuffs and is accompanied by skarn alteration. There is a spatial relationship to the gabbro.

The principal showings are near the boundary between the Iron Mac and Iron Jim claims. Massive magnetite is exposed to a depth of about 10 feet in one pit; grains and blocks of brown garnetite are included in the magnetite. Magnetite shows in various exposures to a point nearly half way across the Iron Mac. The continuity of magnetite between exposures is not known. Along the location-line between the Iron Tom and Iron Dick claims, magnetite shows in a succession of small pits for a distance of about 200 feet; again, continuity between exposures is

* By N. D. McKechnie.

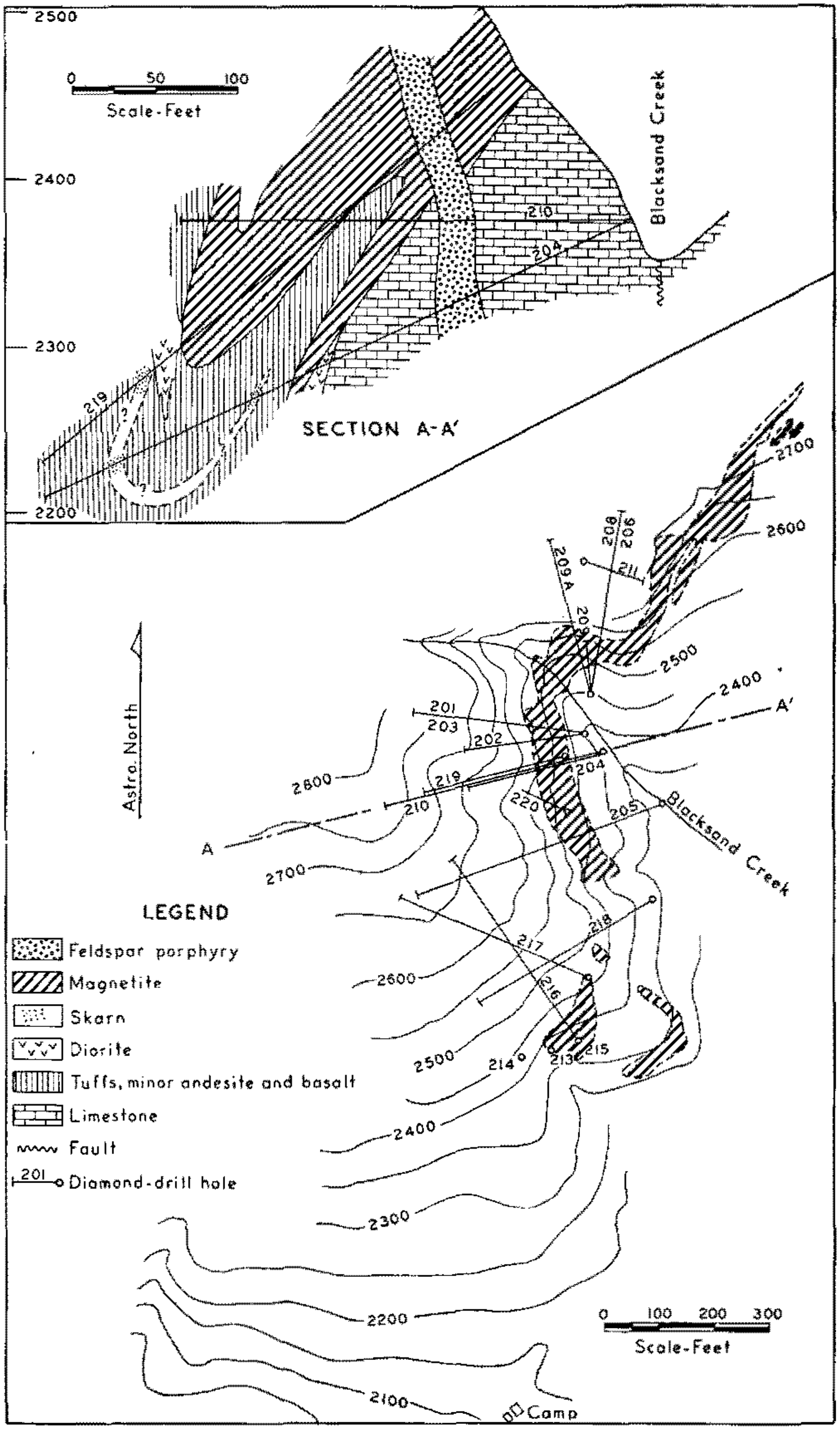


Figure 10. Zeballos Iron Mines Limited. Plan and cross-section of F.L. ore zone.

in doubt. On the Iron Mike and Iron Dan claims there are four exposures of veins and stringers of magnetite in garnetite in banded tuffaceous rocks; the distance between the first and last exposures is about a claim length.

Dip-needle readings taken by Mr. Hartt in the presence of the writer indicated areas of appreciable to strong magnetic attraction underlain by overburden, and in one instance limestone, on the Iron Herb, Iron Jim, Iron Milly, Iron Sue, and Iron Sally claims.

NOOTKA SOUND (49° 126° N.W.)*

Iron

Hualpai Enterprises Ltd.—Operations at this property, 1 mile north of Head Bay on Nootka Sound, were suspended in January, with no ore having been shipped in 1960. The company assets were placed in the hands of a liquidator for disposal.

HERBERT INLET (49° 125° S.W.)*

Gold

Berton Gold Mines Limited

Company office, 610 Jervis Street, Vancouver 5; mine office, Herbert Inlet via Tofino. B. L. Clayton, president; J. C. Jackson, manager. This company owns twenty-one Crown-granted and two recorded mineral claims on the south slope of Abco Mountain at the head of Herbert Inlet on the west coast of Vancouver Island. The company formerly operating this property was known as Abco Mines Limited. Previous work on the property comprised extensive surface stripping on several vein occurrences and the driving of adits at elevations of 2,300 and 2,145 feet. Eighty-six tons of ore was shipped during the period 1935 to 1938.

A truck-road, 1½ miles long, extends from the camp and loading-dock at the mouth of Cotter Creek to a new adit commenced in 1960 at an elevation of 1,000 feet. The 1000 level adit was driven a distance of 450 feet northward along a strong shear zone. It was reported the adit had intersected a narrow quartz vein which followed the adit for a short distance. A crew of three men was employed.

BEDWELL RIVER (49° 125° S.W.)†

Gold

You (Tanar Gold Mines Ltd.)

Company office, 285 Seventeenth Street, West Vancouver; A. D. Ross, president. The property is on You Creek, a northwestward-flowing tributary of the Bedwell River and about 13 miles upstream from the head of Bedwell Sound. It consists of four Crown-granted mineral claims—Ex (Lot 1644), Ten (Lot 1645), You (Lot 1646), Eight (Lot 1647)—and twenty recorded claims—the D'Or 1 to 20. The principal showings are on the You claim on the steep northwest slope above You Creek at an elevation of about 2,000 feet.

Access is by chartered boat from Tofino to the head of Bedwell Sound. From there a truck-road, now in need of minor repair, traverses a distance of about 7½ miles to the old Musketeer mine, beyond which point the road deteriorates to a primitive trail which leads to the You workings.

The showings were first located in 1912 and Crown grants were obtained in 1921. In 1923 a small cyanide mill was installed; no figures on its production are available, but the remains suggest a capacity of about 5 tons per day.

Notes on the property appear in Annual Reports for the years 1913, 1915, 1916, 1917, 1921, 1922, 1929, 1930, 1932, and 1933; that in the 1921 Report is

* By J. E. Merrett.
† By N. D. McKechnie.

the most complete. H. Sargent describes the occurrence in detail in Bulletin No. 8, Preliminary Report on Bedwell River Area, 1940, pages 55–60. The geology of the region and the position of the Crown-granted claims are shown on the map accompanying Bulletin No. 13, Supplementary Report on Bedwell River Area, 1941.

The workings, essentially as described in Bulletin No. 8, consist of an upper drift adit 337 feet long, some trenching below this adit, and a lower drift adit about 7 feet long and 120 feet lower in elevation than the long adit. The portal of the upper adit is in the precipitous bed of a southward-flowing tributary of You Creek. Above the portal the vein is exposed at intervals in the creek bed.

The mineral occurrence is a gold-bearing quartz vein, with minor carbonate, which follows a shear in an andesite dyke in quartz diorite country rock. As exposed in the upper adit, the vein strikes north 60 degrees east and dips about 85 degrees northwest for 200 feet then swings to north 45 degrees east in strike and dips 80 to 85 degrees southeast. The dyke is 3 to 6 feet thick until, just beyond the swing in strike of the vein, it thickens to a maximum of about 12 feet, then thins again to 4 feet at the drift face. The vein follows the hangingwall of the dyke except at the thick section, where both walls of the vein are andesite. Gouge occurs alternately on either wall of the vein and, locally, on the footwall of the dyke. The vein quartz is well shattered and in places is easily removed with a hand-pick. The vein is seen to pinch out in trenches about half way between the two adits. At this point another quartz vein in the footwall of an andesite dyke is on the west or hangingwall side of the upper adit vein and about 6 feet from it. A narrow quartz vein striking north 74 degrees east and dipping 47 degrees northwest connects the two. At the lower end of the trench the andesite dyke pinches out. In the lower adit a vein on the footwall side of an andesite dyke dips 76 degrees northwest. It is not certain that this vein is continuous with the quartz last seen in the trench.

Vein widths in the upper adit range from 3 inches to nearly 2 feet; the average for the length of the drift is about 9 inches. Vein widths in the trenches are about 6 inches, and at the lower adit the width is 3.5 inches.

The quartz is erratically mineralized with sulphides which occur as thin bands and irregular masses. Pyrite, the most abundant sulphide, is the earliest, followed by chalcopyrite, sphalerite, and galena. No gold was seen.

No samples were taken by the writer. An assay section showing a composite of sampling results obtained at different times by several engineers was provided by the present company. Calculations by the writer indicated two higher-grade gold sections in the upper adit; the first, starting just inside the portal, averaged 3.48 ounces per ton over a width of 7.6 inches, or 0.73 ounce over 3 feet, for a length of 47.5 feet; the second, starting 145 feet from the portal, averaged 1.84 ounces over a width of 10.2 inches, or 0.52 ounce over a width of 3 feet, for a length of 108 feet.

An indication of a possible rake of shoots in the You vein is given by the calculated orientation of the intersection between the main vein and the small connecting vein exposed in the trenches, assuming the two veins to be parts of the same fracture system. This calculated orientation implies a rake of about 20 degrees northeast. Correlation of the higher-grade sections in the adit with higher-grade sections in the creek-bed exposures above the adit indicates a possible rake slightly flatter to the northeast.

Four men were employed for a period of one month surface stripping the vein.

TRANQUIL INLET (49° 125° S.W.)*

Gold

Tofino Mines Limited

This property, 2½ miles north of Tranquil Inlet on the west coast of Vancouver Island, is owned by Moneta Porcupine Mines, Limited, and was under lease to Allied Mining Services Limited, Room 26, 425 Howe Street, Vancouver 1. David A. Sloan, manager. A crew of three men was employed for a two-month period completing the driving of 35 feet of raise, retimbering 165 feet of raise, and mining 200 tons of ore between the 15th and 17th levels. Of the 200 tons mined, 53 tons was milled in a 3- by 4-foot Marcy grate-type ball mill. Work was discontinued in November.

KENNEDY LAKE (49° 125° S.E.)†

Iron

Kennedy Lake Iron (Noranda Exploration Company, Limited)

British Columbia office, 202, 2256 West Twelfth Avenue, Vancouver 9; mine office, Ucluelet. J. R. Billingsley, mine manager. This company, a wholly owned subsidiary of Noranda Mines, Limited, owns eight recorded claims and holds by option twenty-five recorded claims on Draw Creek between Maggie and Kennedy Lakes, 7 miles east of Ucluelet on the west coast of Vancouver Island. Access to the property is by way of 2½ miles of MacMillan, Bloedel and Powell River Limited logging-road from the shore of Kennedy Lake on the Alberni–Tofino road, approximately 10 miles from the Tofino–Ucluelet road.

The occurrence of magnetite in the vicinity of Draw Creek was first mentioned by W. Fleet Robertson in the 1902 Annual Report, page 210, in the section entitled "The Iron Ores of the Coast." Draw Creek is referred to as "Magnetic Creek," and the report states that "magnetic iron and a strong local magnetic attraction had been reported on Magnetic Creek. . . ." The creek bed was examined for float, but none was found, nor was magnetite found in place. In the light of recent developments, the following sentence is interesting: "While no magnetite could be found at any point on the creek, a rather remarkable magnetic attraction was observed at a point about 4 miles up the stream, which may possibly be caused by a body of ore under the surface and as yet unexposed." In the summer of 1907 a study was made of iron deposits on Vancouver and Texada Islands, and the results were published in Publication No. 47, Mines Branch, Ottawa, 1909. On page 16 it is noted that work done on Magnetic Creek, 4 miles from Maggie Lake, had failed to expose bedrock, but the presence of a strong magnetic attraction was verified. The property was relocated in January, 1960, by E. Chase, who carried out dip-needle surveys in the same magnetic area.

Preliminary diamond drilling was started in March and continued after Noranda Exploration Company, Limited, took over the property in May. A total of 22,542 feet of diamond drilling, principally of AX core size, was completed in eighty holes.

There is no map of the geology of the area. The magnetite is shown by diamond drilling to lie in a series of limestone and volcanic rocks, chiefly tuffs, presumably of the Vancouver group. The rocks show degrees of alteration to serpentine, metamorphic pyroxenite, and epidote-garnet skarn; silicification is general though not intense. The limestones are recrystallized. Chrome garnet was recognized in one thin-section of a skarn rock. The limestone-volcanic series is intruded by syenite porphyry and dioritic rocks. Magnetite is found in both limestone and volcanic

* By J. E. Merrett.
† By J. E. Merrett and N. D. McKechnie.

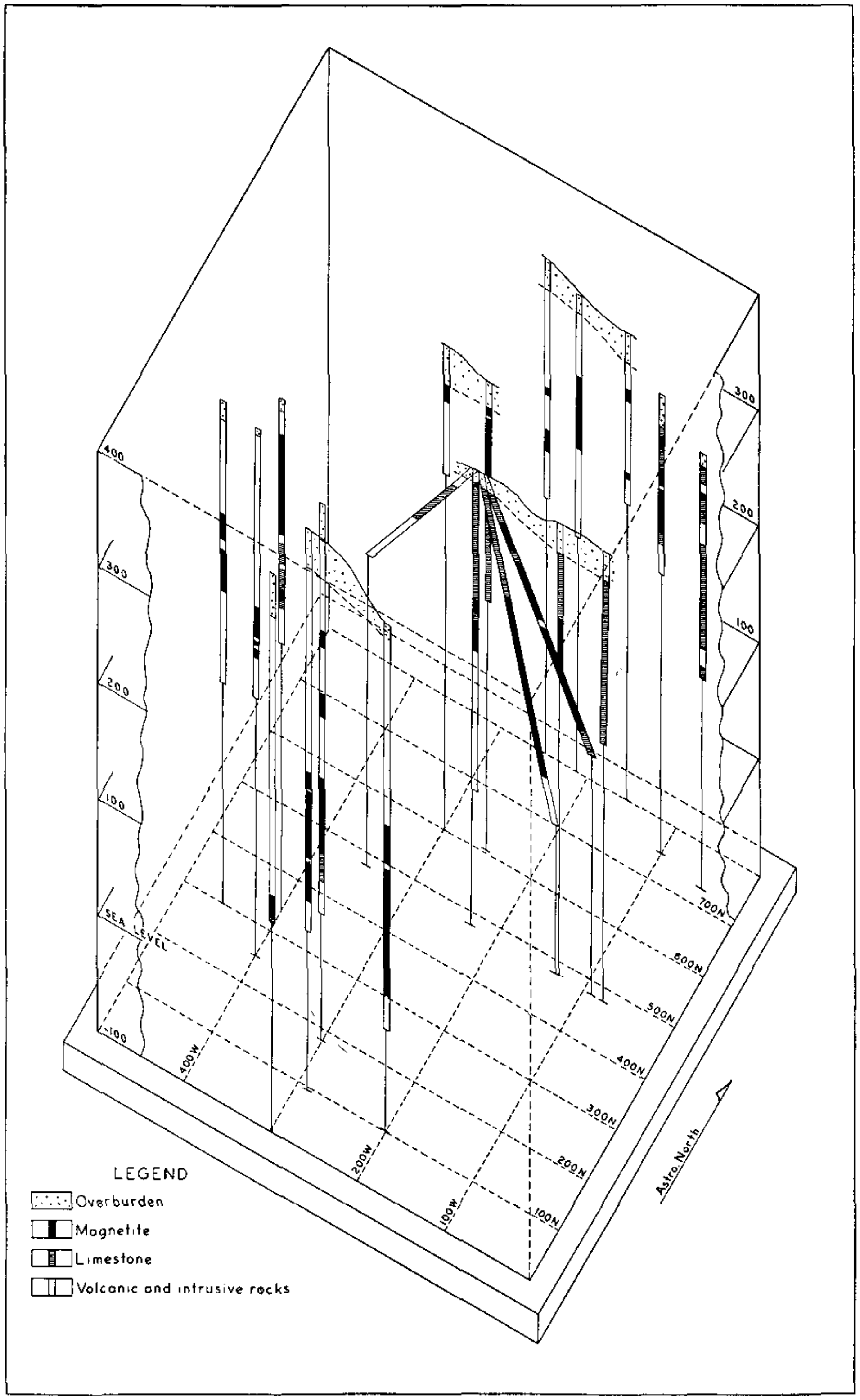


Figure 11. Block diagram illustrating diamond drilling on Kennedy Lake iron property.

rocks and along contacts between the two. It may or may not be directly associated with skarn.

Two main areas of magnetic highs were found in an area with a north-south length of about 1,500 feet and a width of about 500 feet on the C.C. Nos. 3, 4, 5, and 6 mineral claims and the C.C. No. 2 Fraction. The stronger anomalies were in the north half of the area.

The distribution of magnetite and limestone is shown in projection on Figure 11. Not all of the holes drilled could be shown without too much confusion. The limestone is thickest toward the east side and either pinches out or is eroded toward the west; holes on the extreme west side show no limestone. A possible interpretation of the magnetite intersections is that of an arch-shaped body plunging flatly east of north. If this is true, there are several magnetite-bearing horizons.

A survey grid was established over the property and the most important claims surveyed. No construction or underground work was done, but a cut 20 feet deep was made to obtain sufficient ore for mill test purposes.

The number of men employed varied between six and twenty-six.

[References: *Minister of Mines, B.C.*, Ann. Rept., 1902; Publication No. 47, Iron Ore Deposits of Vancouver and Texada Islands, B.C., *Mines Branch,* Ottawa, 1909.]

Great Central Lake (49° 125° S.E.)*

Gold

Apex, Morning (Sileurian Chieftain Mining Company Limited)

Company office, 995 Marine Drive, North Vancouver. William R. Miller, president. The property comprises twenty-eight recorded claims, including the former Apex and Morning groups, north of Doran Lake between Sproat and Great Central Lakes, 26 miles north of Alberni. The property, at an elevation of 2,100 feet, was serviced by helicopter from the Kopan Developments Limited camp on Great Central Lake.

British Columbia Department of Mines Bulletin No. 1, 1932, reports the occurrence to be quartz veins mineralized with pyrite and pyrrhotite mainly, with lesser amounts of galena, sphalerite, and chalcopyrite, and carrying gold and silver.

It was reported a crew of two men completed four X-ray diamond-drill holes totalling 430 feet and located approximately 50 feet below the main vein.

Della Lake (49° 125° S.W.)†

Copper

Big Interior (Kopan Developments Limited)

Company office, 1500 Marine Building, 355 Burrard Street, Vancouver 1. W. W. Dennis, president; A. Robertson, manager; G. L. Mill, property manager. This company, formerly Slocan Van Roi Mines Limited, holds options on eight Crown-granted and eighteen recorded claims in the Big Interior Mountain area in Strathcona Park on Vancouver Island. They are 8 miles northwest of the west end of Great Central Lake.

A supply camp was established on Great Central Lake, from which point the property was serviced by helicopter. Between September and November a crew of fifteen men was employed in geological and topographical mapping and in completing 4,000 feet of diamond drilling in a total of twenty-six holes. This work was done in the vicinity of the west wall of the Big Interior Mountain cirque, the summit, and the Bedwell River slope of the summit.

* By J. E. Merrett.
† By N. D. McKechnie and J. E. Merrett.

The geology of the property is described in Bulletin 13, Supplementary Report on Bedwell River Area, pages 61 to 77, under Ptarmigan and Big I. The rocks in the vicinity of the present work are limestones and volcanic flows intruded by quartz diorite. At the time of the writer's visit in November, the ground was snow covered, so this account is confined to a discussion of the drilling results.

Twenty-three holes were drilled on the southerly shoulder of the mountain above the cirque, eighteen of which encountered mineralization, consisting of pyrrhotite, chalcopyrite, and minor pyrite. The distribution of the mineralized sections in fifteen of the holes conforms with a plane striking nearly north-south and dipping 55 to 65 degrees east. Many of the drill cores cross the plane at low angles, and if the plane represents a sulphide-bearing zone, it is evident that the true widths indicated by many of the holes are narrow, measuring 5 feet and less. Holes T10, T11, and T17, however, indicate true widths up to about 20 feet. It may be significant that these widths seem to correspond to a flattening of dip. Hole A7, drilled wesward from near the bottom of the cirque, at an elevation of about 3,650 feet, cored 13 feet of pyrrhotite-chalcopyrite-pyrite mineralization in andesite on what could be the downward projection of this plane.

TSOLUM RIVER (49° 125° N.W.)*

Copper

Domineer (Qualicum Mines Limited) Operating company, Noranda Exploration Company, Limited. British Columbia office, 202, 2256 West Twelfth Avenue, Vancouver 9; mine office, Box 956, Courtenay. In September, W. I. Nelson, Jr., replaced K. G. Rose as property manager. The operating company is a wholly owned subsidiary of Noranda Mines, Limited. This property, comprising four Crown-granted and seventy-five recorded claims and having an approximate area of 17.6 square miles, is near the summit and on the northeast slope of Mount Washington, 15 miles northwest of Courtenay. Access is by public motor-road to the Comox Logging Company gate near the southwest end of Wolf Lake. From there logging-roads and a short connecting road lead to the camp at about 4,000 feet elevation. The claims lie within the land grant of the Esquimalt and Nanaimo Railway Company Limited, the owners of the base-metal occurrences and with whom an operating agreement was made by Noranda Exploration Company, Limited.

Mt. Washington Copper Co. Ltd., the owners of the claims and the precious-metal occurrences therein, formed a new company, Qualicum Mines Limited, in conjunction with Noranda Exploration Company, Limited, in order to develop the property. By the terms of the agreement, when one million dollars has been spent on the property, Noranda will be entitled to 52 per cent of Qualicum Mines Limited and Mt. Washington to 48 per cent, with funds being provided to Qualicum Mines at the rate of 70 per cent by Noranda and 30 per cent by Mt. Washington.

The general geology of the region is outlined in Geological Survey of Canada, Summary Report, 1930, pages 56 to 78. The geology in the vicinity of the property is briefly outlined in the 1959 Annual Report. Noranda mapping shows the sedimentary and volcanic rocks to be intruded by a stock and sills of quartz diorite. The age of the sediments is postulated as late Cretaceous.

The mineralization consists of chalcopyrite, pyrite, and arsenopyrite in a flat-lying quartz vein which is shown in drill core to cut the quartz diorite. It apparently passes into the diorite from a friable quartzitic horizon in the sediments, and the controlling factor may well have been the friable horizon. Some of the core, logged

* By J. E. Merrett and N. D. McKechnie.

since 1959, shows the vein at a sill contact, and in no instance does the vein attitude in the quartz diorite differ appreciably from that conforming to the flat-lying sediments, suggesting that the position and orientation of the vein fracture was related to structural characteristics of the sediments rather than to those of the quartz diorite.

Approximately 1½ miles northeast of the Domineer No. 1 claim, narrow lenses and low-grade disseminations of chalcopyrite are exposed in the bed of Murex Creek, where Triassic andesite and basalt are cut by dioritic intrusive rocks. About a mile farther upstream, disseminated sulphides show in brecciated volcanic rocks in the creek bed.

In 1960 work began late in May with electromagnetic surveying, followed by trenching and diamond drilling on the various conductors thus located.

Boyles Bros. Drilling Company Ltd. completed 1,695 feet of diamond drilling in a total of eleven holes, and Noranda Exploration Company, Limited, did 375 feet of packsack drilling in ten holes. Additional test-hole drilling was done by Mt. Washington Copper company in sampling and tracing one of the better upper showings.

The test-holes drilled by Mt. Washington Copper company are on the Domineer No. 22 claim and extend the mineralization exposed in a trench there and also in the cores of 1958 holes Nos. 1 to 4 (*see* Fig. 23, Ann. Rept., 1959, p. 136). The results are illustrated in isometric projection in Figure 12. The flat-lying sulphide-bearing quartz was cut in test-holes Nos. 1 to 8. In diamond-drill hole 58-4 it is in tuffs, but from diamond-drill hole 58-2 to test-hole 1 it has diorite on one or both walls. In test-holes 7 and 8 it has a tuff footwall and from here eastward apparently dips below the depths of test-holes 9, 10, 11, and 12. These last four holes show sulphides in tuffs in what appears to be a persistent zone about 10 feet wide, lying about 20 feet above the quartz vein. The tuffs are highly silicified, but the sulphides are rather sparse. A projection of the quartz eastward from test-holes 1, 7, and 8 indicates that it may lie about 30 feet below the mineralized tuff. This interval suggests that the mineralized tuff may correspond to the exposure west of diamond-drill hole 58-2 mentioned in the 1959 Annual Report.

Trenching on the western slope of Mount Washington disclosed small amounts of chalcopyrite and considerable pyrrhotite disseminated in quartzite. Some trenching was done also on a molybdenite showing above McKay Lake.

The road to the upper workings was rebuilt during the summer, but work in that area was suspended in September in order to build a camp on Murex Creek at about 2,200 feet elevation. An extensive low and high electromagnetic survey, closely controlled by transit surveying, was conducted in the Murex Creek area, and at the end of the year trenching was in progress on a strong conductor thus located.

The average number of men employed was nine.

NITINAT (48° 124° N.W.)*

Copper

Nadira Mines Limited Company office, 620 Howe Street, Vancouver 1. O. G. MacDonald, president; G. E. Apps, superintendent. The property comprises fifty-four recorded claims at and north of the headwaters of Horse Creek, a westward-flowing tributary of Parker Creek which enters the Nitinat River 7 miles northeast of Nitinat Lake.

* By N. D. McKechnie.

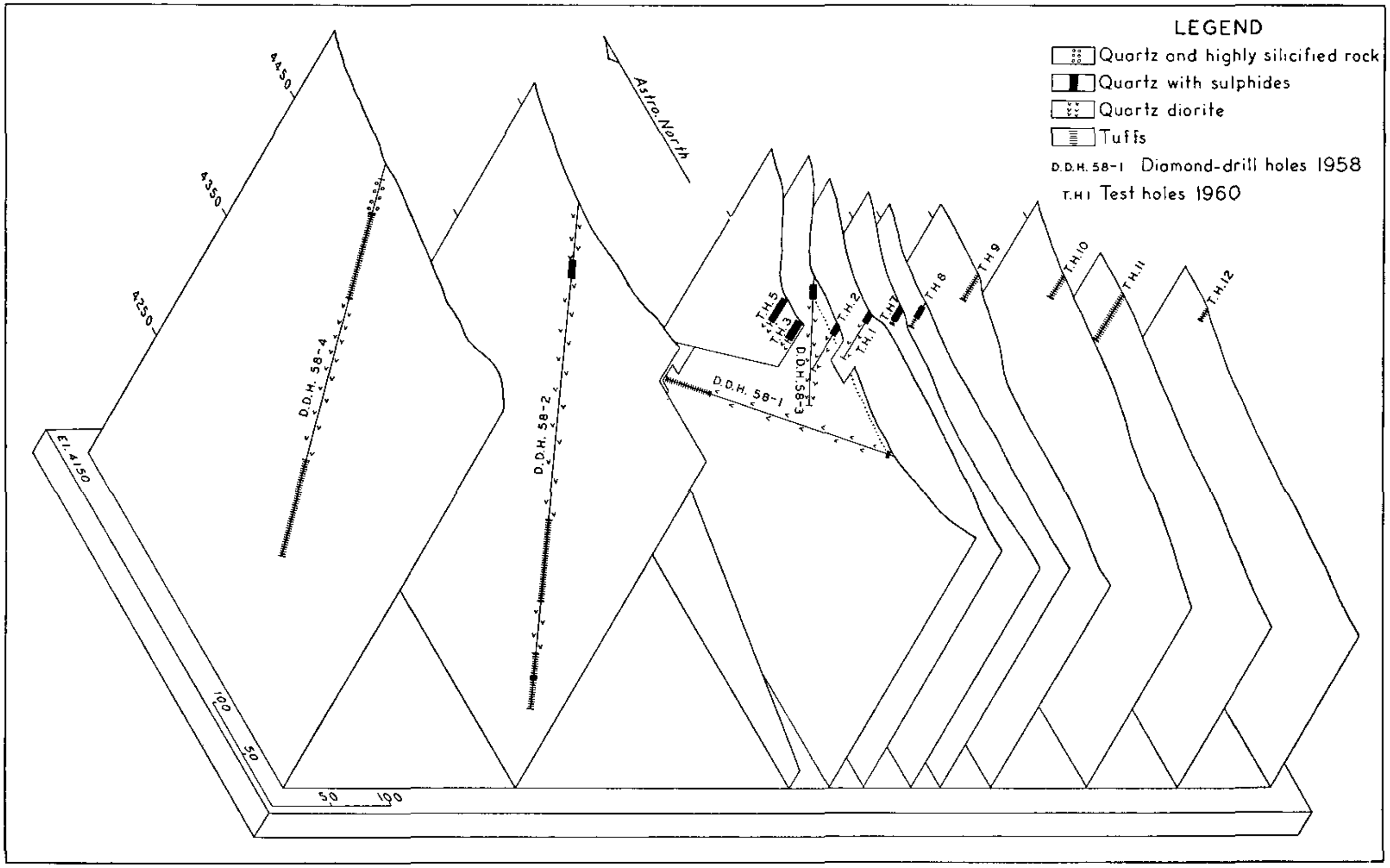


Figure 12. Qualicum Mines Limited. Block diagram illustrating diamond drilling on Domineer No. 22 mineral claim.

Descriptions of the mineral occurrences are in the Annual Reports for 1931 and 1932 under Southern Cross, for 1953 under Bornite, and for 1956, 1957, and 1959 under Nadira. There is no published geological map of the region.

The rocks are basaltic flows, with minor intercalations of limestones and thin-bedded tuffs, on the eastern contact of a dioritic stock. The volcanics and limestones are intruded by numerous dykes and sills of diorite and feldspar porphyry. A zone containing ilvaite-brown garnet-epidote skarn strikes northwestward across the O.G.M. 18A mineral claim, between elevations of about 1,350 to 1,800 feet. The mineralization, chalcopyrite, pyrite, and a little bornite, is associated with skarn.

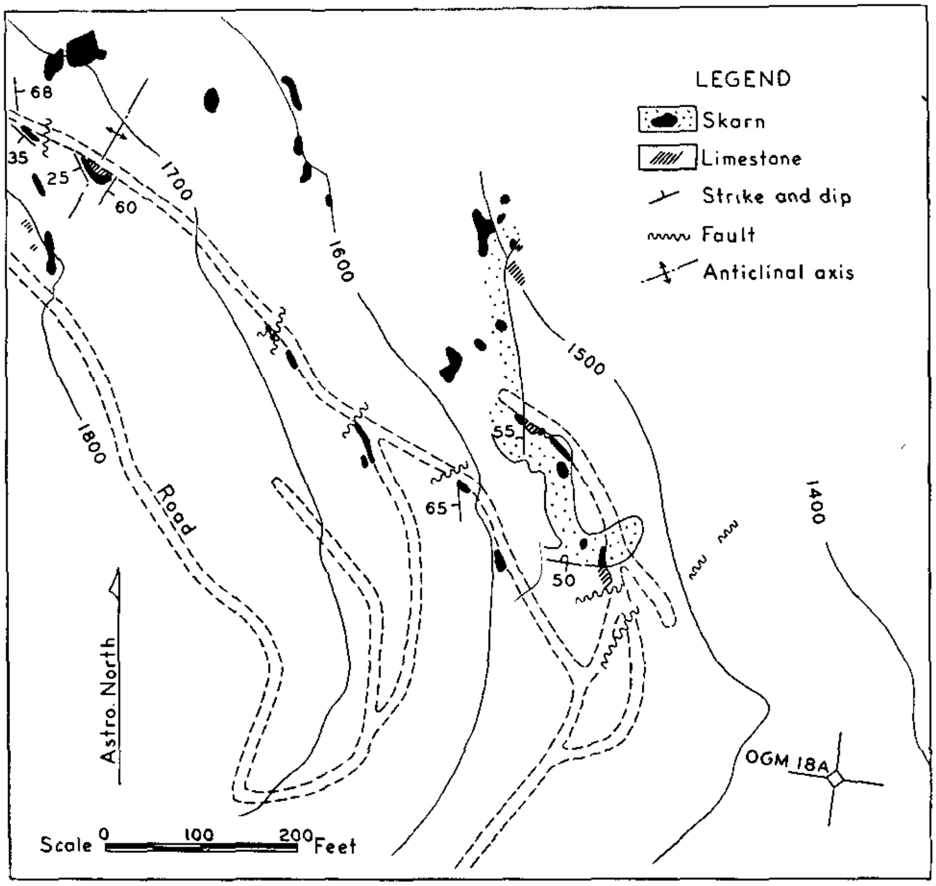


Figure 13. Nadira Mines Limited. Possible correlation of part of skarn zone.

The mineralized area is bounded on the northwest by a nearly north-south striking fault dipping 70 degrees east. Nothing is known of the movement, but the appearance of the fault suggests that it may be appreciable. Near the northwest corner of O.G.M. 18A the fault shows mineralized skarn which is drag material. Near the southeast corner of O.G.M. 18A another post-mineral fault, apparently smaller than the first, strikes northeast and dips 60 degrees southeast. Numerous and apparently minor post-mineral faults, striking north to northeast and generally steep dipping to east or west, are exposed along tractor-roads and in outcrops.

Lack of marker beds or of readily recognizable and continuous pre-mineral fractures has made exploration of the occurrence difficult. Recent work has exposed possible relationships which may be used to advantage. A small dragfold at a skarn-limestone contact is exposed on the upper tractor-road about 100 feet from its end. It plunges southwestward. About 650 feet farther southeast along the same road a faulted but readily recognizable anticlinal crest plunges about 20 degrees southwestward. In both instances the skarn has a limestone footwall; in the second exposure the hangingwall also shows and is a finely banded tuff. About 300 feet northwest of the southeast corner of O.G.M. 18A a series of exposures along and north of a tractor-road follows the 1,550-foot contour for some 300 feet. The exposures are of skarn with a limestone footwall in what probably represents a crumpled zone against the northeast-striking post-mineral fault (Fig. 13). The average strike of this contact, ignoring local crumples, is slightly west of north and the dip is about 60 degrees west. This possibly represents the west limb of an anticline having a northeastward-striking axial plane and, if so, it may be possible to trace it to the faulted anticline some 500 feet to the northwest. The folding on northeast axes probably is a cross-folding which, if it is due to the strong north-south post-mineral fault, may be found only in that vicinity.

A crew of six men was employed for five months open-pitting on surface outcrops of ore. A test run of 5,142 tons of ore was trucked to the Cowichan Copper Company's mill on Cowichan Lake. The 261 tons of copper concentrate produced was shipped to Japan.

Cowichan Lake (48° 124° N.E.)*

Copper

Blue Grouse (Cowichan Copper Co. Ltd.) Company office, 620 Howe Street, Vancouver 1; mine office, Lake Cowichan. Oswood G. MacDonald, president and general manager; A. H. Harder, mine manager; G. E. Apps, mine superintendent; H. Arms, mill superintendent. The property consists of three Crown-granted and sixty recorded claims. It includes two old properties, the Blue Grouse and Sunnyside, on the south side of Cowichan Lake about 3 miles by road northwest of Honeymoon Bay.

The mine has been developed by two adits—the main haulage or 1100 level and an upper level known as the 1340 level. Open shrinkage stoping methods were used to remove the ore in the various zones between 1100 level and the surface above the 1600 level horizon.

Mining and milling operations were suspended in mid-November after the available ore reserves above 1100 level were depleted. Underground exposures on 1100 level and diamond drilling below it indicate a downward continuance of ore, but a shaft will be necessary before mining can be done below that horizon.

In 1960, 66,419 tons of ore was milled and 4,901 tons of copper concentrate was shipped from the Hatch Point loading-dock to Japan.

A summary of production from this property is: Previous operators between 1917 and 1919 shipped approximately 2,500 tons of ore grading 6 per cent copper; the present company shipped 22,338 tons of ore grading 5.99 per cent copper during the years 1954 to 1957; the flotation mill commenced operation in 1957, and from then to November, 1960, 248,500 tons of ore, grading 2.73 per cent copper, was milled to produce 23,650 tons of concentrate. The total copper production from 1917 to 1960, inclusive, was approximately 16,000,000 pounds.

* By J. E. Merrett.

Copper

KOKSILAH RIVER (48° 123° N.W.)*

King Solomon (Cellardor Mines Ltd.)

Company office, 620 Howe Street, Vancouver 1. Oswood G. MacDonald, president. This company controls the King Solomon, Queen of Sheba, Koksilah, and Bluebell Crown-granted claims and a large surrounding group of recorded claims. The property is near Kinsol station on the Canadian National Railway. It is at about 1,000 feet elevation, north of the Koksilah River, about 7 miles south of Duncan. It is reached by 5 miles of road from a point on the highway 2 miles south of Duncan. The four original claims were Crown granted more than fifty years ago. A crew of four men enlarged the lower adit for a distance in excess of 400 feet to permit the use of mechanical mucking and tramming equipment.

Iron

PORT RENFREW (48° 124° N.E.)*

Bugaboo Creek Iron (Noranda Exploration Company, Limited)

British Columbia office, 202, 2256 West Twelfth Avenue, Vancouver 9. O. W. Nichols, property superintendent. This property comprises seven Crown-granted and three recorded mineral claims on Bugaboo Creek, approximately 10 miles north of Port Renfrew. The Crown-granted claims are held by option agreement by Noranda Exploration Company, Limited. Access is by 5 miles of rough truck-road up Gordon River and by 6 miles of good pack-trail. Additional access is by way of helicopter, two landing strips having been constructed for this type of aircraft.

The ore consists of massive magnetite occurring within zones of pyroxene and garnet skarn formed along or near the contacts of the Upper Jurassic Coast Intrusions with Triassic limestone. Two relatively high-grade orebodies, the Daniel and the Conqueror, have been located. Some sulphur is present in the form of pyrite and pyrrhotite, but other impurities are negligible.

Between May and November six men were employed completing 6,169 feet of AX core diamond drilling in twenty-two holes and on improving the pack-trail.

Copper

JORDAN RIVER (48° 124° S.E.)*

Sunloch and Gabbro (Sunro Mines Limited)

Head office, Tadanac. The property is on the Jordan River about 1 mile upstream from the mouth and is reached by a road which leaves the Victoria highway about one-half mile east of the River Jordan Post Office. The original showings were diamond drilled in the past and were explored by adits from the Jordan River canyon, 2 miles upstream from the river mouth and at elevations of from 500 to 1,000 feet above sea-level. Work was begun in 1917 and resumed at intervals. Three principal mineralized zones, designated upstream as the Cave, Central, and River zones, were defined. The results of the work to 1950 and the geology of the deposit were fully described in the 1950 Annual Report, pages 180 to 193. In 1957 an adit was started from the east side of Jordan River at an elevation of about 100 feet above sea-level and driven to a total length of 7,805 feet beneath the surface showings.

In 1960 an operating lease to remove the ore from the Cave, Central, and River zones was obtained from The Consolidated Mining and Smelting Company of Canada, Limited, by Cowichan Copper Co. Ltd. Late in December a small crew was sent to the property to reopen the underground workings and to prepare for active operation.

* By J. E. Merrett.

REPORTS ON GEOLOGICAL, GEOPHYSICAL, AND GEOCHEMICAL WORK

Reports accepted to the end of 1958 for credit on assessment requirements for properties held under the *Mineral Act* and the *Placer-mining Act* since January 17th, 1947, and reports on geochemical surveys accepted since April 6th, 1951, are listed in the Annual Report for 1958. 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. 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.

REPORTS CREDITED FOR ASSESSMENT, 1960

Geographic Position		Property Owner or Principal Author of Report Date of Submission of Report	Kind of Work		
1° Quadr.	Quarter		Geological	Geophysical	Geochemical
49° 117°	S.E.	"A" Group McIntyre Porcupine Mines Ltd. J. A. C. Keefe and J. W. MacLeod. December 14, 1960.	—	×	×
49° 118°	S.E.	Anomaly 1–48 Claims West Coast Resources Ltd. H. Lundberg and F. J. Hemsworh. March 10, 1960.	—	×	—
49° 118°	N.W.	Moe Nos. 1–6 Phoenix Copper Company Ltd. and The Granby Mining Company Limited. P. R. Matthew. February 17, 1960.	—	×	—
49° 118°	N.W.	Ox Nos. 1, 5, 9 Fractions and Caberfae Fraction Phoenix Copper Company Ltd. P. R. Matthew. March 24, 1960.	—	×	—
49° 118°	S.W.	Texas Group The Granby Mining Company Limited. K. C. Fahrni. November 30, 1960.	×	—	—
49° 120°	S.E.	F. H. Group Kennco Explorations (Western) Limited. J. M. Anderson and J. A. Gower. June 13, 1960.	×	×	×
49° 122°	S.E.	Grand Trunk, Rambler, Morning Star, Stonie Creek K. C. McTaggart. W. H. White. February 29, 1960.	—	×	—
49° 120°	S.E.	South Pasayten Claims R. J. Perelli. Edward P. Chapman. October, 20, 1960.	—	×	—
49° 120°	S.W.	Whip and Saw Groups Texas Gulf Sulphur Company. W. R. Bacon. July 26, 1960.	×	×	×
50° 120°	N.W.	DRG Mineral Claims Kennco Explorations (Western) Limited. R. W. Stevenson. September 23, 1960.	×	×	×

REPORTS CREDITED FOR ASSESSMENT, 1960—*Continued*

Geographic Position: 1° Quadr.	Geographic Position: Quarter	Property / Owner or Principal / Author of Report / Date of Submission of Report	Kind of Work: Geological	Kind of Work: Geophysical	Kind of Work: Geochemical
50° 120°	S.W.	Lil Group L. B. Gatenby. L. B. Gatenby. October 15, 1960.	—	×	—
50° 120°	S.E.	Molly and B.E. Claims Spokane Syndicate Limited. C. F. Millar. November 17th, 1960.	—	×	—
50° 120°	S.W.	Shot Claim Group Prospectors Airways Co. Ltd. Roderick Macrae. December 29, 1960.	—	×	—
50° 120°	N.W.	Stump Lake Area Stump Lake Metal Mines Ltd. W. P. McReynolds and E. B. Nichols. May 20, 1960.	—	×	—
50° 121°	S.E.	K.T.I. Groups 1 and 2 Kennco Explorations (Western) Limited. R. W. Stevenson. January 7, 1960.	—	×	×
50° 121°	N.E.	Cache Claims Cache Creek Silica Co. Ltd. D. D. Campbell. March 23, 1960.	×	—	—
50° 121°	S.E.	Hank, Domino, Freda, P.C.M., and Cap Claims Britmont Mines Limited. F. J. Hemsworth. December 16, 1960.	—	—	×
50° 122°	N.W.	Hurley River Groups 1 and 2 Hurley River Mines Limited. Walter E. Clarke. November 22, 1960.	×	—	—
50° 122°	N.W.	Jean and June Claims Gray Rock Mining Company. Clive W. Ball. April 13, 1960.	×	—	—
50° 122°	S.W.	Tug No. 1 Mineral Claim A. C. Skerl. A. C. Skerl. April 8, 1960.	×	—	×
50° 124°	S.W.	Star and Ace Claims Norco Resources Ltd. H. H. Cohen. May 26, 1960.	—	×	—
50° 125°	N.W.	H. S. Group H. H. Cohen. H. H. Cohen. November 3, 1960.	×	—	—
50° 125°	N.E.	Fred 1–13, Red 1–12, J.D. 1–3 Fractions Phelps Dodge Corporation of Canada Limited. D. C. Malcolm. August 17, 1960.	×	—	—
50° 126°	S.W.	Fern Hill, Cedar Hill, and Trygg Fractions George Uebel. J. S. Ives. June 7, 1960.	×	—	—
51° 119°	S.E.	Buzz, Blip, and Bell Claims Magnum Copper Limited. D. W. Smellie. April 1, 1960.	—	×	—
51° 120°	S.E.	The Windpass Lease Fort Reliance Minerals Limited. A. D. Wilmot. December 28, 1960.	×	×	—

REPORTS CREDITED FOR ASSESSMENT, 1960—*Continued*

Geographic Position: 1° Quadr.	Geographic Position: Quarter	Property / Owner or Principal / Author of Report / Date of Submission of Report	Kind of Work: Geological	Kind of Work: Geophysical	Kind of Work: Geochemical
52° 122°	N.E.	Axis and J.G. J. Gallo and A. Berglund. R. A. Knutson. May 24, 1960.	—	×	—
52° 122°	N.W.	Brooks 1–16 Claims Island Prince Copper Limited. J. S. Scott. March 22, 1960.	—	×	—
52° 122°	N.E.	Duncan Claims J. Gallo. R. A. Knutson. May 31, 1960.	—	×	—
53° 122°	N.W.	Wed 13–80 Claims Totem Minerals Limited. R. A. Knutson. March 10, 1960.	—	×	—
54° 121°	S.W.	Lucky and Chalco W. L. Cannon. M. M. Menzies. September 14, 1960.	—	×	—
54° 122°	S.E.	Ace Groups I and II Totem Minerals Limited. Basil T. Wilson. September 1, 1960.	—	×	—
54° 126°	S.W.	Owl 1–12 and Nadina 1–4 Claims Farwest Mining Limited. W. M. Sirola. February 3, 1960.	—	×	—
55° 127°	S.W.	Strike and Ridge Groups G. L. Oates. G. L. Oates. November 3, 1960.	—	×	—
56° 130°	S.E.	Blue 1–3 and Mona 1–8 Granduc Mines Limited. G. W. H. Norman. March 23, 1960.	×	—	—
56° 130°	S.E.	Geo, Ajax, and J.P. Groups Granduc Mines Limited. G. W. H. Norman. February 4, 1960.	×	—	—
58° 129°	N.W.	Eye Group Totem Minerals Limited. R. A. Knutson. June 16, 1960.	—	×	—
58° 130°	N.W.	Raft Group Totem Minerals Limited. R. A. Knutson. June 16, 1960.	—	×	—
58° 130°	N.W.	Tuya 2 and 4 Erik Ostensoe. Roderick Macrae. January 14, 1960.	×	—	—
59° 133°	S.E.	Cop Claim Groups 1 and 2 Totem Minerals Limited. Basil T. Wilson. August 19, 1960.	—	×	—

Placer

CONTENTS

ATLIN*

SQUAW CREEK (59° 137° N.E.)

Ad Astra Minerals Ltd.—This company is reported to have bulldozed a number of test trenches on its property on Squaw Creek. Some sluicing was also done during the season.

SPRUCE CREEK (59° 133° N.W.)

Spruce Creek Placers

This company, under the supervision of Maynard Wilson, continued to sluice gravel on its property on Spruce Creek. Another slide occurred which buried the dragline and mobile sluice-box. This equipment was removed from the slide, but the operation on Spruce Creek was abandoned. By the end of the season the equipment had been moved to Pine Creek, where a sluicing operation is planned.

Duncan Falconer continued to work alone on a drift on his lease.

* By W. C. Robinson.

Pine Creek (59° 133° N.W.)

The Matson brothers sluiced gravel on ground which they had drilled in 1959. Karl Sieger continued to work his lease near Discovery.

Birch Creek (59° 133° N.E.)

Terry and Carriere sluiced gravel on their lease on Birch Creek during 1960, but have since allowed their leases to lapse.

McKee Creek (59° 133° S.W.)

Joe and Louis Piccolo hydraulicked a considerable amount of gravel on McKee Creek. Some drifting was done by the partners during the winter.

OMINECA*

Germansen River (55° 124° N.W.)

Gene Jack did considerable work during 1960 in preparing the hydraulic property, originally known as the de Ganahl pit, for operation. An airstrip, which had been constructed near the pit during 1959, supplied a suitable landing area for light wheel-equipped aircraft to service the area.

Mrs. Tait set up a dragline and sluice-box on Placer-mining Lease No. 1460 on Germansen River 2½ miles below Little Slate Creek. Some road construction was also done along the west bank of the Germansen River in preparation for a sluicing operation.

Manson Creek (55° 124° N.W.)

Manson Creek Gold Mining Co. Ltd. Charles Nolan and two men continued to sluice gravel on Placer-mining Lease No. 1470, which is on Manson Creek about 5 miles up from the mouth. An HD-20 tractor was used for stripping, and a TD-14 overhead loader was used for handling the material to be sluiced.

Evan Ostjord did some sluicing on his lease directly below the ground worked by C. Nolan. A tractor, a Trojan loader, and a semi-mobile sluice-box were used for this operation.

Lost Creek (55° 124° N.W.)

Glen James and McCollough laid about 1,700 feet of pipe-line in preparation for hydraulic operations on Lost Creek.

CARIBOO†

Hixon Creek (53° 122° S.W.)

Hixon Placers Inc. Company office, 2032 Third Avenue, Seattle, Wash.; mine office, Hixon. H. W. Hargood, president; C. J. Norris, mine superintendent. This company holds twenty-one placer leases on Hixon Creek, the camp being on Placer-mining Lease No. 2288, about 3 miles east of the Quesnel–Prince George highway. Up to the end of July little work was done on the property other than maintenance work on dams, pipe-lines, ditches, etc. However, later in the season a total of 25,000 cubic yards of gravel was stripped in the large pit. A slide on the south side of the creek was cleared by

* By W. C. Robinson.
† By A. R. C. James.

bulldozer, and 800 feet of pipe-line and a monitor were installed. The north bridge over the creek was rebuilt and some repairs were made to the road. Construction was also reported to have been started on 550 feet of 3 feet by 3 feet sluice-box, which will facilitate hydraulicking of gravel on the upper creekside. An average crew of five men was employed under the supervision of Charles Norris. Work was terminated for the season on November 15th.

WILLOW RIVER (53° 121° S.W.)

McJana Placers. This company, under the supervision of R. E. MacDougall, continued to hydraulic on the southwest side of the upper end of the Lowhee pit. A No. 5 monitor with a 7-inch nozzle was used, and a crew of four men was employed. Shortage of water restricted operations through much of the season.

Mosquito Creek.—Jack Gunn hydraulicked on his lease in the upper part of Mosquito Creek. A good recovery of gold was made this year, but operations were limited by shortage of water.

Big Valley Creek.—Nolan Fisher sluiced gravel on his lease on the south side of Big Valley Creek near Nine Mile Lake.

Marius Anderson installed a hydraulic set-up and worked on his lease on the south side of Big Valley Creek near Eight Mile Lake.

Coffee Creek.—Arthur Delorme ground-sluiced on his lease on Coffee Creek.

George and Little Creeks.—James Lahay ground-sluiced on his lease on George Creek.

Coulter Creek.—John Chouse ground-sluiced 6,000 yards of gravel and did some drifting on his lease on Coulter Creek.

Promise Creek.—A. Corlick hydraulicked with a No. 1 monitor on his lease on Promise Creek.

Devils Lake Creek.—H. McGowan ground-sluiced in a small gulch near the headwaters of Devils Lake Creek.

Pundata Creek Placers Ltd.—This company did some ditch construction and sank test-pits on Pundata Creek.

WILLIAMS CREEK (53° 121° S.W.)

Kumhila Exploration Co. Ltd. This company did not resume operations after the sinking of its dredge at the end of 1959. Attempts made early in the season to recover gold from the sunken dredge were not successful. Arthur Pederson ground-sluiced on the west side of Williams Creek one-quarter mile below the old Richfield court-house.

Larsen and Broswick hydraulicked 3,500 yards of gravel on the east bank of Williams Creek opposite the old Richfield court-house.

Donald Bates sank a 4-foot-square shaft 25 feet deep on Devlin's bench on the northeast side of Williams Creek midway between Barkerville and Wells.

Conklin Gulch.—Eric Larsen sank a 50-foot inclined shaft and drifted 63 feet in Conklin Gulch.

ANTLER CREEK (53° 121° S.E.)

Beggs Gulch.—Harry Wade hydraulicked with a No. 1 monitor on his lease at the lower end of Beggs Gulch.

Stevens Gulch.—Harold Tensing and Tony Driscoll ground-sluiced on their lease about 1½ miles up Stevens Gulch.

China Creek.—John Kelly ground-sluiced on the south side of the creek.

Canadian Creek.—A. McGuire ground-sluiced on his lease.

Antler Creek.—Arvid Holm ground-sluiced on his lease on upper Antler Creek.

Albert Bindschadler ground-sluiced and sank a test shaft on his lease on lower Antler Creek.

Lightning Creek (53° 122° S.E.)

D. H. Wells prepared to hydraulic on his lease on the upper part of Lightning Creek just below the canyon. The work included cleaning out and rehabilitating an old ditch which runs along the high bench east of Amador Creek. One man was employed.

Campbell Creek.—Edward Johnson hydraulicked with a No. 1 monitor on his lease on Campbell Creek.

Bassford Creek.—T. G. Crawford ground-sluiced with a boomer dam on his lease on Bassford Creek.

Peter Creek.—R. H. MacDougall did some testing and road construction on his leases on Peter Creek.

Cottonwood River (53° 122° S.E.)

F. Goodheart ground-sluiced on his lease about 3 miles above Cinema.

Hannandor Gold Ltd.

Company office, Box 937, Quesnel. E. R. Wiegand, secretary. This company holds seven leases on Mosquito (Mostique) and Lightning Creeks, 28 miles by road from Quesnel. The property is approached by road running about 1 mile south from the Quesnel–Barkerville road. Work done in 1960 included the construction of 1½ miles of access road and a bridge across the creek; a washing plant was erected on the site, consisting of a hopper, trommel screens, tables, and stacking conveyor, and 5,000 cubic yards of gravel was excavated by dragline and put through this plant. A further thousand cubic yards of gravel was hydraulicked. An average crew of five men was employed under the supervision of E. R. Wiegand.

Keithley Creek (52° 121° N.E.)

Ernest Lang and G. A. Goldsmith worked on the former's lease 1,700 feet below the confluence of Snowshoe and Keithley Creeks. At the beginning of the season a new drift on bedrock was started on the east side of Keithley Creek which was driven toward a buried channel disclosed by previous drilling. At the time of the writer's visit in July this drift was 70 feet long. Lang believed that pay gravel would be found at 95 feet.

Century Gold Placers Ltd.—This company holds four leases near the junction of Snowshoe and Keithley Creeks. Garson C. Mitchell and another man did maintenance work on the leases.

Four Mile Creek.—Lee Fournier ground-sluiced on his lease in the Placer Engineers pit near the mouth of the creek.

Little Snowshoe Creek.—T. E. Kinvig worked on his lease near the mouth of Little Snowshoe Creek.

French Snowshoe Creek.—Albert Sandberg ground-sluiced on the left bank of French Snowshoe Creek.

Quesnel River (52° 121° N.W.)

Thomas Corless sluiced 400 cubic yards of gravel on his lease approximately 20 miles up Quesnel River.

Cedar Creek.—Using a small monitor, P. Ogden ground-sluiced on his leases north of Cedar Creek, where he made a substantial recovery of gold in the autumn of 1959.

SIMILKAMEEN*

Granite Creek (49° 120° N.W.)

Geojimal Mining Development Co. Ltd. Company office, 120 Second Avenue, Chilliwack. J. A. Robb, manager. The company worked on Placer-mining Lease No. 1333 on Granite Creek three-quarters of a mile upstream from its mouth. A drift in rock 347 feet long was driven. A skipway was built from the portal to the service road. The operation was hampered by a fire in June which destroyed the compressor-house and equipment. A crew of three men was employed.

CRANBROOK†

Monilee (49° 116° S.W.) This claim near the falls on the Moyie River, 17 miles southwest of Cranbrook, is held by D. J. Oscarson, of Kimberley, and is operated by two parties of workmen who subleased the property in 1958. Activities are confined to week-end work, and each party is driving a small adit level toward the bed of an old course of the river.

T. O. Bloomer and partner completed the hard-rock drift in the No. 1 tunnel and advanced a further 30 feet into the river gravel. A short 30-degree incline was driven from the drift to a bench below the falls to obtain water for sluicing at a later date. A small electric-light plant was installed on the surface.

P. Kotush and two partners advanced the No. 2 tunnel a further 85 feet. Progress was considerably restricted due to high water on the river.

These two operations were formerly known as the Nero No. 1 and No. 2, but the name was changed to Monilee in 1959 to avoid confusion with former workings in the area.

Carpender (49° 116° S.W.) This claim is 2 miles north of the falls on the Moyie River and is operated during week-ends by C. Bruhaug and M. Petrosky, of Kimberley. Near the river a small shaft timbered and down 30 feet is being sunk to bedrock.

FORT STEELE*

Boreas Mines Limited (49° 115° N.W.) Company office, 525 Seventh Avenue West, Calgary, Alta. J. E. Treacy, president. This property is near the mouth of Fisher Creek, a tributary of the Wild Horse River, 5 miles northwest of Fort Steele. No work was done on the property during 1960. Early in the year most of the equipment that had been in use was removed.

Maus Creek (49° 115° N.W.)

G. R. Castles, of Lethbridge, commenced a new shaft on the Maus Creek Placers. The shaft was timbered and was sunk 15 feet.

* By David Smith.

† By D. R. Morgan.

KIMBERLEY*

Lisbon Creek (49° 115° N.W.)

This claim is near the confluence of Lisbon and Perry Creeks, 9 miles south of Kimberley. Access is by a road leading from Wycliffe. The claim was owned by D. McIntosh, of Cranbrook, but was subleased to R. E. Williams and W. Kludash, of Kimberley. A small tunnel being driven alongside Lisbon Creek was extended 35 feet. A small diesel unit was installed on the property to generate electric power for operating a small hoist.

McCULLOCH CREEK†

Gold Acres Development Ltd. (51° 118° S.E.) Registered office, Box 463, Revelstoke. L. Latham, president; G. Laforme, manager. This company has leased from McCulloch Creek Gold Placer Mining Co., Limited, of Revelstoke, nine placer leases which extend to the headwaters of McCulloch Creek.

At an elevation of 4,100 feet a main camp was completed consisting of a bunk-house, wash-house, cook-house, and office. It is reached by a road which leaves the Big Bend Highway at Mile 57 and follows the north side of Goldstream River for a distance of 5 miles, then turns and follows the east side of McCulloch Creek for 3 miles.

Installation of a hydraulic system was completed, consisting of a pressure-box, 1,600 feet of pipe starting at 30 inches at the pressure-box and reducing to 15 inches at the monitor, and 156 feet of 42-inch sluice-boxes at the lower end of the leases. Eight men were employed during the working season. Operations were shut down in the late fall due to snow conditions. Some of the present road was widened and ditched as part of a programme to improve the road to the Big Bend Highway.

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

Structural Materials and Industrial Minerals

CONTENTS

ASBESTOS IN BRITISH COLUMBIA*

Many occurrences of both chrysotile and amphibole asbestos have been reported in British Columbia. To date, however, only one, the Cassiar chrysotile deposit, has been developed into an active mining operation.

Chrysotile Asbestos

Chrysotile asbestos has been reported from nearly every known serpentine deposit in the Province. In most deposits the veins containing the fibre are scarce, widely separated, and contain fibre less than one-eighth of an inch long. In a few deposits, fibre as much as one-half inch long has been found, but the apparent quantity available is too small to be of economic interest.

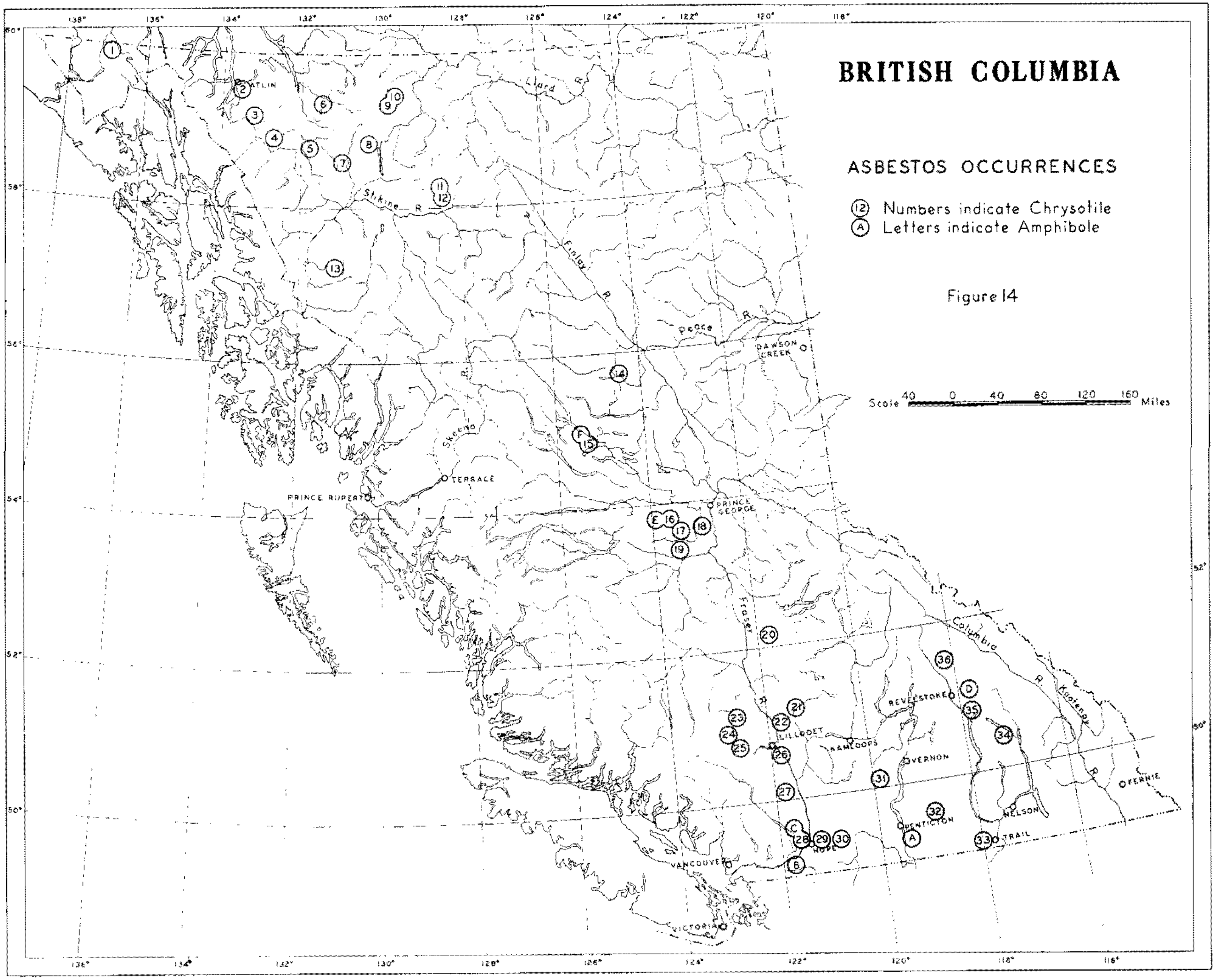
Atlin (2) (59° 133° N.W.) Rather harsh cross-fibre chrysotile asbestos occurs in 1/16- to 1/8-inch-wide veinlets in a large mass of serpentine on the top of Monarch Mountain, 3 miles southeast of Atlin. No long fibre and no large concentrations of short fibre veinlets are known.

[References: *Geol. Surv., Canada,* Paper 54-9, Atlin, 1954; Mem. 307, 1959, p. 78; *Minister of Mines, B.C.,* Ann. Rept., 1951, pp. 208–209.]

Tachilta Lake (7) (58° 130° N.W.) Cross-fibre chrysotile asbestos has been found in a body of serpentinized peridotite 3 miles long and one-half mile wide located 2½ miles southeast of Tachilta Lake. Veins wider than one-eighth inch are spaced about one per square yard and in several places are found several to the square foot. Many veins have central partings, but ½-inch clean fibre is not unknown. The longest fibre reported was 1¼ inches.

[Reference: *Geol. Surv., Canada,* Information Circular No. 2, 1958, p. 7.]

* By J. W. McCammon, except as noted.


BRITISH COLUMBIA
ASBESTOS OCCURRENCES
(12) Numbers indicate Chrysotile
(A) Letters indicate Amphibole
Figure 14
Scale 40 0 40 80 120 160 Miles
ATLIN
Stikine R
Liard R
Finlay R
Peace R
DAWSON CREEK
Skeena R
TERRACE
PRINCE RUPERT
PRINCE GEORGE
Fraser R
Columbia R
Kootenay R
REVELSTOKE
LILLOOET
KAMLOOPS
VERNON
PENTICTON
NELSON
TRAIL
FERNIE
HOPE
VANCOUVER
VICTORIA

Cassiar Asbestos Corporation Limited* (9)

Mount McDame (59° 129° S.W.). Head office, 1001, 85 Richmond Street West, Toronto, Ont.; mine office, Cassiar. F. M. Connell, president; J. D. Christian, general manager; N. F. Murray, general superintendent. The property is 86 miles by road southwesterly from Mile 648.8 on the Alaska Highway. It consists of forty-two Crown-granted and five recorded claims. The mine is on McDame Mountain at an elevation of approximately 6,300 feet. The mill and townsite are in Troutline Creek valley at 3,500 feet elevation.

The first claims covering the Cassiar asbestos deposit were located in June, 1950. Conwest Exploration Company Limited acquired the original claims and located others surrounding them later in the year. In July, 1951, Cassiar Asbestos Corporation Limited was organized to explore the property. During 1952 construction of the surface plant and townsite was begun and 229 tons of ore was milled. By the end of 1953 much of the construction was completed, and for the final six months of the year the mill processed ore at an average daily rate of 240 tons. Production has been continuous since then, and by the end of 1960 a total of 185,687 tons of fibre valued at $53,734,263 had been shipped to market.

The Cassiar orebody is in a mass of serpentine that intrudes an interbedded series of sedimentary and volcanic rocks a few hundred feet stratigraphically above a faulted contact with older sediments. The entire rock assemblage strikes between 15 and 30 degrees west of north and dips rather steeply east, forming the west limb of a large syncline. Gabrielse (Ref. 1) has mapped the serpentine as one of the post Middle Devonian McDame intrusions which here intrudes Devono-Mississippian Sylvester group rocks. The mine area lies just within the outer limits of the contact metamorphic aureole of a coarse-grained plug of Mesozoic granite which is exposed 3,000 feet to the west.

The serpentine forms an elongate lens mostly concordant with, but locally transgressive to, the bedding of the surrounding strata. It is exposed for nearly 2,000 feet along strike. At the south end the serpentine lenses out. A few small barren disconnected serpentine pods can be found along the mountainside for the next mile and a half on strike. At the north end the main mass bulges to more than 500 feet wide and exposures end in talus at the headwall of a large cirque. In the bottom of the cirque, 1,200 feet north of the last outcrop in the headwall, is a large heap of shattered serpentine that may represent a continuation of the main body. No serpentine has yet been found on the mountainside north of the cirque. Along the footwall, the serpentine is in sheared contact with slate that is folded and fractured but little altered. At the hangingwall the serpentine is in contact with andesite, which for a few feet has been metamorphosed into hornfels. Gabrielse (Ref. 2) has shown that the original rock from which the serpentine was derived was probably harzburgite.

Chrysotile asbestos forms cross-fibre veinlets that fill multi-directional fractures in the serpentine. Veins range from microscopic to more than 3 inches wide, a large proportion being wider than one-half inch. Most veins contain one or more irregular central partings; nevertheless, the yield of fibres longer than one-half inch is abnormally high. The veins are usually a few inches to a few feet long and end by pinching out, forking, or joining other veins. The asbestos is concentrated in the bulge in the serpentine near the north end where fracturing has been best developed. The fibre zone forms an orebody that is roughly triangular in shape and plunges to the southeast. For the most part the orebody has gradational margins and " ore " limits are determined from sample results. Production figures indicate

* By W. C. Robinson and J. W. McCammon.

the ore processed has averaged more than 8 per cent fibre of economic grades. Much additional fibre, of grades at present uneconomical to recover, is sent to waste. Exploration to date shows the orebody maintains its grade and size for at least 350 feet below the present quarry floor.

The original surface showings of the orebody were between 6,100 and 6,300 feet elevation. In 1960, except for 4,623 tons obtained from underground development work, the ore was mined from benches at elevations of 6,140, 6,110, 6,080, and 6,050 feet in the main open pit. During the mining season, from February 19th to December 15th, 538,252 tons of ore and 2,205,924 tons of waste were broken. A rock rejection circuit, installed at the head of the tram-line early in the year, treated 345,416 tons of ore and rejected 88,668 tons of waste. The aerial tramline operated from March 15th to December 15th and carried 437,735 tons of ore; trucks hauled an additional 4,623 tons. The mill operated for 321 days to process 475,099 tons of ore which yielded 41,405 tons of fibre. The fibre produced is premium-grade low-iron chrysotile.

Underground exploration, consisting of 1,574 feet of drifting and 4,192 feet of diamond drilling, was carried out on the 5700 level.

New construction at the townsite included the erection of a 60- by 160-foot recreation building, a dental clinic, five Pan-abode dwellings, and fourteen privately owned frame dwellings.

[References: (1) *Geol. Surv., Canada,* Preliminary Map 54-10, 1954; (2) *Economic Geology,* Vol. 55, No. 2, 1960, pp. 327–337; (3) *The Geology of Canadian Industrial Mineral Deposits,* 6th Commonwealth Mining and Metallurgical Congress, 1957, pp. 49–53; (4) *Minister of Mines, B.C.,* Ann. Repts., 1950 to date; (5) *Western Miner,* Nov., 1953, p. 68; (6) *Compressed Air Magazine,* Aug., 1959, pp. 12–17.]

Blue River (10)

(59° 129° S.W.) In 1950 and 1951 claims were located on an asbestos-bearing serpentine body 8 miles northeast of Cassiar. The serpentine mass is about 3 miles long with a maximum width of 1½ miles. Asbestos can be found to some extent almost everywhere in the serpentine, but with a few exceptions it is in veinlets less than one-eighth inch and usually less than one-sixteenth inch wide. Fibre one-half inch long is rare, and the longest reported is three-quarters of an inch. The veinlets are normally scattered widely and run in random directions. A few single veinlets are present that are traceable for several feet along strike and contain fibre one-half inch long.

Several companies have examined the deposit, but as far as known, apart from geological and geophysical surveys, no other work has been done.

[References: *Geol. Surv., Canada,* Map 54-10, McDame, 1954; *Minister of Mines, B.C.,* Ann. Repts., 1950, p. 209; 1951, pp. 209–211.]

Letain Asbestos (Conwest Exploration Company Limited) (11)

King Mountain (58° 128° S.W.). Company office, 1001, 85 Richmond Street West, Toronto, Ont. F. M. Connell, president. This property consists of twenty-eight Crown-granted mineral claims on an unnamed mountain 6 miles northeast of King Mountain, approximately 50 miles east of the south end of Dease Lake. The original claims were recorded by F. Letain and W. Smitheringale in August, 1955. Conwest Exploration Company Limited did a limited amount of open-cut work on the property in 1956. Later some diamond drilling and bulk sampling was carried out, the claims were surveyed, and Crown grants were issued in February, 1960. Access is by float-plane to Letain Lake and thence by trail to the showings.

On the property, cross-fibre chrysotile asbestos is found in veinlets concentrated in an area near the centre of an irregular northwest-trending lens of serpentinized ultrabasic rock that is about 7½ miles long and averages 1 mile wide. The fibre area is toward the upper part of a steep, barren talus-strewn slope on which very few outcrops of bedrock project through the rubble mantle. Abundant fibre was found in veins in bedrock or loose in talus in an area 1,200 feet long and ranging from 200 to 400 feet wide as shown on Figure 15. With the exception of a few small isolated harsh fibre patches one-quarter to one-half mile to the northwest of the area shown, no other occurrences of any significance were discovered.

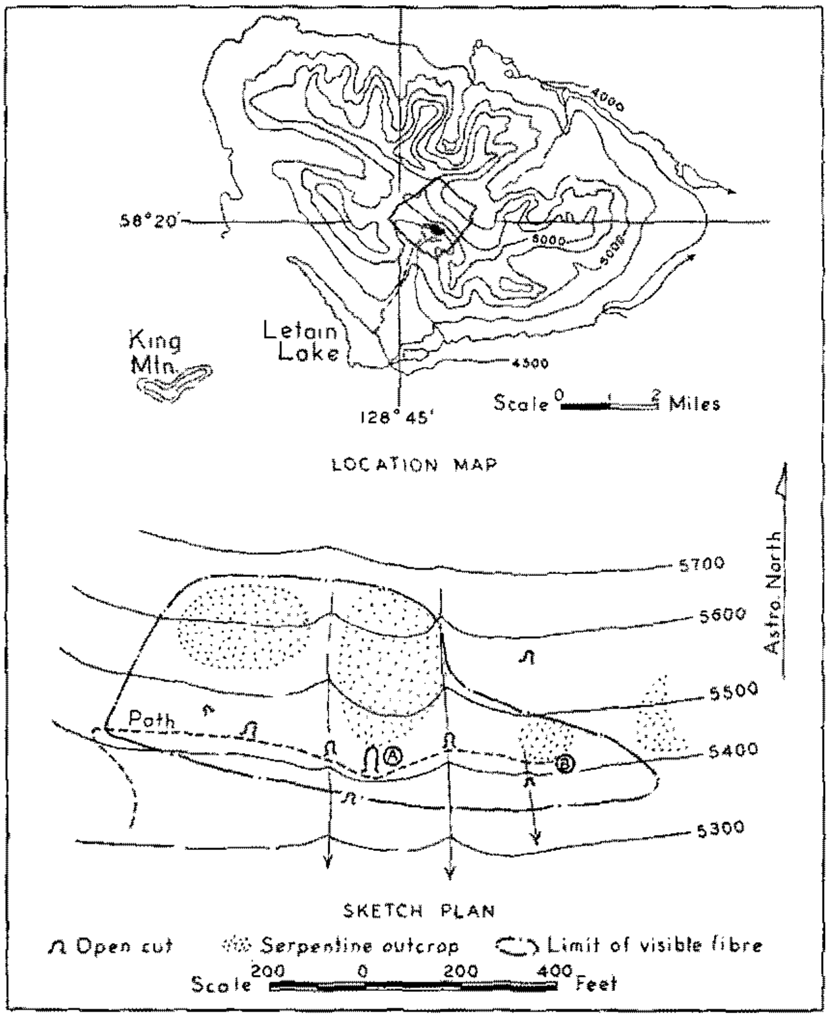


Figure 15. Letain asbestos showing.

The serpentine that contains fibre is generally medium to light green and weathers to a greyish pitted surface, the pits having been formed by the weathering-out of bastite crystals. Slickensided fractures are uncommon, but fractures filled with fibre veinlets are abundant. The fractures occur chiefly in two sets—one striking north 50 to 60 degrees east and dipping steeply northwestward, and the other striking north 30 to 40 degrees west and dipping nearly vertical. A thin-section of the rock consisted mainly of granular and mesh antigorite, pyroxene "ghosts," and abundant magnetite and chrysotile veinlets.

The serpentine without fibre is generally darker green, tends to weather brownish, and seems harder and brittler than the other type. It is commonly highly sheared and slickensided. Vein fractures are not abundant, and most of those present contain picrolite or a massive apple-green material that has the optical properties of chrysotile but cannot be divided into fibres, although under the microscope it is seen to consist of extremely fine fibres. One thin-section of the rock consisted essentially of feathery sheaves of antigorite with considerable carbonate, some actinolite, and very little magnetite.

The chrysotile veins range from microscopic to 1¼ inches wide, and most have one or more central partings. The partings are sometimes thin irregular films of magnetite or serpentine, but often they are ¼- to ½-inch-thick seams and brecciated masses of the light-green massive "chrysotile" mentioned previously. Where the massive material is brecciated, it is frequently striped and striated parallel to the vein walls, but tiny multi-directional fractures within it contain asbestos fibres oriented perpendicular to the walls of the main vein. In some places the massive material was found to grade laterally into good cross-fibre asbestos. Because of the partings, the fibre length is normally much less than vein widths. Although the longest fibre seen was 1 inch long, very little was more than one-half inch long, and most was in the ⅛- to ¼-inch range. Exposures suitable for grade estimate measurements were scarce, and only two satisfactory measurements were made: one at A where a 10-foot-wide bedrock exposure gave an indicated content of 7.7 per cent fibre, and another at B where a 7-foot-wide exposure showed a 9.6-per-cent fibre content. Short exposures in the bluffs north and northwest of A gave comparable results. The fibre has a somewhat harsher feel than that at Cassiar.

The workings were badly sloughed when the property was visited, and no diamond-drill core was available for examination.

[References: *Geol. Surv., Canada,* Map 9-1957, Stikine River Area; *Minister of Mines, B.C.,* Ann. Rept., 1956, p. 148.]

Mount Sidney Williams (15)

(54° 125° N.E.) Asbestos is reported in serpentine on the north slope of Mount Sidney Williams, 10 miles north of the west end of Trembleur Lake. A zone about 25 feet wide contains an estimated 5 per cent of harsh chrysotile in stringers one-eighth to 1½ inches wide spaced one-eighth inch to 1 foot apart.

[Reference: *Geol. Surv., Canada,* Mem. 252, p. 197.]

Clinton (21)

Mond Ranch (51° 121° S.E.). Harsh chrysotile, in veinlets generally narrower than one-sixteenth inch, is abundant in a small serpentine mass across the road from the Mond Ranch, 6 miles by road northeast of Clinton.

Mount Penrose (24)

Bridge River (50° 122° N.W.). A body of serpentine containing chrysotile asbestos veinlets occurs on the top of the ridge three-quarters of a mile north of Mount Penrose peak, about 3 miles west of Gun Lake. The serpentine body is 800 feet wide and half a mile long. The asbestos is in short veinlets that pinch and swell abruptly and occur in parallel swarms in scattered parallel zones 6 inches to 2 feet wide. Fibre length ranges up to one-half inch but averages one-eighth inch or less; ½-inch material is rare. The over-all fibre content of the serpentine is very low.

[References: *Geol. Surv., Canada,* Map 43-15, Tyaughton Lake, 1943; *Minister of Mines, B.C.,* Ann. Rept., 1953, p. 181.]

Cadwallader Mountains (25).—Bridge River (50° 122° N.W.). Scattered veinlets of good-quality chrysotile asbestos with fibre lengths to one-quarter inch are reported in serpentine bodies of the Cadwallader Mountains.

[References: *Geol. Surv., Canada,* Mem. 130, p. 77; Mem. 213, p. 70.]

Sproat Mountain (35)

Sidmouth (50° 117° N.W.). Some stripping, trenching, and diamond drilling has been done on a chrysotile asbestos occurrence on Sproat Mountain, 2 miles northeast of Sidmouth. The asbestos is in an ultrabasic dyke now altered to talc and serpentine that is exposed for a length of more than one-quarter mile and a width of up to 700 feet. The asbestos, occurring as cross and slip fibre, is found chiefly within an area about 540 feet long and 300 feet wide near the south end of the dyke. The cross-fibre is in scattered veinlets of random strikes that range up to three-quarters of an inch wide. The wider veins generally contain an irregular central parting. Some of the slip-fibre is as much as 8 inches long. Visual estimates indicate a total fibre content of 1 to 3 per cent with small selected areas running slightly higher. A bulk sample tested by the Federal Department of Mines in 1928 was classed as cement stock, and a second sample tested in 1949 was classed as paper stock or 4z grade.

[References: *Geol. Surv., Canada,* Mem. 161, 1930, p. 112; Sum. Rept., 1921, Pt. A, pp. 111, 112; *Mines Branch, Ottawa,* Publ. 711, 1928, pp. 95, 96; Invest. 2594, October, 1949; *Minister of Mines, B.C.,* Ann. Repts., 1921, p. G 160; 1928, p. C 313; 1950, p. 214; 1953, p. 184.]

Other reported occurrences of chrysotile asbestos, generally in narrow, scattered veinlets, are the following:—

(1) Near Squaw Creek (59° 136° N.W.) (*B.C. Dept. of Mines,* Bull. 25, p. 25).

(3) On Chikoida and Focus Mountains, 25 miles east of the south end of Atlin Lake (59° 133° S.E.) (*Geol. Surv., Canada,* Mem. 307, p. 78).

(4) In the Menatatuline Range (58° 132° N.) (*Geol. Surv., Canada,* Map 6-1960).

(5) Near the Dudidontu River (58° 131° N.W.) (*Geol. Surv., Canada,* Sum. Rept., 1925A, p. 28).

(6) In the Tuya-Teslin area (59° 129° S.W.) (*B.C. Dept. of Mines,* Bull. 19, p. 21).

(8) At the head of Dease Lake (58° 130° N.E.) (*Geol. Surv., Canada,* Ann. Rept., 1887–88, Pt. I, p. B 78; Sum. Rept., 1925A, pp. 84, 99; Map 9-1957).

(12) West of the head of Kehlechoa River (58° 128° S.W.) (*Geol. Surv., Canada,* Map 9-1957).

(13) On Mount Hickman (57° 131° S.E.) (*Geol. Surv., Canada,* Map 9-1957).

(14) South of Germansen Landing (55° 124° N.W.) (*Geol. Surv., Canada,* Paper 45-9, 1945, pp. 8, 15).

(16) On Sinkut Mountain, in a road cut one-half mile from the British Columbia Forestry lookout (53° 123° N.W.) (*Geol. Surv., Canada,* Information Circular No. 4, p. 20).

(17) On Bobtail Mountain, between elevation 3,700 and 4,200 feet on extreme southwest ridge about 1½ miles from the south end of Naltesby Lake; cross-fibre one-quarter to one-half inch long in veins to 3 feet long; veins generally widely spaced, but in one place four such veins occur in 2-foot

distance (53° 123° N.E.) (*Geol. Surv., Canada,* Information Circular No. 4, p. 20).

(18) At a point 6 miles on a bearing 280 degrees from Baldy Hughes Mountain, about 25 miles southwest of Prince George; fibre one-sixteenth inch long is reported (53° 123° N.E.) (*Geol. Surv., Canada,* Information Circular No. 4, p. 21).

(19) On the west side of Telegraph Range from a point 6½ miles on a bearing 110 degrees from Tagai Lake; cross-fibre to one-quarter inch long in veins 2 to 3 feet long widely distributed for one-half mile (53° 123° N.W.) (*Geol. Surv., Canada,* Information Circular No. 4, p. 20).

(20) In the vicinity of Ochiltree (52° 121° S.W.) (*Geol. Surv., Canada,* Map 59-1959).

(22) On the south side of Mount Soues, southwest of Clinton (51° 121° S.W.) (*Geol. Surv., Canada,* Ann. Rept. VIIB, 1895, p. 345).

(23) In the Yalakom River area (51° 122° S.W.) (*B.C. Dept. of Mines,* Bull. 32, p. 54).

(26) Along the Fraser River between Bridge River and Texas Creek (50° 121° N.W.) (*Geol. Surv., Canada,* Ann. Rept. VIIB, 1895, p. 345).

(27) At the head of Kwoiek Creek (50° 121° S.W.).

(28) On Gordon Creek (49° 121° N.E.) (*Geol. Surv., Canada,* Sum. Rept., 1911, p. 111).

(29) In the Coquihalla area (49° 121° S.E.) (*Geol. Surv., Canada,* Sum. Rept., 1929A, p. 183).

(30) In the Tulameen area, especially near Britton Creek (49° 120° N.W.) (*Geol. Surv., Canada,* Mem. 26, pp. 51, 60, 62, 171, 172; Information Circular No. 3, p. 14).

(31) In the vicinity of Nicola River (50° 119° S.W.) (*Geol. Surv., Canada,* Sum. Rept., 1931A, pp. 94, 95; Paper 48-4, pp. 5, 7; Mem. 296, pp. 35, 154, 155).

(32) On Hall Creek, 6 miles north of Carmi (49° 119° N.E.) (*Geol. Surv., Canada,* Mem. 79, pp. 17, 143).

(33) In Sheep Creek valley, 1½ miles west of Rossland (49° 117° S.W.) (*Geol. Surv., Canada,* Mem. 77, p. 211).

(34) In the Lardeau region on Brown and Poplar Creeks near Gerrard (50° 117° S.E.) (*Geol. Surv., Canada,* Mem. 161, pp. 111, 112; *Minister of Mines, B.C.,* Ann. Rept., 1914, p. 323).

(36) In the Big Bend area north of Revelstoke (51° 118° S.E.) (*Geol. Surv., Canada,* Sum Rept., 1928A, p. 193).

Amphibole Asbestos

One amphibole deposit, on Shuttleworth Creek, has had some exploration work done on it. Several other occurrences have been reported but have not been developed.

Shuttleworth Creek (A)

(49° 119° S.E.) Anthophyllite asbestos occurs in a dunite mass half a mile south of Shuttleworth Creek, 4 miles southeast of Okanagan Falls. The dunite forms an irregular mass exposed for a length of half a mile and a width of as much as 700 feet. Anthophyllite is found in irregular lenses and cross-fibre veinlets scattered through the dunite. The fibre is grey-green to white and occurs as hard, woody chunks with fibres 8 to 10 inches long; as randomly oriented sheaf-like clumps of fibres one-quarter to three-quarters inch long; and as powdery aggregates of tiny needle-like fibres. Some vermiculite is found with the anthophyllite.

During 1953 the property was explored by means of five diamond-drill holes and twenty-five trenches.

[References: *Geol. Surv., Canada,* Sum. Rept., 1910, pp. 117, 118; *Minister of Mines, B.C.,* Ann. Repts., 1920, p. 164; 1948, p. 182; 1953, pp. 181–184.]

Wahleach (Jones) Creek (B)

(49° 121° S.W.) Actinolite has been reported in a series of north- and west-striking fractures in altered diorite along 200 feet of the bank of Wahleach Creek, one-half mile south of the Trans-Canada Highway. The mineral occurs in coarse brittle fibres with little tensile strength.

[Reference: *Geol. Surv., Canada,* Map 737A, 1944.]

Harrison Lake (C)

(49° 121° N.W.) Light- to dark-green fibrous tremolite has been reported in 6-inch- to 1-foot-wide veins in altered basic rocks on the north side of the south tributary of Fifteen Mile Creek, 1½ miles east of Harrison Lake. The tremolite is coarse and brittle with little tensile strength.

Illecillewaet (D).—(51° 117° S.W.) Amphibole asbestos has been reported from the vicinity of Illecillewaet station near the main line of the Canadian Pacific Railway.

[Reference: *Minister of Mines, B.C.,* Ann. Rept., 1921, p. 153.]

Sinkut Mountain (E).—(53° 123° N.W.) Brittle tremolite asbestos is reported to occur on the upper slopes of Sinkut Mountain, 15 miles south of Vanderhoof.

[Reference: *Minister of Mines, B.C.,* Ann. Rept., 1930, p. 147.]

Mount Sidney Williams (F)

(54° 125° N.E.) On the north slope of Mount Sidney Williams, 2 miles northwest of the chrysotile asbestos deposit, three veins of tremolite asbestos are reported. The veins are 4 to 10 inches wide and occur 200 feet apart in a body of serpentine. They can be traced for 20 feet. The fibres are very brittle.

[Reference: *Geol. Surv., Canada,* Mem. 252, 1949, p. 197.]

BARITE*

Mile 397

Alaska Highway (58° 124° N.W.). Claims have been located on a mass of barite exposed beside a small creek 400 feet upstream from the culvert on the Alaska Highway halfway between mile-posts 397 and 398.

The barite is in thin-bedded, dark-grey to black fetid limestone mapped by Williams (Ref. 1) as probably of Silurian age. Small local folds are present, but the limestone has a general over-all northwesterly strike and 30- to 40-degree southwesterly dip. It is on the west limb of a large anticline associated with a major thrust fault located a few miles to the east.

At the showing the creek flows through a narrow steep- to vertical-walled canyon. The barite forms an irregular vein-like mass that extends up the north wall from the creek bed to the lip of the canyon approximately 200 feet above. At the creek the barite has a fairly regular hangingwall that strikes north 25 degrees west and dips 60 degrees west, crosscutting the flatter-lying limestone. About half-

* By J. W. McCammon, except as noted.

way up the canyon wall, the dip flattens and the barite is almost parallel to the limestone beds from that point to the top of the exposure. The footwall is very irregular and has several long apophyses projecting into the wallrock, some as far as 90 feet or more. There is some brecciation, and there are limestone inclusions in the barite along the vein walls. Considerable replacement of limestone by barite has taken place, especially along the footwall. Post-mineralization slickenside is present on the hangingwall. At creek level the barite is 20 feet wide; in the centre, near the change in dip of the hangingwall, the barite is more than 100 feet wide; and at the top, or north end, it is 70 feet wide. The plan length of the exposure is roughly 200 feet.

Physically, the barite is variable: part is massive; part is coarsely crystalline; and part, near the creek, is so friable it crumbles into sand. The chief visible impurities are limestone, coarsely crystalline white calcite, and a little purple fluorite.

At the north end the barite is covered by talus. On a traverse, along strike for two claim lengths northwestward to the next creek, no continuation of the main barite deposit could be found, although numerous small scattered veinlets of barite and fluorite were seen. To the south the barite ends at the creek. About 100 feet upstream from the main showing a few small barite-fluorite stringers are exposed in the south wall of the canyon, and 500 feet upstream a rounded plug-like mass of barite, roughly 25 feet in diameter, occurs in the centre of the creek bed. Small scattered lenses and veinlets of barite, fluorite, and coarse white calcite are relatively abundant along the mountainside for 1½ miles to the south, but no deposit was seen of a size comparable to that of the main showing.

One sample, consisting of chips taken at 1-foot intervals across 60 feet, was collected from the exposure 50 feet from the north end. It had the following analysis: Ba=55.67; Ca=1.78; F=0.70; CO_2=1.67; SO_3=33.19; SiO_2= 0.38. The specific gravity of the sample was 4.36.

About one-third of a mile southeast of mile-post 396 an old tote-road joins the Alaska Highway from the north. Where the telegraph-line crosses the tote-road, one-quarter mile north of the highway, barite can be seen in small irregular discontinuous lenses and veinlets scattered through the limestone outcrops. Little bedrock is exposed in the vicinity, but barite can be traced over an area at least 100 feet wide and more than 600 feet long on the pole-line right-of-way.

[Reference: *Geol. Surv., Canada*, Paper 44-28, 1944, p. 27.]

Mile 428

Alaska Highway (58° 125° N.E.). Claims have been located on a deposit of barite on Nonda Creek, 8 miles north of the Alaska Highway at mile-post 428. The barite is in a vein that strikes down the west side of a limestone ridge just north of Nonda Creek about 2 miles west of the Canadian National Telegraph microwave station road 8 miles from the highway. The vein is reported to be 25 to 50 feet wide and has been traced for 1,500 feet on the surface between elevations of 6,300 and 6,800 feet.

Muncho Lake.—Alaska Highway (58° 125° N.W.). Veins of fluorite and barite are reported to be relatively common in the limestone south and east of Muncho Lake.

Mountain Minerals Limited*

Company office, Meech Building, P.O. Box 273, Lethbridge, Alta.; quarry office, Brisco. R. A. Thrall, managing director; William MacPherson, superintendent. This company operates two barite properties in the Windermere Valley, south of

* By D. R. Morgan.

Golden. One property is at Brisco (50° 116° N.E.) and the other at Parson (51° 116° S.W.). Activities are directed mainly to quarrying, and a full description of the properties is given in the 1958 Annual Report.

The Brisco operation was active for a ten-month period in 1960, during which time a crew of three men quarried, crushed, and shipped 7,304 tons of barite to the company's processing plant at Lethbridge. The original quarry was abandoned in September, and operations were transferred to a new quarry face that was prepared 2,000 feet south of the old quarry. The barite at the new quarry is 4 to 6 feet thick, but is faulted, and pinches and swells in the same erratic manner as in the old quarry. The adit drift being driven to test the continuation of the barite body below the location of the old quarry was advanced 543 feet. Diamond drilling totalled 221 feet.

Operations at the Parson property were restricted to the mining of 510 tons of chemical-grade barite for shipment to Montreal. The barite was mined from the drift that was driven in 1959. No new development work was carried out.

Baroid of Canada Ltd.*

Company office, 44 King Street West, Toronto, Ont.; J. A. Martino, president; T. A. Studer, mine manager. This company operated two barite properties in the Golden Mining Division during 1960—the Larrabee property near Invermere (50° 116° S.E.) and the Silver Giant property at Spillimacheen (50° 116° N.E.).

The Larrabee property is on the south side of Toby Creek, 8 miles by road west of Invermere. The present company optioned the property in 1959, and since then has worked two quarries on the hillside. A crew of four men produced 6,815 tons of barite during 1960. Operations were restricted to a five-month period, and were temporarily suspended for the winter months in November. The production came from both quarries, and was trucked to a railway siding at Goldie Creek, near Invermere, for shipment to the company's processing plant at Onaway, Alta. All the barite is shipped in a crude state.

The Silver Giant property is on the west side of Jubilee Mountain, 8 miles by road from Spillimacheen station on the Kootenay Central Railway. It was formerly owned and operated by Giant Mascot Mines Limited, and was mined for lead and zinc in 1908, 1916, and from 1947 to 1957. The present company entered an agreement to produce barite from the property in 1959, and has since purchased the property. The property comprises forty-five Crown-granted and one recorded mineral claims. During 1960 activities were confined to a three-month period, and a working crew of five men produced 1,607 tons of barite. Of this quantity, 846 tons was mined from an open pit and the remainder was recovered from the large tailings pile left by the Giant Mascot operation. Both the crude and concentrated barite were trucked to a railway siding at Spillimacheen, and shipped to the company's processing plant at Onaway, Alta.

BERYL†

Linda and Linda No. 1

Hellroaring Creek (49° 116° N.E.). In 1958 Harold Bennett, of Cranbrook, located the Linda and Linda No. 1 mineral claims on a pegmatite showing in which he found beryl crystals. The claims are on the east side of Hellroaring Creek between 4,000 and 5,000 feet elevation, 2½ miles due south of the east end of St. Mary Lake. Access is by means of the road from the east end of the lake to the old Boy Scout (Warhorse) mine workings.

* By D. R. Morgan.
† By J. W. McCammon.

The beryl occurs as erratically scattered crystals and groups of crystals in coarse-grained pegmatite which consists essentially of quartz, feldspar, muscovite, and black tourmaline. This pegmatite, in turn, forms irregular discontinuous patches in a pegmatitic mass mapped by Leech (Ref. 1) as being half a mile wide and extending for more than 2 miles from Hellroaring Creek southeastward to Angus Creek. During an examination of the property, one single crystal of beryl about an inch long and one-quarter inch in diameter was found. It was in a small cut opened in a low pegmatite bluff beside the mine road, 3¾ miles from St. Mary Lake. Larger crystals and irregular masses of beryl up to 3 inches in diameter have been found in the deposit. The beryl is very pale bluish-green to white and, particularly in irregular crystals, is difficult to distinguish from quartz.

[References: (1) *Geol. Surv., Canada,* Map 15-1957, St. Mary Lake, 1957; (2) *Geol. Surv., Canada,* Paper 60-21, Beryllium Occurrences in Canada, 1960.]

BUILDING-STONE*

Kootenay Granite Products Limited† Sirdar (49° 116° S.W.). Company office, 1410 Fourth Street S.W., Calgary, Alta.; quarry office, Sirdar. R. Staal, superintendent. This company operates a quarry and processing plant 2 miles north of Sirdar, about 100 yards from the Creston–Kootenay Bay highway. Mining is done with jacklegs, and the rock is scraped to the grizzly.

The plant consists of a crushing, screening, and bagging circuit to produce five sizes of grits. The sizes and uses are as follows: +10 mesh to −⅛-inch chick, sander, and monumental grit; +⅛-inch to −³⁄₁₆-inch chicken grit; +³⁄₁₆-inch to −¼-inch turkey grit; +¼-inch to −⁵⁄₁₆-inch roofing and stucco grit; +⁵⁄₁₆-inch to −½-inch construction grit. Larger-sized material can be produced on demand. The plant and quarry worked intermittently in the first six months and were shut down for the last six months of 1960.

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, 11 miles northeast of Rosedale. A detailed description of the plant installation was made on page 152 of the 1959 Annual Report. Turkey, chicken, and bird grits, stucco dash, sand-blast materials, and filler for asphalt roofing are produced.

In 1960 a crew of nine men produced 5,500 tons of grit products and 2,000 tons of granitic filler flour.

Evans, Coleman & Evans Limited (Gilley Quarry) Pitt River (49° 122° S.W.). Company office, Box 120, 902 Columbia Street, New Westminster. J. Hollis Gilley, manager, transport and operations; James Gilley, production supervisor; Francis J. MacDonald, superintendent. The quarry is on Pitt River immediately south of its confluence with Munro Creek. A description of the quarrying procedure and crushing plant is detailed on page 153 of the 1959 Annual Report. The quarry was operated for a short period in 1960, during which time a crew of ten men produced 45,000 tons of quartz diorite jetty rock.

* By J. E. Merrett, except as noted.
† By J. D. McDonald.

Indian River Quarries Limited.—Granite Falls (49° 122° S.W.). Company office, 1255 West Pender Street, Vancouver 1. McKenzie Barge and Derrick Co. (1957) Ltd., of Vancouver, operated the quarry for a short period at the beginning of 1960. During that time a crew of ten men was employed and 36,686 tons of granite jetty rock was produced.

Enemark Construction Limited.—Indian Arm (49° 122° S.W.). Company office, Port Mellon; quarry, Clementine Creek, Indian Arm. The quarry is immediately south of the mouth of Clementine Creek, due west of the north end of Croker Island. This quarry was operated for a short period at the beginning of 1960. During that time a crew of ten men was employed and approximately 45,000 tons of granite jetty rock was produced.

Vancouver Granite Co. Limited.—Nelson Island (49° 124° N.E.). Company office, 744 West Hastings Street, Vancouver 1; quarry, Nelson Island. H. T. Wilson, secretary. Dimension stone for building purposes and monuments, jetty rock, and rubble are produced at this quarry. The rock is drilled to size following a mineral fracture pattern, blasted, and wedged for removal. Two 20-ton-capacity derricks are used to move the rock from the pit to the scows for shipment to the Vancouver plant, where it is cut and finished. Approximately 1,600 tons of stone was produced during the operating period between March and September. Ten men were employed.

Parsons Tractor Service Ltd.—Powell River (49° 124° N.W.). E. Parsons, manager. The quarry is east of Cranberry Lake, midway between Powell River and Westview. Between January and May a crew of ten men produced 47,255 cubic yards of diorite for the Westview breakwater.

CEMENT*

British Columbia Cement Company Limited.—Bamberton (48° 123° N.W.). Head office, 540 Burrard Street, Vancouver 1. W. F. Foster, president; B. M. Brabant, vice-president and general manager; R. E. Haskins, vice-president in charge of production. During 1960 this company operated its cement plant, rated at 3½ million barrels per year.

Lafarge Cement of North America Ltd.—Lulu Island (49° 123° S.E.). This company operated a cement plant with a rated capacity of 1½ million barrels per year on Lulu Island.

CLAY AND SHALE†

Clayburn-Harbison Ltd.—(49° 122° S.E.) Head office, 1025 West Seventy-seventh Avenue, Vancouver 14; plants, Kilgard and Abbotsford. Gordon Farrell, president; R. M. Hungerford, general manager; G. H. Peterson, manager. Two plants are operated by this company—one at Kilgard where sewer-pipe and flue-linings are manufactured, and the other at Abbotsford where face brick and refractories are made.

A description of the various open-pit and underground workings, the mining methods, and the plant processes used may be found in the 1959 Annual Report, page 154.

A twelve-man mining crew produced 50,564 tons of clay, which was obtained as follows: 12,336 tons from the Matsqui Selby open pit; 969 tons from the Sumas Fireclay pit; 16,391 tons from the Sumas No. 9 pit; 4,253 tons from the

* By R. B. Bonar.
† By J. E. Merrett, except as noted.

Sumas Fireclay new portal mine (underground); and 16,615 tons from the Sumas Fireclay mine (underground).

Richmix Clays Limited

Kilgard (49° 122° S.E.). Office and plant, 2890 Kent Avenue, Vancouver 12; quarry, Kilgard. G. W. Richmond, manager. Surface mining of clay was carried on intermittently at this property. Fireclay is drilled and blasted, then loaded onto trucks for shipment to the Vancouver plant or to markets. In 1960, 6,100 tons was produced by one man.

Bear Creek Building Supply Ltd.

Surrey (49° 122° S.W.). Office and plant, 7940 One Hundred and Forty-fourth Street, Surrey. R. Wickson, president. James McBeth, plant manager. This company succeeded the former Bear Creek Brick Company and Victoria Tile & Brick Supply Co. Ltd. No clay products were produced in 1960.

B.C. Clay Products Limited

Surrey (49° 122° S.W.). Head office and plant, 3439 Euclid Street, Vancouver 16; pit, Archibald Road at Mahood Creek, Surrey. C. Madden, manager. Six hundred tons of clay was excavated from a small pit opposite the Bear Creek Building Supply pit. The clay was trucked to the Vancouver plant for the manufacture of flower-pots.

Haney Brick and Tile Ltd.

Haney (49° 122° S.W.) Company office and plant, Haney. E. G. Baynes, president; J. Hadgkiss, managing director. Clay is excavated in a pit adjacent to the plant. It is removed by a ½-cubic-yard-capacity gasoline shovel and trucked to a covered air-drying area. Further drying is done in a rotary wood-fired kiln, with the product being conveyed to a dry-pan for grinding. Brick and tile are formed by a stiff-mud extrusion process and then dried in a controlled-temperature drying-room. After drying, the products are burned in down-draught beehive kilns. A crew of thirty-five men produced 9,200 tons of clay products comprising approximately 55 per cent agricultural drain-tile, 40 per cent structural tile, and 5 per cent flue-lining and brick.

Mainland Clay Products Limited

Barnet (49° 122° S.W.). Head office, 8699 Angus Drive, Vancouver 14; plant, Barnet. Clay is excavated from a pit adjacent to the plant and transported to a covered drying area. Some fireclay is obtained from Kilgard. Three men produced 1,600 tons of red clay building-bricks and firebricks.

Fairey & Company Limited.*—Vancouver (49° 123° S.E.). L. T. Fairey, manager. This company produced a variety of fireclay blocks, shapes, and high-temperature cements. Local and imported raw materials were used.

British Columbia Lightweight Aggregates Ltd.†—Saturna Island (48° 123° N.E.). This company has a shale expanding plant and quarry at Lyall Harbour on Saturna Island.

Deeks-McBride Ltd. (Clay Division).†—Bazan Bay (48° 123° N.E.). The clay plant remained inactive, and along with the property was put up for sale.

Baker Brick & Tile Company Limited.†—Victoria (48° 123° N.E.). Office and works, 3191 Douglas Street, Victoria. Blocks, flue-lining, drain-tile, and flower-pots were manufactured at this plant from local surface clay.

* By J. W. McCammon.
† By R. B. Bonar.

DIATOMITE*

Fairey & Company Limited Quesnel (53° 122° S.E.). Company office and plant, 661 Taylor Street, Vancouver 3. L. T. Fairey, president. Two carloads (153 cubic yards) of diatomite were quarried on Lot 6182, on the east bank of the Fraser River about 6 miles north of Quesnel. The material was excavated by bulldozer and front-end loader. It was used to make insulating brick.

Lots 1616, 8011 Buck Ridge (52° 122° N.W.). A test shipment of four truck-loads of diatomite was taken from the deposit on Lots 1616 and 8011 on the Lepetich farm on the west side of the Fraser River, 20 miles south of Quesnel. The shipments were tested in a plant being erected at Two Mile Flat, Quesnel, by N. Lacey, Box 271, Quesnel.

GYPSUM†

O'Connor Gypsum (Ventures Limited)‡ (59° 136° N.W.) Head office, 25 King Street West, Toronto, Ont. H. W. Fraser, president; Alex. Smith, manager. This property consists of seventeen recorded claims that straddle the head of the O'Connor River 6 miles west of the Haines Road at Kusawak Lake, near mile-post 66 north of Haines. On the property an extensive deposit of white gypsum accompanied by anhydrite occurs in a series of Permo-Carboniferous sedimentary rocks. A surface grab sample taken from a large bluff of gypsum on the west bank near the river had the following analysis: $CaO=32.52$; $SO_3=46.48$; $CO_2=0.12$; H_2O (215° C.)$=20.55$.

Between July 25th and August 16th a crew of four men under the direction of J. McDougall did 120 feet of packsack drilling and collected several hundred pounds of gypsum for test purposes from rock cuts. Access was by foot and helicopter from the Haines Road.

Western Gypsum Products Limited Windermere (50° 115° S.W.). Company office, 306 Electric Railway Chambers, Winnipeg 2, Man.; quarry office, Athalmer. A. E. Portman, superintendent. This company operates a large gypsum property on the north side of Windermere Creek, 8 miles east of Windermere. Gypsum is quarried, crushed, and trucked to Athalmer for shipment by rail.

All the 1960 production was mined from the No. 2 quarry, which has been in operation since 1958. The quarry is 400 feet long by 300 feet wide with the walls sloped back to a 45-degree angle. The gypsum is extracted in 15-foot lifts, and the rock is loaded by power-shovel. Total production during 1960 was 119,077 tons, of which 112,500 tons was shipped by rail and the remainder placed on the stockpile. The quarry was idle for the first three months of the year and again in December owing to winter conditions. During the period of operation the average number of men employed was fifteen.

The crusher and other equipment at the mill near the quarry were dismantled late in the summer of 1960 and have been relocated at a new site adjacent to the Kootenay Central Railway on the east side of the Columbia River near Wilmer.

* By A. R. C. James.
† By D. R. Morgan, except as noted.
‡ By J. W. McCammon and W. C. Robinson.

Construction of the new plant was completed by December, and several trial runs were made. The machinery consists of a 20 by 36 primary crusher, a 10 by 14 secondary crusher, and two screens with large storage tanks for two sizes of rock. Other activities carried out included the construction of a new private road, 7 miles long, to connect the mountain road from the quarry to the new mill, and the installation of a rail spur and car-mover at the mill for the loading of the railway cars.

During 1960, 5,181 feet of diamond drilling was done in thirty-four holes.

United Gypsum Corporation Ltd. Canal Flats (50° 115° S.W.). Office address, 549 Howe Street, Vancouver 1. This company holds twenty-seven claims beside Lussier River near the confluence of Roam Creek, 16 miles southeast of Canal Flats. The property is reached by 21 miles of old logging-road that branches off Highway No. 95 north of Skookumchuck. Activities were confined to a three-month period. Two men drilled five diamond-drill holes totalling 1,496 feet. Further drilling was suspended on November 17th owing to winter conditions.

LIMESTONE

Limestone in the Greenwood-Grand Forks Area*

In the Greenwood-Grand Forks area limestone is found in pods and lenses associated with greenstones and greywackes of the Permian(?) Anarchist group of rocks. A few small lenses are found also in the Proterozoic(?) Grand Forks group. Many of the lenses are small, but several are 1 to 2 miles long and half a mile wide.

Two limestone lenses are exposed on the hill northeast of No. 3 highway, 4 miles west of Midway. One lens shows in a road cut on the highway 4.3 miles from the town. The lens is roughly half a mile in diameter and extends from the edge of the Kettle River up the west slope of the hill to an elevation 750 feet above the highway. The rock is impure, poorly bedded, mixed medium-grained light-grey to white and fine-grained black limestone. Greywacke, argillite, and some light-grey chert interbeds are with the limestone. Some igneous dykes cut the sedimentary rocks. Visible beds have a general northwesterly strike and northeast dip, but folding and faulting have taken place. The limestone is badly fractured and in several places is brecciated. Sample No. 1 in the accompanying table consisted of a chip sample taken across 14 feet of beds exposed in the highway road cut. The second lens is on the upper part of the south slope of the same hill, one-quarter mile north of the highway 3.2 miles west of Midway. Outcrops of limestone begin 700 feet above the highway and extend upward to the top of the hill 700 feet higher still. The mass underlies an area approximately half a mile in diameter. It appears to be surrounded chiefly by volcanic rocks. The limestone is medium- to fine-grained light-grey rock containing many argillaceous inclusions, some fossil fragments, and inclusions and dykes of volcanic rock. Sample No. 2 consisted of chips taken at random over the top of the exposed limestone.

Two small calcareous deposits were examined near Boundary Falls. Cream to blue mottled and streaky dolomite forms a small elongate knoll 50 feet west of the railway track 600 feet north of the Boundary Falls sawmill. The dolomite lens is 60 feet wide and 170 feet long. A small quarry and the remains of a small pot kiln are at the south end of the deposit adjacent to the track. Streaky white and bluish-grey medium-grained limestone forms a lens enclosed in sheared greywacke on the hillside 300 feet above and one-half mile northeast of Boundary Falls. The lens is 350 feet long and has a maximum thickness of 130 feet. It strikes north

* By J. W. McCammon.

60 degrees west and dips 58 degrees northeast into the hill. A small quarry and the ruins of a pot kiln lie at the base of the exposure on the southwest side. Sample No. 3 consisted of chips taken across 100 feet of beds near the centre of the lens.

Limestone lenses of all sizes are numerous in the area south of Eholt and northeast of Phoenix. One of the most accessible of these forms a steep 300-foot-high cliff face a few hundred feet west of and parallel to No. 3 highway 1¾ miles south of Eholt. The lens can be traced on the surface over an area roughly half a mile in diameter. The rock is medium-grained light-grey marble. Locally there are concentrations of chert and other impurities. The analysis of a sample of chips collected at random across the top of the cliff is shown as No. 4 in the table.

One mile south of the deposit just described are two parallel elongate lenses of limestone, each at least 1¼ miles long and one-half mile wide. The east lens is exposed at its north end in a road cut on the highway, is visible in several cuts along the two old railway grades west of the highway, and is cut at its south end by the Phoenix road 1 mile west of the highway junction. The limestone is mostly white fine-grained rock, although in places it is black or dark grey. Thin cherty and argillaceous beds occur in scattered narrow bands, and volcanic dykes and sills are relatively numerous. The analysis of a sample of this lens taken by Goudge* on the abandoned railway grade one-half mile south of the old Oro Denoro mine workings is shown as No. 5 in the table. The western lens is exposed near its south end on the Phoenix road 1.6 miles west of the highway junction and on the old railway grade south from the Oro Denoro workings, but the best exposure is on a bare knoll half a mile north of the road exposure. The rock is mostly white medium-grained limestone with some grey patches. Thin chert beds and some dykes occur in various parts of the lens. Sample No. 6 consisted of chips taken across 300 feet on the top of the bare knoll forming the main exposure north of the road.

Two large and several small limestone lenses are exposed on the western slope of Thimble Mountain. About 2½ miles south of Eholt a side road that leads to the top of the mountain branches east off highway No. 3. This road crosses the two larger lenses at points 0.3 mile and 2.2 miles from the highway. The first lens is 100 to 200 feet wide and can be traced for about half a mile south from the road up and over the ridge from Thimble peak. The rock is coarse grained, light grey, and poorly bedded. The second lens has a maximum width of one-quarter mile and can be followed for three-quarters of a mile southwest across the west peak of the mountain. The rock is chiefly medium-grained, light-grey, highly fractured limestone. Thin-bedded cherty argillite forms interbeds with the limestone toward the eastern contact. The limestone appears to be in the trough of a north-plunging syncline. The analysis of a sample consisting of chips taken at 10-foot intervals across the sound end of the lens is shown as No. 7 in the table. A smaller lens caps a low bare hummock half a mile southwest of the lens just described. The rock in this lens is light-grey to creamy fine-grained limestone with frequent cherty and argillaceous streaks. A sample taken across 400 feet of beds on the top of the hummock had the analysis shown as No. 8 in the table.

One of the largest limestone lenses in the area is on the northeast slope of Thimble Mountain. It extends from the road on the west side of Granby River, at 1,900 feet elevation, southwestward up the side of the mountain to about 3,400 feet elevation. It is nearly 2 miles long and over half a mile wide at its widest part. The Canadian Pacific Railway track crosses the centre of the lens and exposes it in cutbanks for three-quarters of a mile south of mile-post 104. The limestone is

* *Bureau of Mines, Canada,* Publ. No. 811, 1944, pp. 193–202.

in general thin-bedded dark rock containing much argillaceous and cherty material. Small white calcite stringers are numerous in parts, and locally, around dykes, the limestone is recrystallized to medium-grained white marble. One large dyke and several smaller ones were seen. Some volcanic rocks form discontinuous layers and lenses in the limestone. Sample No. 9 consisted of chips taken at random along 700 feet of exposures on the road at the northeast end of the lens. Sample No. 10 shows the results of an analysis of a sample taken by Goudge* across 40 feet of beds exposed on the track near mile-post 104, and sample No. 11 was taken by Goudge* from an old quarry 300 feet below the track at mile-post 104.

The largest limestone body examined is on the hillside 1½ miles northwest of Grand Forks. The mass forms a large V with the apex on Hardy Creek half a mile west of the railway track. One leg of the V extends for 2 miles westward up and across the south side of Eagle Mountain, and the other leg extends northward for 1½ miles up a nose to the peak of Goat Mountain. The rock on the Eagle Mountain side is fairly uniform dark-grey to black, fine-grained, fetid limestone containing siliceous-argillaceous inclusions and fossil fragments and criss-crossed by tiny white calcite veinlets. A sample across 200 feet of exposure on the hillside half a mile southwest of the creek had the analysis shown as sample No. 12 in the table. A small quarry was once worked on the south side of Hardy Creek where the limestone band crosses the creek. Goudge* took a sample from exposures around the quarry, the analysis of which is shown as sample No. 13 in the table. The rock north of the creek on the slope to Goat Mountain is dark highly fractured limestone with the fractures healed with white calcite. Chert is present as angular fragments and discontinuous, irregular seams 1 to 3 inches thick. Igneous dykes are abundant. A sample across 600 feet of beds at the summit of the mountain had the analysis shown as No. 14 in the table.

A limestone lens one-half mile in diameter caps the westernmost peak of Hardy Mountain. The rock is grey to white and contains abundant siliceous and argillaceous inclusions. Other small limestone lenses are exposed in cuts on the railway between Grand Forks and Eholt at mile-posts 98, 99, and 101. The rock contains many visible impurities. No samples were taken at any of these exposures.

Beds of dolomite and impure limestone are exposed one-quarter mile north of No. 3 highway on either side of Morrissey Creek, 3 miles east of Grand Forks. East of the creek a 300-foot-thick band of dolomite can be traced for nearly one-half mile along the base of the rock bluffs parallel to the highway. The band is interbedded with white quartzite and gneiss, and all strike northwest and dip steeply southwest. The dolomite is coarsely crystalline white rock with streaks and spots of yellow-green serpentine. Microscopic examination indicates a considerable forsterite content. One sample, taken from a small quarry near the west end of the exposure, had the analysis shown as No. 15 in the table. West of the creek a 100-foot band of coarse-grained, impure, light-grey dolomitic limestone is exposed for a few hundred feet along strike parallel to the highway. The remains of two old pot kilns can be seen at the base of the slope near the creek. About half a mile due south of these showings and 100 yards east of mile-post 44, the Great Northern Railway track cuts across 200 to 300 feet of highly contorted medium- to fine-grained limestone. The deposit does not appear to be large.

* *Bureau of Mines, Canada*, Publ. No. 811, 1944, pp. 193–202.

Greenwood-Grand Forks Limestone Analyses

Sample No.	Insol.	R_2O_3	Fe_2O_3	MnO	MgO	CaO	P_2O_5	S	Ig. Loss	H_2O
1	6.70	0.52	0.80	0.07	0.37	52.10	0.03	0.18	40.12	0.07
2	2.30	0.30	0.16	0.01	0.25	54.04	0.07	0.01	42.85	0.10
3	0.68	0.16	0.14	0.01	0.23	55.15	0.13	0.01	43.55	0.08
4	4.94	0.38	0.32	0.03	0.38	52.40	0.04	0.03	41.75	0.09
5[1]	5.70	0.42	0.39	......	0.67	51.39	0.09	0.04	......	......
6	11.20	1.04	0.74	0.04	0.70	48.47	0.13	0.02	38.69	0.28
7	25.62	2.18	1.76	0.04	0.91	38.29	0.06	0.04	31.23	0.12
8	14.36	1.52	1.10	0.05	0.40	46.02	0.17	0.03	36.97	0.20
9	10.16	0.62	0.56	0.05	0.88	48.76	0.14	0.04	39.41	0.06
10[1]	16.38	0.97	0.46	......	0.72	45.06	0.009	0.22	......	......
11[1]	4.80	0.52	0.35	......	0.80	52.09	0.09	Tr.	......	......
12	5.34	0.44	0.33	0.03	0.49	51.94	0.20	0.03	41.81	0.04
13[1]	2.12	0.18	0.12	......	0.58	54.03	0.058	Tr.	......	......
14	9.86	1.84	1.22	0.08	0.99	48.48	0.12	......	38.99	0.08
15	2.36	0.42	0.32	0.03	21.30	30.90	0.13	0.008	45.00	0.10

[1] By M. F. Goudge.

[References: (1) *Bureau of Mines, Canada,* Publ. No. 811, 1944, pp. 193–195, 202; (2) *Geol. Surv., Canada,* Maps 82A, 83A with Mem. 38, 1912; Map 828, 1905; Map 6-1957.]

Limestone in the Salmon Arm Area*

Many of the rocks in the vicinity of Salmon Arm are calcareous, but the only readily accessible material of any apparent possible potential commercial value as a source of limestone is found in the Archæan (?) Sicamous formation. Jones (Ref. 1) describes the formation as consisting of three main lithological units of approximately equal thickness, the upper and lower units being predominantly limestone and the middle unit being predominantly sericitic calcareous schist. The distribution of the Sicamous formation, undivided, is shown in Figure 16, taken from Geological Survey of Canada Map 1059A by Jones. Good exposures of the Sicamous limestone can be seen in road cuts and on beaches in the Sorrento-Notch Hill-White Lake region, along the north shore of Salmon Arm opposite Canoe, and in road and railway cuts just west of Sicamous.

Where examined, the Sicamous formation consists essentially of impure, fine-grained, dark-grey to black limestone lying in thin platy layers. The layers, probably originally beds, are usually about 2 inches thick but vary from 2 to 8 inches thick. Some layers can be traced for a considerable distance along strike but others lens out within a few feet. Commonly mica or graphite coats the platy surfaces. White to brownish-orange coarse-grained calcite layers and lenses are fairly commonly interlayered with the darker rock. Thin lenses and small pods of white quartz are often noticeable lying parallel to the platy foliation. Thin white calcite veinlets, frequently accompanied by white quartz, are characteristic of most outcrops. Dykes and sills occur in some places but are not abundant. Frequently the rock has a distinct schistose to gneissic appearance. Some zones were found that consisted of schisty argillaceous rock with little or no true limestone.

Three samples were collected at widely separated points to check the composition of the rock. Sample No. 1 was from a road cut on the Trans-Canada (No. 1) Highway 1.9 miles east of Sorrento. The cut is 850 feet long and has a maximum height of 25 feet. The sample consisted of chips taken at 20-foot intervals along the entire cut. The rock is platy, schistose, dark-grey limestone with graphitic coated partings. Cross-cutting white calcite veinlets are abundant and scattered pyrite

* By. J. W. McCammon.

patches are present. Sample No. 2 came from a cut on a side road on the hill 1 mile west of Grindrod. The sample was cut across 40 feet of platy orange and black limestone with much mica and graphite on the plate faces. A few hundred feet to the west the limestone is in contact with an intrusive granitic plug. Sample No. 3

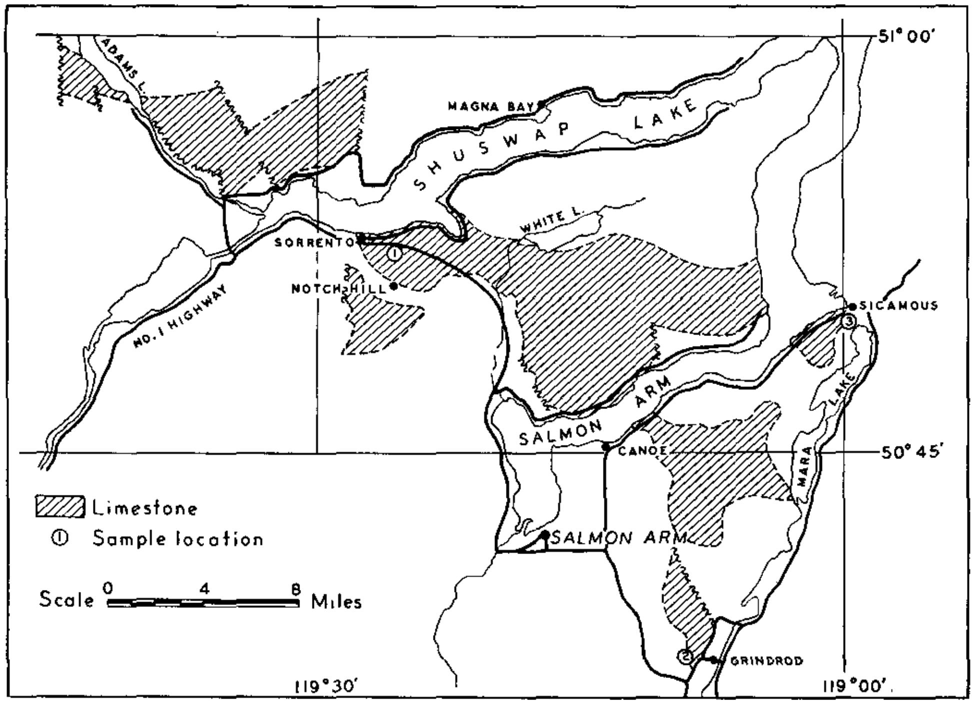


Figure 16. Limestone in the Salmon Arm area.

was from the type locality of the Sicamous formation. The sample consisted of chips taken at 20-foot intervals along the first 900 feet of the cut on the road on the west bank of the Shuswap River south from the Trans-Canada Highway at Sicamous. The rock consists of thin grey and white platy bands of limestone with disconnected pods and lenses of quartz up to 8 inches thick. Graphite and mica coat the plate faces.

Salmon Arm Limestone Analyses

Sample No.	Insol.	R_2O_3	Fe_2O_3	MnO	MgO	CaO	P_2O_5	S	Ig. Loss	H_2O
1	11.84	1.20	1.29	0.04	0.90	46.44	0.01	0.04	38.77	0.06
2	11.80	1.28	1.22	0.04	0.57	47.53	0.03	0.09	38.72	0.24
3	23.84	2.98	2.47	0.08	1.34	38.66	0.03	0.28	32.21	0.07

[References: (1) *Geol. Surv., Canada,* Mem. 296, pp. 21, 22, and Map 1059A; (2) *Bureau of Mines, Canada,* Publ. No. 811, 1944, pp. 185–187, 191.]

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

Fort Steele (50° 115° N.W.). This quarry lease is located on the north side of the Kootenay River 5 miles northwest of Wardner, or 2 miles west of Bull River. The quarry is owned and operated under contract by The Consolidated Mining and Smelting Company of Canada, Limited, to supply dolomite flux for the new iron-reduction plant at Kimberley. The material to date has been produced from a talus slope,

* By D. R. Morgan.

and 1,200 tons of screened product was shipped to Kimberley at the end of 1960. Most of the material was transported by truck, but a new spur line has since been connected to the Kootenay Central Railway to enable further shipments to be sent by rail. Two men were employed at the quarry.

B & P Lime Development*

Procter (49° 116° S.W.). A limestone property beside the Canadian Pacific Railway track 1½ miles east of Procter was leased by the B & P Lime Development company from the owner, The Consolidated Mining and Smelting Company of Canada, Limited. The latter company had developed the property as the Kootenay Lake Lime Quarry between 1935 and 1938.

The limestone occurs as coarse- to fine-grained white and bluish-white rock that forms a 30- to 50-foot-wide band in schist near a granite contact. The band strikes northeastward and dips moderately northwest. An analysis of a sample from underground taken by Goudge (Ref.) was as follows: $SiO_2=5.61$; $Fe_2O_3=0.26$; $Al_2O_3=0.20$; $Ca_3(PO_4)_2=0.04$; $CaCO_3=78.85$; $MgCO_3=15.35$; $S=0.02$.

The deposit was developed by 1,600 feet of drifts. Mining by the lessees was carried out underground from the old workings. A railway spur was put in to spot railway ore-cars below a new chute. Ore-cars from the mine dumped directly into the chute. The 1960 production consisted of 350 tons of limestone shipped in seven railway cars to Marble-X Company in Edmonton. Three men were employed for four months.

[Reference: *Bureau of Mines, Canada,* Publ. No. 811, 1944, pp. 198, 202.]

Fraser Valley Lime Supplies†

Popkum (49° 121° S.W.). Head office, 905 Edmonds Street, Burnaby. Thomas Mairs, manager. The quarry and crushing plant are on the east side of the Trans-Canada Highway adjoining the southernmost tip of the Indian Reserve No. 1, three-quarters of a mile east of Popkum station on the Canadian National Railway. Limestone is quarried in 25-foot benches by horizontal jackleg-drilled holes. Broken rock is loaded onto trucks by a 1-cubic-yard front-end loader and transported to the crushing plant. Agricultural lime and industrial filler are produced. A crew of seven men mined and crushed approximately 7,000 tons of limestone.

Beale Quarries Division (Lafarge Cement of North America Ltd.)†

Vananda (49° 124° N.W.). Head office, 744 West Hastings Street, Vancouver 1; quarry office, Vananda. W. D. Webster, superintendent. The quarry and plant are on the east coast of Texada Island, 1 mile south of Vananda. Limestone is quarried in 40-foot-high benches by vertical-hole drilling using a Joy Heavyweight Champion drill. Secondary drilling and some horizontal benching is done with jacklegs. Primary blasting is done with Hydromex, 40 per cent Forcite, and ammonium nitrate-diesel oil mixture primed with 50-grain and 400-grain Primacord using electric blasting-caps as initiators. Secondary blasting is done with 40 per cent Forcite. The broken rock is loaded by a 3-cubic-yard-capacity Bucyrus shovel onto Euclid 63T trucks and transported to the crushing plant. Primary crushing is done by an Allis-Chalmers 48- by 60-inch jaw crusher. Secondary crushing is done by an Allis-Chalmers 36- by 48-inch jaw crusher and a Pennsylvania impactor.

* By J. D. McDonald and J. W. McCammon.
† By J. E. Merrett.

Screens are used to separate pulp rock, 6 to 12 inches in diameter, from cement rock, three-quarters of an inch in diameter. The rock is transported by conveyors to the stockpiles and loading-docks. The crushed limestone produced is sold for pulp rock for paper-mills, agricultural limestone, and crushed limestone or shipped as cement rock to the cement plant operated by this company on Lulu Island. Custom crushing is done on some rock supplied by Imperial Limestone Company Limited.

A crew of twenty men mined 390,000 tons of limestone and crushed and shipped 356,000 tons.

Ideal Cement Company Ltd.* Vananda (49° 124° N.W.). British Columbia office, 1155 West Georgia Street, Vancouver 5; quarry office, Vananda. W. S. Beale, manager, Rock Products Division; J. K. Johnson, superintendent. The rock quarry is on Lot 25, Texada Island, about 2 miles south of Vananda. The crushing plant and loading-dock are at Marble Bay, adjacent to Vananda. A new private road is under construction between the quarry and crushing plant.

Limestone is quarried in 25-foot benches using an air-track for vertical-hole drilling. Blasting is done using 40 per cent Forcite and ammonium nitrate-diesel oil mixture. The broken rock is loaded onto trucks with a 2½-cubic-yard-capacity Marion shovel and transported to the crushing-plant stockpile. The rock is delivered from the stockpile to the crushing plant by a front-end loader. The rock is crushed and screened into the following sizes: 6-inch to 14-inch, 1½-inch to 6-inch, ¾-inch to 1½-inch, and —¾-inch. The materials produced are stockpiled in the old Marble Bay quarry or loaded by conveyor-belt onto barges for shipment. In 1960 the production was approximately 120,000 tons, of which 85,000 tons was shipped. Nine men were employed.

Imperial Limestone Company Limited* Vananda (49° 124° N.W.). Office, 7309½ East Marginal Way, Seattle 8, Wash.; plant and quarry office, Vananda. Don McKay, superintendent. The quarry is on the main east road, 2 miles southeast of Vananda. Limestone is quarried in 25-foot benches by horizontal- and vertical-hole drilling with jacklegs. Blasting is done by charging the 2-inch drill-holes with 40 per cent Forcite and ammonium nitrate-diesel oil mixture. The broken rock is loaded onto trucks by a ¼-cubic-yard-capacity Bucyrus shovel and a ¾-cubic-yard-capacity Marion shovel. The material is then trucked to the primary crusher at the quarry, where it is crushed and hand-sorted into white or grey fractions. The select white limestone is trucked to the plant at Vananda for further crushing to produce stucco dash and whiting. The grey limestone is trucked to the nearby Lafarge Cement crushing plant.

A new road, 1½ miles in length, was constructed from the quarry to Butterfly Bay, immediately north of Raven Bay on the east coast of the island. Work commenced on the construction of a breakwater at Butterfly Bay preparatory to constructing a loading-dock.

Production: 2,686 tons of sacked white limestone shipped; 33,794 tons of bulk grey limestone shipped; 2,000 tons of bulk grey limestone stockpiled.

Five men were employed.

* By J. E. Merrett.

Gypsum Lime & Alabastine Limited*

Blubber Bay (49° 124° N.W.). Head office, 50 Maitland Street, Toronto 5, Ont.; British Columbia office, 1105 West Pender Street, Vancouver 1; quarry office, Blubber Bay; lime plants, Blubber Bay and Vancouver. W. M. Tully, British Columbia area manager; Arthur Pitt, Blubber Bay plant manager. This company is a subsidiary of Dominion Tar & Chemical Company Limited. The limestone quarry is approximately 2 miles south of Blubber Bay on Texada Island.

Limestone is quarried in 25-foot benches by horizontal- and vertical-hole drilling using a wagon-drill. Blasting is done with 70 per cent Dynamex and 40 per cent Forcite. The broken rock is loaded by a 1½-cubic-yard-capacity Dominion K-450 shovel into four 17-ton-capacity trucks which haul the rock to the crushing plant at Blubber Bay. The rock is crushed, sized, and stockpiled for direct shipment or for use in the lime-burning plants at Blubber Bay and Vancouver. Products were crushed stone, including sized rock, spalls, and fines or screenings; quicklime (lump, crushed, and pulverized); and hydrated lime. Stone is supplied to such industries as pulp and paper, cement, smelting and refining of iron and steel, agriculture, etc.; lime is supplied for building, coal-mining, pulp and paper, chemicals, agriculture, steel, and sugar industries.

The total number employed at Blubber Bay in 1960 was fifty-one, of whom fifteen were employed at the quarry and crushing plant.

Production: 408,427 tons mined; 303,133 tons shipped.

Koeye River (Widsten Marine Services Limited)*

Koeye River (51° 127° N.W.). Company office, Bella Bella; mine office, Koeye River. A. O. Widsten, manager. This company commenced operations in February after acquiring the assets of Koeye River Limestone Co. Ltd. Limestone is mined from two adjacent quarries on the north side of Koeye River, less than a mile from its mouth on Fitz Hugh Sound, 6 miles south of Namu.

Limestone is quarried in 20-foot benches by vertical-hole drilling with a small portable drill. A front-end loader is used to convey the rock from the quarry to the loading-dock, from whence it is barged to the Crown Zellerbach Canada Ltd. paper-mill at Ocean Falls. Six men were employed.

Production: 12,796 tons.

Rayonier Canada Limited*

Jeune Landing (50° 127° S.W.). Head office, 1111 West Georgia Street, Vancouver 5; quarry office, Port Alice. Lucien Godbout, quarry contractor. Two adjacent quarries were operated at Quarry Bay, on the east shore of Neroutsos Inlet about 1¼ miles north of Jeune Landing. Horizontal- and vertical-hole drilling by wagon-drill is used to mine the 35-foot-high quarry bench. Broken rock is trucked to a scow-loading dump and barged to Port Alice, for use as pulp rock in the pulp-mill.

The quarry, employing three men, was closed in November after producing 19,150 tons of limerock in 1960; 16,953 tons was shipped to the pulp-mill.

British Columbia Cement Company Limited†

Cobble Hill (48° 123° N.W.). Head office, 540 Burrard Street, Vancouver 1. W. F. Foster, president; B. M. Brabant, vice-president and general manager; R. E. Haskins, vice-president in charge of production. Limestone for the Bamberton cement plant is quarried by this company from a

* By J. E. Merrett.
† By R. B. Bonar.

deposit at Cobble Hill on Vancouver Island. In 1960, 270,053 tons of raw material was mined.

MARL*

Cheam Marl Products Ltd. Popkum (49° 121° S.W.). Office, 13 South Fletcher Street, Chilliwack. R. S. Davidson, manager. This company took over all of the marl-producing area of Cheam Lake. A crew of four men was employed to excavate marl and overlying humus from a post-Glacial deposit which has accumulated on the floor of Cheam Lake. Three ½-cubic-yard-capacity dragline shovels were used to excavate the marl and topsoil from the north end of the lake. The materials thus produced were either trucked wet to the consumer or stockpiled for draining. In 1960, 31,500 tons of marl and 7,400 cubic yards of topsoil were sold for agricultural purposes.

MICA†

Georgian Mineral Industries Ltd. Cedarside (52° 119° N.E.). Company office, 108 Bamlett Building, Calgary, Alta. James Millar & Associates, management. This company built a small mica-grinding plant near Cedarside. Mica schist from deposits on Canoe River, about 2½ miles west of Cedarside, was used as a raw material. The plant operated in November and December, during which time 100 tons of mica products was produced for market by an average crew of ten men.

SAND AND GRAVEL

Data on sand and gravel production are presented in a table on the following pages. Descriptions of new operations and details of plant alterations follow the table. References to detailed descriptions previously published are shown in the table as follows: (MM 1959) meaning the report appeared in the Annual Report of the Minister of Mines for 1959.

The following abbreviations are used in the table for the types of sand and gravel produced: AA=asphalt aggregate; SA=sized aggregate; WS=washed and sized aggregate; RP=run-of-pit material; AP=asphalt paving mix; RM=ready-mix concrete.

* By J. E. Merrett.
† By D. Smith.

Sand and Gravel Pits

Location	Operator	Equipment and Plant	Men	Production
Fort St. John—				
(1) 2½ mi. south of town	H. Blair	Overhead loader	....	RP.
(2) Chuilli pit, 4 mi. southwest of town	Columbia Bitulithic Limited, Granville Island, Vancouver	Crushing and screening	11	AA.
Kitimat	Kitimat Concrete Products Limited	Dragline, conveyor, washing, crushing, screening	13–45	RP and WS.
Prince George—				
(1) North Nechako Road	Central Sand and Gravel Ltd. (J. W. Phillips, president)	Scoopmobile, screening, washing, ready-mix	11	No. 4 sand=1,610 yd. ⅜-in. sand=4,560 yd.
(2) Fifteenth Ave., Central Fort George	As above	Scoopmobile, screening	1	⅜-, ¾-, 1-, 1½-in. rock=4,820 yd. RP gravel=1,470 yd. Fill gravel=7,220 yd.
(3) Parcel Y, Lot 2507, Plan 833, Central Fort George	Northwest Paving Company Limited	Bucyrus-Erie shovel, portable crushing and screening, paving	3	....

Sand and Gravel Pits—Continued

Location	Operator	Equipment and Plant	Men	Production.
Hixon	Columbia Bitulithic Limited, Granville Island, Vancouver	Paving	—	AP=24,056 tons.
Creston—Goat River bank	Louis Salvador and Son	Crushing, screening, washing	—	WS.
Wynndel — Beside highway 4½ mi. north of town	F. Merriam	Crushing, screening	—	WS and AA.
Nelson — Anderson Creek above Fairview district	Premier Sand and Gravel Company Limited (A. Shrieves, president)	Dragline, crushing, screening (MM 1959)	4	SA=35,000 yd.
Salmo—Feeney pit, 5 mi. south of Salmo on Nelway highway	Associated Enterprises Limited, Salmo	Portable screening (MM 1959)	—	SA.
Trail—				
(1) Ferraro pit, Casino Road, 2 mi. south of Trail	Korpack Cement Products Limited, Trail	Portable crushing, screening	3	SA.
(2) McGauley pit, Casino Road, 1 mi. south of Trail	McGauley Ready-Mix Concrete Company (J. McGauley, owner)	Scraper, crushing, screening, washing, ready-mix	—	WS=24,000 yd.
Castlegar — McGauley pit, river bank east of Castlegar	McGauley Ready-Mix Concrete Company, Trail	Loader, crushing	—	
Vancouver — Granville Island	Columbia Bitulithic Limited	Asphalt pavement	—	AP=44,788 tons.
North and West Vancouver—				
(1) Capilano River mouth	Capilano Crushing Co. Ltd. (J. Jenkins, general manager)—			
	Plant No. 1, 606 Marine Drive, West Vancouver	Scraper, Lorain shovel, dumpsters, 130 tons per hour crushing, washing, screening	25	WS=521,324 yd.
	Plant No. 2, 33 East First Ave., Vancouver	Crushing, washing, screening		
(2) Lynn Creek mouth, lower end of Brooksbank Ave.	Routledge Gravel Limited (T. C. Routledge, president)	Scraper, portable crushing, washing, screening	5	WS=97,500 yd.
(3) Lynnmour	Highland Sand and Gravel Company Limited	Plant removed, production suspended; operating at Langley.	—	
(4) Seymour Creek mouth, foot of Riverside Drive	Seymour Gravel Company Limited (E. S. Livesey, manager)	Scraper, portable crushing	8	AA=93,748 yd.
(5) East of Seymour Creek	Deeks-McBride Limited, 1051 Main St., Vancouver	Gravel production suspended; stockpile and ready-mix.	—	
(6) West end of East Keith Road, east of Seymour Creek	E. R. Taylor Construction Co. Ltd., Deep Cove Highway	Shovel, paving plant	4	AA=25,810 yd.
City of Port Moody—One block south of junction Barnet Road and St. John St.	City of Port Moody		—	Sand fill.
Coquitlam Municipality—				
(1) Junction of Laurentian and Austin Roads, west end of Westwood Road	Corporation of the District of Coquitlam		—	
(2) North Road and Lougheed Highway	Burquitlam Sand and Gravel Co. Ltd. (A. J. Percy, manager)	Front-end loader	2	RP and fill=52,034 yd.
(3) South end of Schoolhouse Road	T. B. Allard and Son	Two shovels	3	Fill=41,375 yd.
(4) Pipeline Road, 1 mi. north of Lougheed Highway	Deeks-McBride Ltd., 1051 Main St., Vancouver	Shovel, washing, screening, ready-mix	14	WS=197,000 yd.
	Columbia Bitulithic Limited	Paving plant in same pit	—	AP=46,234 tons.

Sand and Gravel Pits—Continued

Location	Operator	Equipment and Plant	Men	Production
Coquitlam Municipality—*Continued*				
(5) Westwood Road	Independent Ventures Limited, 2065 Coquitlam Ave., Port Coquitlam	Shovel, crushing, screening	1	RP and SA=35,000 yd.
(6) Pipeline Road, 2¾ mi. north of Lougheed Highway	Peter Kiewit Sons Company of Canada Limited	Crushing, screening	12	SA=56,400 yd.
(7) Pipeline Road, 2¾ mi. north of Lougheed Highway	E. R. Taylor Construction Company, Deep Cove Highway	Crushing, screening	4	SA=44,574 yd.
(8) Pipeline Road, 3¼ mi. north of Lougheed Highway	S. & S. Sand & Gravel Limited, 1101 Eighth Ave., New Westminster	Front-end loader, washing, screening	6	RP and SA=67,602 yd.
(9) Pipeline Road, 3½ mi. north of Lougheed Highway	Jack Cewe Blacktop Ltd., 309 Cedar St., New Westminster	Shovel, paving plant	8	AP=47,065 yd.
(10) East side of Coquitlam River, 2½ mi. north of Lougheed Highway	Scott Bros. Gravel Co. Ltd., Port Coquitlam (J. Scott, manager)	Two loaders, two shovels, crushing, screening, washing	16	WS=107,000 yd.
(11) Pitt River Road, west of McLellan farm	Scott Bros. Gravel Co. Ltd.	Sub-lease to private producer	8	18,000 yd.
Port Coquitlam — Fraser River at Mary Hill, 2 mi. south of Port Coquitlam	Evans, Coleman & Evans Limited, 902 Columbia St., New Westminster	Shovel, 500 tons per hour processing plant producing fourteen sizes of products (MM 1960)	35	WS=478,000 yd.
Pitt Meadows Municipality—				
(1) 1 mi. northwest of Port Hammond	Haney Brick and Tile Ltd.		----	Sand.
(2) Bronson Road, 1 mi. north of Fraser River	Lassier Trucking and Contracting Co. Ltd.		----	Gravel and topsoil.
Maple Ridge Municipality—				
(1) Grant Hill, 1 mi. east of Albion	Corporation of the District of Maple Ridge	Columbia Bitulithic paving plant	----	Fill. AP=8,000 tons.
(2) Grant Hill, ¼ mi. north of above pit	McIntosh Sand and Gravel	Shovel, screening	3	RP and SA=16,000 yd.
(3) Grant Hill, north of McIntosh pit	Henry Van Boeyen	Shovel	1	RP=2,943 yd.
(4) Grant Hill, 1 mi. north of municipal pit	Hammond Pioneer Sand and Gravel Company	Shovel, coarse grizzly; delivered to Valley Ready-Mix, Albion	2	25,414 yd.
(5) East end of No. 27 Road, Alouette River	Kirkpatrick Sand and Gravel Co. Ltd., Box 188, Haney	Crushing, washing, screening, shovel, front-end loader	3	RP and WS=16,164 yd.
(6) Lougheed Highway 1 mi. east of Whonock	R. E. George, Whonock	Front-end loader	1	RP=100 yd. per month.
Mission Municipality—				
(1) 1 mi. east of Stave River power-house	Corporation of the District of Mission	Screening plant	----	
(2) 3½ mi. east of Stave River power-house	Corporation of the District of Mission	Screening plant	----	
(3) Dewdney Road, 1.8 mi. south of Steelhead	Department of Highways	Small pit	----	
Dewdney—Highway 2 mi. west of Squakum	Department of Highways	Large pit	----	
Kent Municipality — West end of Cemetery Road, south of Mount Agassiz	Corporation of the District of Kent	Rock quarry and large gravel pit	----	
Yale—				
(1) Schoolhouse Road, ¼ mi. north of Yale	R. J. G. Richards, West Vancouver	Small pit	----	RP.
(2) No. 1 Highway, ½ and 3½ mi. south of Yale	Department of Highways	Small pit	----	RP.
(3) No. 1 Highway, 2.2 mi. south of Yale	Highway Construction Co. Ltd.	Large pit	----	RP.
(4) Fraser River, 3 mi. south of Yale	Canadian National Railway	Shovel, large pit	----	RP.

Sand and Gravel Pits—Continued

Location	Operator	Equipment and Plant	Men	Production
Hope—				
(1) Princeton Highway, ½ mi. east of Hope	Village of Hope	Front-end loader	—	Sand.
(2) No. 1 Highway, 12 mi. north of Hope, Haig Station, 2 mi. northeast of Laidlaw	Department of Highways		—	
Chilliwhack Municipality—				
(1) Indian Reserve No. 1 pit, south end of Rosedale - Agassiz bridge		Columbia Bitulithic paving plant	—	Fill. AP=51,180 tons.
(2) ½ mile west of Vedder Crossing	The Corporation of the Township of Chilliwhack	Large pit, screening plant	—	WS=85,000 yd.
(3) Chilliwack Creek, 1½ mi. north of No. 1 Highway	B. and G. Sand and Gravel Ltd.	Dragline, screening	3	WS=10,000 yd.
Cultus Lake—north end of lake	Columbia Bitulithic Limited	Paving	—	AP=9,542 tons.
Sumas Municipality—				
(1) Northeast slope of Sumas Peak	Department of Highways	Large pit	—	Fill.
(2) At foot and east of Taggart Peak	H. Quadling	Large pit	—	Fill.
(3) 1 mi. east of Abbotsford	Corporation of the District of Sumas		—	Fill.
(4) Vye Road, 1 mi. north of Huntingdon	Corporation of the District of Sumas	Columbia Bitulithic paving plant	—	AP=39,847 tons.
Matsqui Municipality—				
(1) 1 mi. east of Abbotsford	Blackham's Construction Limited	Screening	2	SA=7,765 yd.
(2) Lefevre Road, 1½ mi. north of border	Corporation of the District of Matsqui		—	
(3) Ross Road, ¾ mi. south of No. 1 Highway	Corporation of the District of Matsqui	Columbia Bitulithic paving plant	—	AP=17,460 yd.
(4) Immel Road, 1 mi. east of Abbotsford	Department of Highways	Small pit	—	Fill.
(5) Tretheway Road, ¾ mi. north of Clearbrook	Department of Highways	Two adjoining pits	—	RP.
(6) Aberdeen Road, 1¾ mi. north of border	Department of Highways	Large new pit	—	Fill.
(7) Tretheway Road, ½ mi. north of Clearbrook	Dueck Ready-Mix Ltd.	Portable screening, ready-mix	8	SA=10,000 yd.
(8) Mission Road, north of Abbotsford	Valley Ready-Mix Ltd.	Small pit, ready-mix	—	
(9) Clearbrook Road, ½ mi. north of border	Abbotsford Gravel Sales	Shovel, loader, screening	3	SA=8,000 yd; RP=4,000 yd.
Langley Municipality—				
(1) Various pits	Corporation of the Township of Langley	*See* MM 1959	—	
(2) Various pits	Department of Highways	*See* MM 1959	—	
(3) Eighth Ave., 3 mi. south of Aldergrove	C. N. Foster, 782 Jackman Road, Aldergrove	Sold to Anderson Construction in November, 1960	—	RP=3,178 yd.
(4) Eighth Ave. at Matsqui boundary	Dupont Bros., Aldergrove	Loader and screening	—	RP and SA.
(5) Jackman Road, ¼ mi. north of Eighth Ave.	J. Craig, Jackman Road, Aldergrove	Loader	—	RP.
(6) Junction of Jackman Road and Eighth Ave.	S. O'Malenick, Aldergrove	Loader	—	RP.
(7) Dogwood Avenue and Brown Road	Kitsul Bros., 24306 Trans-Canada Highway	Loader	2	RP=15,000 yd.
(8) River Road and 260th St.	Miller's Trucking	Loader	1	RP=2,931 yd.
(9) Hudson Bay Ave., Fort Langley	Clark Sand and Gravel	Loader	1	RP=8,332 yd.
(10) Bradshaw and Berry Roads	Hornby General Machinery Company	Screening	1	RP and SA=16,416 yd.

Sand and Gravel Pits—Continued

Location	Operator	Equipment and Plant	Men	Production
Langley Municipality—*Continued*				
(11) Thirty-fifth Ave., east of Carvolth Road	F. W. Monssen Construction Ltd.		1	RP=3,500 yd.
(12) 2962 Lambert Road	Highland Sand and Gravel Company Limited	Shovel, crushing, screening, washing	11	WS=28,120 yd. Rock=4,652 yd. Fill=19,534 yd. RP=14,594 yd.
(13) Boundary Road	Border Sand and Gravel Company	Loader, washing, screening	2	RP and WS=19,500 yd.
	Department of Highways		....	Fill=148,605 tons.
Surrey Municipality—				
(1) East end of Stokes Road	Corporation of the District of Surrey	*See also* MM 1959	....	
(2) 104th St., 1 mi. south of Port Mann	Elderkin's Excavating Ltd.	Shovel	2	RP=12,829 yd.
(3) Adjoining Elderkin pit to east	S.U.B. Quarries Ltd.		2	SA=37,248 yd.
(4) 15945 — 112th Ave., North Surrey	Richmond Sand and Gravel Co. Ltd.	Loader, portable washing and screening	3	RP=270 yd. WS=3,700 yd.
(5) 112th Ave., east of Pike St.	Steeves and Mann Equipment Ltd.	Two shovels	1	RP=50,793 yd.
(6) Fifty-third Ave. at Delta boundary	Colebrook Sand and Gravel Company Limited	Loader, semi-portable washing and screening	2	RP and WS=19,783 yd.
(7) West end of Fifty-fifth Ave.	Colebrook Sand and Gravel Company Limited	Loader, semi-portable washing and screening	....	
(8) 12881 Eightieth Ave., North Surrey	Dueck Ready-Mix	Screening and ready-mix	....	
(9) Larsen and Latimer Road junction	Dueck Ready-Mix	Screening and ready-mix	5	SA=8,340 yd.
(10) Stokes Road, ½ mi. east of 184th St.	A. B. Longstaff & Son Ltd.	Loader	1	RP=8,340 yd.
Delta Municipality—				
(1) 10720 Eighty-fourth Ave.	Knight Gravel, Ltd.		10	RP and SA=15,200 yd.
(2) ¼ mi. south of west end of Seventy-second Ave.	Locke Holmes, 5008 Forty-seventh Ave., Ladner		1	SA=1,190 yd. Fill=2,000 yd.
(3) ½ mi. west of Scott Road at Sixty-eighth Ave.	Linton's Construction Co. Ltd.	Two shovels, paving plant	4	RP=77,592 yd.
(4) Corner of Fifty-sixth St. and First Ave.	Patrick Harrison and Company Limited	Screening	12	RP and SA=61,969 yd.
(5) Corner of Fifty-sixth St. and First Ave.	Corporation of the District of Delta	Large pit	....	
Howe Sound—				
(1) Britannia Beach	Construction Aggregates Ltd.	Crushing, washing screening (MM 1959)	15	WS=400,000 yd.
(2) Hastings Creek, 1 mi. south of Port Mellon	Evans, Coleman & Evans Limited (Hillside Division)	Shovels, crushing, washing, screening (MM 1959)	24	WS=430,000 yd.
(3) Gower Point, 2 mi. west of Gibsons	Pacific Gravel Limited	Scraper, screening	5	SA=8,000 tons.
Powell River—				
(1) Haslam Lake Road, 3 mi. northwest of Westview	G. and H. Sand and Gravel Company Ltd.	Screening, ready-mix	2	SA=1,500 yd.
(2) Allen Road, 3 mi. northeast of Westview	P. Massichuk	Screening	2	RP and SA=4,043 yd.
(3) Midway Powell River and Westview	Parson Tractor Services		4	RP=6,667 yd.
Vancouver Island—				
(1) Keating Crossroad	Butler Brothers Supplies Ltd.	Diesel-driven shovels, overhead loader, washing and sizing	6	RM, RP, WS=132,697 yd.
(2) Saanich	McIntyre & Harding Gravel Company Limited	Diesel-driven shovels, washing and sizing	16	WS=56,534 yd.

Sand and Gravel Pits—Continued

Location	Operator	Equipment and Plant	Men	Production
Vancouver Island—*Continued*				
(3) Royal Bay	Evans, Coleman & Evans Limited	Plant No. 1—scraper on a slack-line cableway, shovel, crushing, screening, and washing; Plant No. 2—diesel-driven shovel, washing and cleaning	22	WS=312,074 yd.
(4) Langford Lake	McRae Bros. Ltd.	Overhead loader	2	RP.
(5) Langford Lake	Midland Pit (George F. Fox)	Overhead loader, cleaning and sizing	—	SA.
(6) 4 mi. from Duncan on Lake Cowichan road	Butler Brothers Supplies (Duncan) Ltd.	Overhead loader, washing, sizing, and ready-mix	3	RP, WS, RM=15,428 yd.
(7) Adjacent to Island Highway at Cassidy	Cassidy Sand and Gravel Ltd.	Overhead loaders, washing and sizing	6	WS=14,804 yd.
(8) 2½ mi. from Courtenay	S. H. Marriott Sand and Gravel	Mobile loader, rotary screening	3	SA.

KITIMAT*

Kitimat Concrete Products Limited

Office and plant, Kitimat. W. Nesbit, manager. At the pit of this company, gravel is excavated by dragline and transported by conveyor to the processing plant, where it is washed, crushed, and sized. The treated product is conveyed to a series of stockpiles. A conveyor in a tunnel beneath the stockpiles removes material as required. Run-of-pit gravel is excavated by an overhead loader and loaded directly into trucks.

When the plant is in full operation, forty-five men are employed, but when only run-of-pit gravel is being produced, thirteen men are employed.

PRINCE GEORGE†

Central Sand and Gravel Ltd.

Office, P. O. Box 96, North Nechako Road, Prince George. J. W. Phillips, president. This company operates two gravel pits and a ready-mix plant. The main pit and offices are at North Nechako on the outskirts of Prince George. Here a Scoopmobile L.D. 7 mobile loader with a 1½-cubic-yard bucket digs in a 25-foot bank and feeds a small screening and washing plant. Three men are employed in the pit itself and an additional eight men on truck-driving and in the office.

The company's other pit is near the end of Fifteenth Avenue in Central Fort George. Here one man is employed loading from a 10-foot face with a Wagner Scoopmobile loader with a 1⅝-cubic-yard bucket. This gravel is either loaded directly into trucks or put through a small screening plant.

Production of sand and gravel products in 1960 was as follows: No. 4 sand=1,610 yd.; ⅜-in. sand=4,560 yd.; ⅜-, ¾-, 1-, 1½-in. rock=4,820 yd.; pit-run concrete gravel=1,470 yd.; fill gravel=7,220 yd.; total, all products=19,680 yd.

NORTH AND WEST VANCOUVER‡

Capilano Crushing Co. Ltd.

J. Jenkins, general manager. M. Greenberg, manager, No. 1 plant. This company operates two crushing and washing plants—plant No. 1 at 606 Marine Drive, West Vancouver, and plant No. 2 at 33 East First Avenue, Vancouver. Gravel

* By W. C. Robinson.
† By A. R. C. James.
‡ By J. E. Merrett.

is scraped from a bar at the mouth of Capilano River by a 240-horsepower, two-drum, Sauerman 2½-cubic-yard-capacity scraper. A 1½-cubic-yard-capacity Lorain shovel loads off the scraper pile into two Curtis-Wright 17-cubic-yard-capacity rock-dumpsters which truck the gravel to the crushing and screening plant. The gravel plant has a rated capacity of 130 tons per hour. Gravel is also dredged from the foreshore near the mouth of Capilano River. This is done with a 1½-cubic-yard-capacity Lorain shovel mounted on a barge. The dredged gravel is loaded onto scows for transport to the No. 2 plant.

In the combined operations twenty-five men were employed and 594,892 tons of gravel products was produced.

Routledge Gravel Limited

Office, Lower Capilano Road. T. C. Routledge, president. This company operates two gravel plants on the north foreshore of Burrard Inlet in North Vancouver. Plant No. 1 at the foot of Lower Capilano Road is now used for stockpiling only. Plant No. 2 is at the mouth of Lynn Creek at the lower end of Brooksbank Avenue. Gravel is scraped by a 7-cubic-yard-capacity scraper from an underwater deposit at the mouth of Lynn Creek. The material thus obtained is crushed, washed, and screened in a portable gravel-screening plant. A crew of five men produced 97,500 cubic yards of gravel. This company did custom gravel producing with portable crushing and screening plants at various places in the Province. These places included Salmo, Trail, Castlegar, Princeton, and the Fraser Canyon.

Coquitlam Municipality*

Deeks-McBride Ltd.

Company office, 1051 Main Street, Vancouver 4. James Sinclair, president; H. W. Rhodes, vice-president, production and development; J. C. Mills, vice-president, administration; J. Hoffmeyer, vice-president, sales. This company operates a gravel pit and washing, screening, and ready-mix concrete plant on Pipeline Road, 1 mile north of the Lougheed Highway. Rutledge Construction Contractors Limited, using a 1-cubic-yard-capacity Koering gasoline-driven shovel and two trucks, supply the gravel-processing plant with gravel. A total of fourteen men was employed and 197,000 cubic yards of processed gravel was produced.

Columbia Bitulithic Limited intermittently operated an asphalt-concrete plant within the Deeks-McBride pit and produced 46,234 tons of blacktop.

Independent Ventures Limited

2065 Coquitlam Avenue, Port Coquitlam. E. Warren, superintendent. G. H. Phillips Contracting Co. Ltd., contractor. A crushing and screening plant was installed within this pit, on Westwood Road about half a mile northwest of the Deeks-McBride Coquitlam washing plant. A ¾-cubic-yard-capacity Marion 32M shovel is used to excavate the gravel, which is trucked to the crushing and screening plant. The crushing plant consists of two 15- by 30-inch jaw crushers and a two-deck 4- by 8-foot Niagara screen. Approximately 35,000 cubic yards of run-of-pit and screened gravel was produced by one man.

* By J. E. Merrett.

PORT COQUITLAM*

Evans, Coleman & Evans Limited (Mary Hill Division) Company office, 902 Columbia Street, New Westminster. Quarry office, Port Coquitlam. J. H. Gilley, manager of transport and operations; E. Johnston, superintendent. The pit and processing plant are adjacent to the Fraser River at Mary Hill, 2 miles south of Port Coquitlam. Sand and gravel are removed from 30-foot faces with a 2½-cubic-yard-capacity diesel-driven shovel and trucked by 12-cubic-yard-capacity trucks to the crushing plant. A new all-steel processing plant having a capacity of 500 tons per hour was erected in 1960. This plant can produce fourteen sizes of products—namely, natural-stone concrete aggregates in six sizes from 2½ inches to No. 4 mesh, three natural-sand sizes from No. 4 mesh to No. 200 mesh, and five crushed-stone sizes. Blending can be done at the plant to produce any required combination of three sizes.

The processing plant is separated into four individual operations:—

(1) Primary crushing, washing, scrubbing, sand classification, and storage of sand, washed stone, and oversize stone. This section has a capacity of 650 to 850 tons per hour.

(2) Secondary crushing, washing, grading, and storage of crushed products. This section has a capacity of 100 to 200 tons per hour.

(3) Rewashing, grading, and storage of natural stone with a capacity of 450 tons per hour.

(4) Reclaiming, blending, and loading of shipments. This section has a capacity of 1,500 tons per hour.

Thirty-five men produced 478,000 cubic yards of sand and gravel at the plant.

SILICA

Mountain Minerals Limited† Golden (51° 116° S.W.) Company office, Meech Building, P.O. Box 273, Lethbridge, Alta. R. A. Thrall, managing director; William MacPherson, superintendent. This company holds leases covering a silica deposit on the southwestern side of Moberly Mountain, 5 miles northeast of Golden. The workings and main showings are at an elevation of 5,000 feet, and can be reached by a 6-mile road leading from the Golden–Field highway, 1 mile east of Golden. A full description of the property is given in the 1959 Annual Report.

A limited amount of development work was carried out on the property for a short period during 1960, and a number of fairly large samples of the silica was shipped for intensive testing purposes.

Oliver Silica Quarry‡ (49° 119° S.W.) Pacific Silica Limited. Registered office, 717 West Pender Street, Vancouver 1; quarry office, Box 397, Oliver. I. A. Hunter, manager. The Oliver silica quarry is on the Gypo mineral claim, owned by The Consolidated Mining and Smelting Company of Canada, Limited, and 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. During 1960 the average crew employed was twenty. Estimated production for the year was 60,000 tons, and shipments made were 12,500 tons sacked and 34,000 tons in bulk.

* By J. E. Merrett.
† By D. R. Morgan.
‡ By David Smith.

Petroleum and Natural Gas

CONTENTS

ADMINISTRATION

By J. D. Lineham

The Petroleum and Natural Gas Branch is responsible for the administration of the " Regulation Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas " made pursuant to the *Petroleum and Natural Gas Act, 1954*. The regulation provides for the use of efficient and safe practices in the drilling, completion, and abandonment of wells; for the orderly development of fields discovered within the Province; and for conservation and prevention of waste of oil and natural gas within the reservoir and during production operations.

Investigations are made of complaints of property damage resulting from geophysical and test-hole drilling programmes. The "Geophysical Regulations" are administered by the Chief Petroleum and Natural Gas Commissioner.

Administrative Staff, Victoria

The Petroleum and Natural Gas Branch is subdivided, for administrative purposes, into five sections, each of which is headed by a supervisor who is responsible for a specific phase of Branch work. These sections and the supervisors in charge are as follows:—

J. D. Lineham	Chief of the Branch
R. R. McLeod	Reservoir Engineering
A. N. Lucie-Smith	Reserves and Evaluation
W. L. Ingram	Development Engineering
S. S. Cosburn	Geology
T. A. Mackenzie	Statistics and Well Records

The headquarters staff includes also one engineer, two geologists, one engineering assistant, one draughtsman, three clerks, one clerk-stenographer, and one clerk-typist.

Field Engineering Staff, Charlie Lake

G. E. Blue	District Engineer
H. B. Fulton	Field Geologist
G. V. Rehwald	Field Engineer
H. A. Sharp	Engineering Assistant
M. A. Churchill	Engineering Assistant

The field office staff includes also one general assistant and one clerk-stenographer. Two university students were employed during the summer months.

The field office, established at Dawson Creek in January, 1953, was transferred on June 24th, 1960, to Charlie Lake, a small community on the Alaska Highway about 5 miles northwest of Fort St. John.

The Charlie Lake property, purchased from McMahon Construction and Development Co. Ltd., consisted of six basic buildings, including four residences, situated on approximately 7 acres of land between the Alaska Highway and the shore of Charlie Lake. The main building was a 60- by 100-foot Butler-type unit with a 24- by 60-foot frame lean-to annex at the back and a frame lean-to office annex on the east side. The other chief buildings included a 30- by 60-foot aluminum-sided frame building, three two-bedroom Pan-abode residential units, and one three-bedroom prefabricated house. The existing water and sewage systems were acquired with the property.

New construction included replacement of the former office annex by a 32- by 100-foot concrete-block unit designed and equipped for use as a geological laboratory; installation of a new reinforced-concrete floor in the main building; installation of steel core racks thereon; rearrangement of the office facilities; and construction of two split-level three-bedroom residences.

The field staff occupy five of the six residences on the property. One of the new units is allocated to the Department of Highways.

Commencing early in 1961, samples of bit-cuttings and the core from all wells drilled in the central and northern parts of the Province will be processed and stored at Charlie Lake, where they will be made available for examination, in accordance with the provisions of the regulations, to all interested persons. A nominal charge will be made for the use of the facilities provided.

EXPLORATION

By S. S. Cosburn

In northeastern British Columbia forty-eight seismic crews did reflection and refraction seismic work for twenty-two oil companies in 1960, much of the recording being done during the winter months; at the end of December, thirteen crews were active in the area. From May to mid-October, geological crews of at least twelve oil companies continued the surface mapping of the plains, foothills, and Rocky Mountains. One company drilled twenty-two correlation test-holes on one of its permits.

In other parts of the Province several sedimentary areas were investigated for oil and gas potential using the following exploratory methods:—

(1) Fernie and Flathead area—seismic and geological surveys.
(2) Chilcotin area—seismic and geological surveys.
(3) Vancouver-Chilliwack area—seismic survey.
(4) Graham Island—gravity, seismic, and geological surveys.

During 1960 there were 179 wells operating in British Columbia. Of these, 174 were drilled in northeastern British Columbia (172 north of the Peace River), two in the Fernie-Flathead area, two in the Chilcotin area, and one in the Vancouver-Chilliwack area.

In northeastern British Columbia 170 wells were located on the plains and four in the Rocky Mountain foothills.

Of 102 exploratory wells drilled in British Columbia in 1960, the following discovery wells were completed:—

Oil Discoveries

Well Name	Oil Zone
Union-HB Woodrush d-74-H	Triassic Halfway.
Union-HB Wildmint d-46-A	Triassic Halfway.

Gas Discoveries

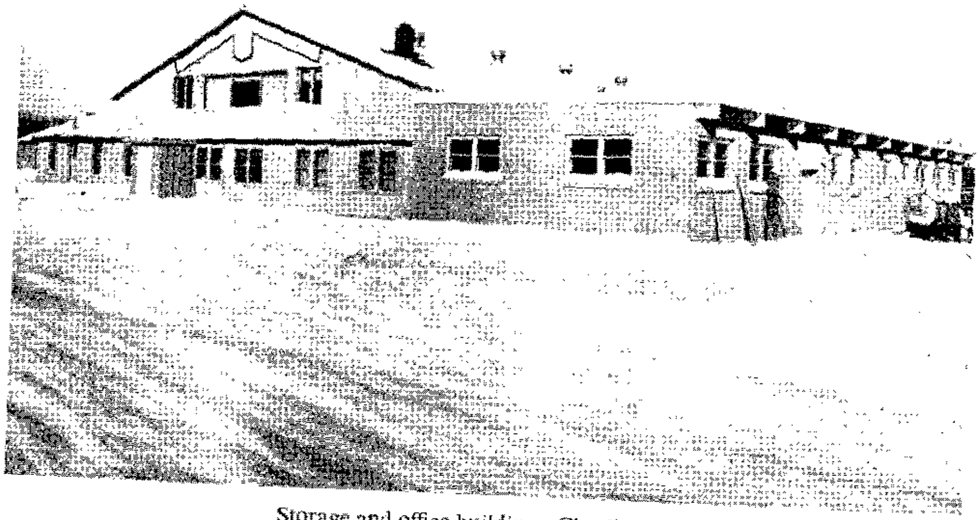
Well Name	Gas Zone
Calvan Tommy Lakes a-29-A	Triassic Halfway.
Imp Pac Sunray Wargen c-58-C	Lower Cretaceous Bluesky-Gething.
Pacific H.B. Pocketknife c-37-L	Mississippian Rundle.
Pacific North Kotcho c-93-C	Mississippian Rundle.
Pan Am A-1 Cam Lake a-31-I	Devonian carbonate.
Pan Am A-1 Deer Lake a-90-I	Devonian carbonate.
Phillips-SR-West Cdn-Kledo c-14-G	Devonian carbonate.
Sinclair Pacific West Beg c-84-C	Triassic Schooler Creek.
Sinclair et al Dogrib a-79-F	Triassic Schooler Creek.
Sinclair et al Dogrib b-17-K	Triassic Schooler Creek.
Sun et al Jeans a-57-A	Mississippian Rundle.
Texaco NFA Silver c-52-K	Lower Cretaceous Bluesky-Gething.
Woodley-Imperial Bigfoot d-27-C	Mississippian Rundle.

FIELD OFFICE

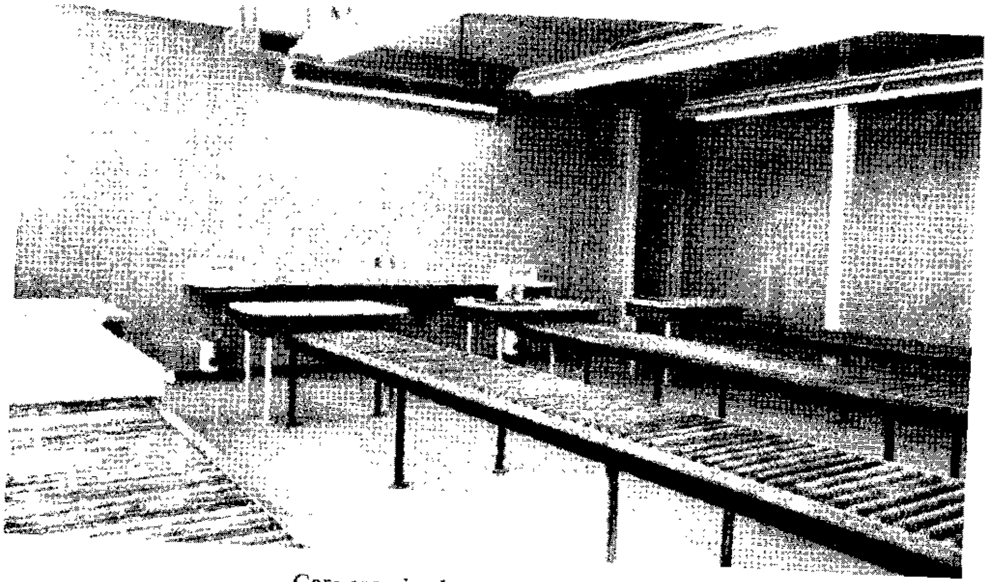
By G. E. Blue

FIELD WORK

Field work was done for the purpose of enforcing the " Regulations Governing the Drilling of Wells and the Production and Conservation of Oil and Natural Gas " and the " Geophysical Regulations," as well as for the promotion of orderly develop-



Storage and office buildings, Charlie Lake.



Core-examination room, Charlie Lake.

ment in exploration, drilling, and production activities. The field staff carried out comprehensive inspections of all phases of drilling and producing operations in northeastern British Columbia and periodic inspection of drilling activities in the Chilcotin area of central British Columbia and in the Fernie and Flathead areas in southeastern British Columbia. A total distance of 96,860 miles was driven in the performance of the inspection work.

Oil exploration was stimulated by the construction of a 6-inch oil-line from the Boundary Lake field to Taylor. A 4-inch line was also laid between Taylor and Dawson Creek. At the end of 1960 work was progressing on an 8-inch line to the Peejay, Milligan Creek, Beatton River, and West Beatton River fields.

Due to the rapid expansion of gas production, and the marked increase in the number of wells that are capable of producing gas but as yet are not tied into the gas-gathering system, a programme involving seventy-seven absolute-open-flow tests was completed. These tests were conducted or witnessed, and the results calculated, by field personnel. Six of the tests were made on wells completed in two productive zones. Open-flow-potential tests were made not only on wells located within fields producing into the gas-gathering system but also on recently discovered wells, including those completed in the Devonian Slave Point reservoirs near and northeast of Fort Nelson. The calculated results of these tests, known as official absolute-open-flow potential tests, are used as the basis upon which production-rate limits are established for gas wells.

The programme of measuring reservoir temperatures and pressures continued throughout the year, weather permitting. A total of 110 successful runs was made with the Branch-owned bottom-hole unit besides a number of runs for which the results were inconclusive, incomplete, or unacceptable, due to mechanical failures or operational difficulties. The charts and results of all successful runs were forwarded to Victoria for use in conjunction with reservoir studies. The bottom-hole unit is not available to conduct surveys for the benefit of any operator. It is operated solely at the initiative of the Branch, which determines its programme in accordance with the information requirements of the engineering staff.

Eighty-seven abandoned well-site inspections and 120 lease inspections were made. The policy of inspecting gas meters on producing wells at least once a month was continued in 1960. Eleven hundred and thirty-eight gas meters were checked and seven operating batteries were inspected. Three hundred and fifty-nine operating rig visits were made over an area from Alexis Creek in the Chilcotin area to the northern boundary of the Province. Two rig inspections were made of the wells drilled in the Flathead and Fernie areas of southeastern British Columbia.

Reported infractions of the " Geophysical Regulations " were investigated, as required, on behalf of the Chief Petroleum and Natural Gas Commissioner.

H. B. Fulton and D. L. Griffin, staff geologists, made a one-week field trip during June to study Devonian outcrops in the vicinity of Mile 420 on the Alaska Highway.

A two-man trailer, acquired during January, and equipped with bunks, stove, refrigerator, and the essential accessories, greatly facilitated accomplishment of field work in uninhabited areas. The trailer also serves as a temporary office at Fort Nelson during the winter drilling season.

Geological Laboratory

A geological laboratory, operated in conjunction with the new field office at Charlie Lake, was completed during December.

The original core-storage unit, a Pan-abode building erected in Pouce Coupe in 1955 and which has been filled to capacity since September, 1957, was abandoned following the transfer of all core to Charlie Lake.

The new laboratory provides core-storage space and facilities for core examination, sample washing, systematic sample filing, and sample examination. Core storage is confined to the main building, and all other facilities are contained in the 32- by 100-foot annex.

1. Core Storage

The main part of the principal building purchased from McMahon Construction and Development Co. Ltd., and the permanent annex attached to it, were converted for core-storage purposes. Conversion of a 60- by 100-foot area involved replacement of the original floor by a reinforced-concrete floor 8 inches thick, supported by reinforced-concrete piles tied together with steel beams. Steel core racks, constructed of 2- by 2- by ¼-inch angle-iron members welded together, are installed in both single and double rows to utilize all available space. They are 10 feet high, 2½ feet deep, and are provided with individual core-box bays 3½ feet wide and 2½ feet high. The racks are designed to carry a load on top to permit an additional 2 feet of storage space, thus providing for core storage 12 feet high.

The maximum capacity of the unit is estimated to be 20,000 boxes 32 inches long, 10 inches wide, and 4 inches high, which represents approximately 102,000 feet, or 19 miles, of core. The ultimate weight of the core and racks is estimated to be approximately 1,000,000 pounds.

An additional storage unit, to adjoin the west side of the main building, is planned for the time when the existing space has been filled. The addition will be required within a year.

An electric fork-lift truck with a capacity of 2,000 pounds is used to transport core within the buildings.

2. Core Examination

The core-examination room, which adjoins the core-storage unit, is lighted by both natural and fluorescent light. It contains four conveyor stands, 18 feet long and 2½ feet wide, equipped with steel rollers to facilitate handling of core-boxes. A core-examination table, 4 feet wide and 2½ feet deep, is provided at the end of each conveyor stand. Utility outlets are located conveniently.

3. Sample Washing

Washing of bit-cutting samples is done with a modern sample-washing machine, operated by two men, which washes and dries the samples in one continuous operation. Three complete sets of samples of all wells are bottled in glass vials. One set is supplied to Branch headquarters at Victoria, one is forwarded to the Calgary office of the Geological Survey of Canada, and one is filed in the sample library at Charlie Lake. A total of 59,907 samples was washed and bottled in Victoria during the year.

4. Sample Examination

The sample-examination room is equipped with four desks, a galvanized-sheeted work bench, two stainless-steel sinks, and utility outlets for the convenience of persons examining bit-cuttings.

The geological laboratory provides facilities for examination of both cores and bit-cuttings, at a nominal charge, to all interested persons. Non-confidential cores and samples are available for examination from 8.30 a.m. to 5 p.m. Monday to Friday, inclusive. Cores and samples from wells classified as confidential may be examined only by personnel employed by the company responsible for drilling the well. However, examination privileges involving any well will be granted, within normal office hours, to anyone who can present written authority from the responsible company giving the Branch District Engineer specific approval to release, to a named person, the cores and samples from a named well.

DEVELOPMENT

By W. L. Ingram

Drilling

Drilling and production activity continued to make substantial increases in the northeastern part of the Province.

During 1960 drilling operations were carried out at 179 locations, an increase of nearly 30 per cent over 1959. Total footage was 769,433 feet, a 25-per-cent increase. This was accomplished by fifty-five drilling rigs that were operated by twenty-two contracting companies.

One of the highlights of the drilling progress was recorded when Canada's deepest well was drilled to a depth of 16,540 feet in the Crowsnest Pass area of British Columbia. A remarkable achievement, and also a Canadian record, the fact that 15,472 feet of the hole was uncased during the drilling operation. This well was partly drilled using compressed air as the circulation medium rather than the conventional drilling mud. Five other drilling locations in the northeastern part of the Province employed the same principle but operated with natural gas from nearby producing wells. This method, still in the experimental stage in British Columbia, proved very successful provided that zones containing large quantities of water were not encountered.

Eighty-four successful completions, represented by forty-seven oil and thirty-seven gas wells, were recorded during 1960. The number of gas wells was seven less than the previous year, but oil-well completions were more than doubled—forty-seven as compared to twenty. This increase was indicative of the concentration of development drilling in the known oil pools. Thirty-two of the completed oil wells were in the Boundary Lake field.

The number of abandoned holes showed a marked increase, being sixty-six in 1960 as compared to forty-six in 1959.

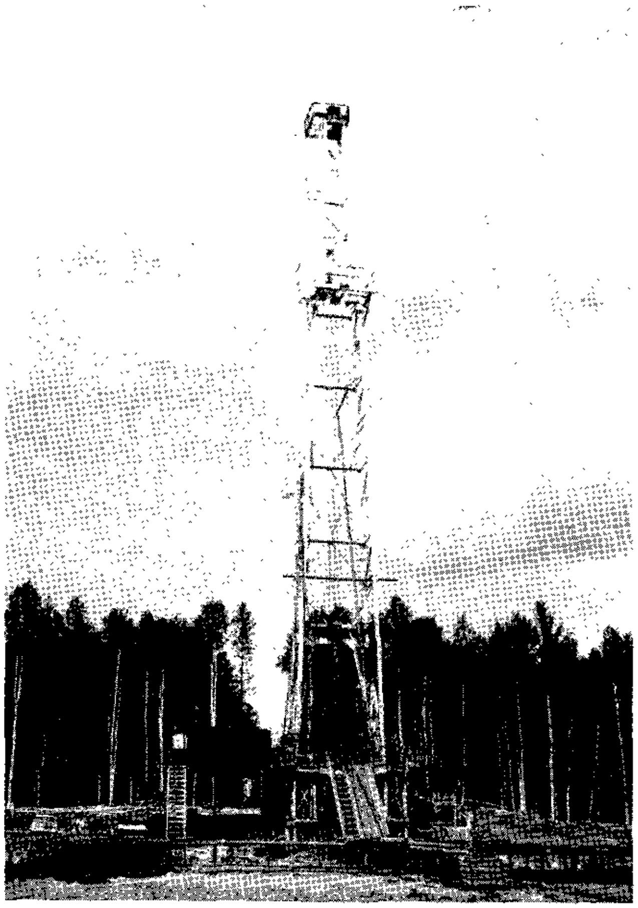
At the end of 1960 twenty-eight wells were drilling and two were classified as suspended pending further drilling.

A complete summary of the wells drilled during 1960 is shown in Table 2, and a tabulation of general statistics concerning well operation and production data is shown in Table 1.

Four new fields were designated at Aitken Creek, Clarke Lake, Laprise Creek, and Peejay, and revisions were made to thirteen of the previously existing fields. The Branch designates a field when one well is placed on steady production or a minimum of three contiguous potential wells are proven. The total fields, as of December 31st, 1960, are shown in Table 3.

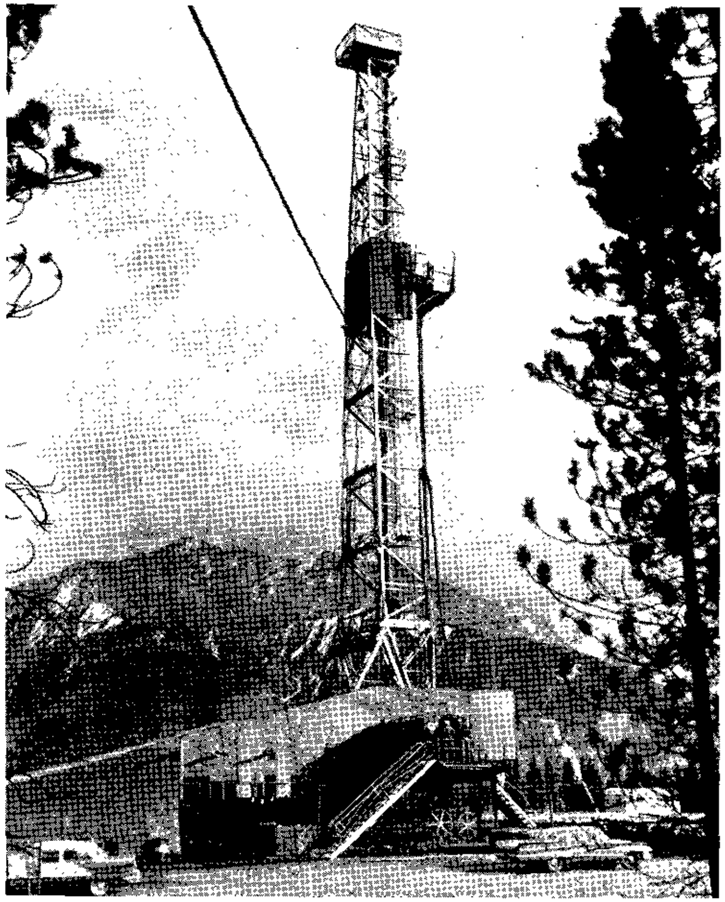
Production

At the end of 1960 there were 230 wells considered capable of producing natural gas and 104 capable of producing oil. A total of 104 gas wells and fifty-two oil wells were on production.



(Western Natural Gas Co. photo.)

West Nat et al Evie Lake b-89-E wildcat well,
15 miles west of Fort Nelson.



(Commonwealth Drilling Company Ltd. photo.)

Calstan Fording Mtn d-61-L wildcat well. The deepest
well in Canada, 16,540 feet.

During 1960 eighty-two oil wells produced 867,057 barrels of crude oil and 121 gas wells produced 85,516,996,000 cubic feet of natural gas. Relative to 1959, crude-oil production increased by 2,307 barrels while natural-gas production increased by 16,388,288,000 cubic feet or 24 per cent.

Compared with 1959, production of by-products showed a 29-per-cent increase in propane to 125,091 barrels, a 42-per-cent increase in butane to 293,368 barrels, a 46-per-cent increase in condensate/pentanes plus to 750,857 barrels, and a 12-per-cent increase in sulphur to 60,454 short tons.

Most of the produced crude oil was sold to the refineries at Dawson Creek and Taylor, the quantities being 724,813 barrels and 73,709 barrels respectively. Smaller shipments were made to the Alberta refinery at Grande Prairie and for completion programmes at British Columbia wells. With losses amounting to 3,696 barrels, the total British Columbia crude oil sold was 838,598 barrels.

The Westcoast Transmission Company Limited purchased the net natural gas produced in British Columbia,* plus 29,949,566,000 cubic feet from northwestern Alberta fields. With a reported line loss of 2,121,268,000 cubic feet, delivery of natural gas to British Columbia Electric Company Limited was 18,120,117,000 cubic feet, to Inland Natural Gas Co. Ltd. was 6,108,999,000 cubic feet, to Plains Western Gas and Electric Co. was 1,510,417,000 cubic feet, and the balance of 82,204,164,000 cubic feet was sold to the El Paso Natural Gas Company (formerly Pacific Northwest Pipeline Corporation) for consumption in the United States. The quantity exported represents almost 75 per cent of the total distributed.

The communities of Pouce Coupe and Dawson Creek were supplied from Alberta wells, consuming 1,234,455,000 cubic feet of gas during the year.

The annual production of salt water was 154,147 barrels from eighty wells, of which sixty-three were natural-gas wells and seventeen were oil wells. This water was disposed of by the injection of 107,333 barrels into the disposal well, Pacific Ft St John 3-30-83-18(6), and by evaporation from surface pits at the well locations.

Gas-gathering System

The gas-gathering system was extended from West Buick Creek field by a 16-inch line to Nig Creek field and thence by 12-inch line to Laprise and East Laprise fields, an over-all distance of 55 miles. A short lateral from this line tied in the Snyder Creek well.

In addition, a 16-inch line, 30 miles long, was built from the McMahon plant at Taylor to the Boundary Lake field. This line will be extended later into Alberta to connect with the Worsley gasfield.

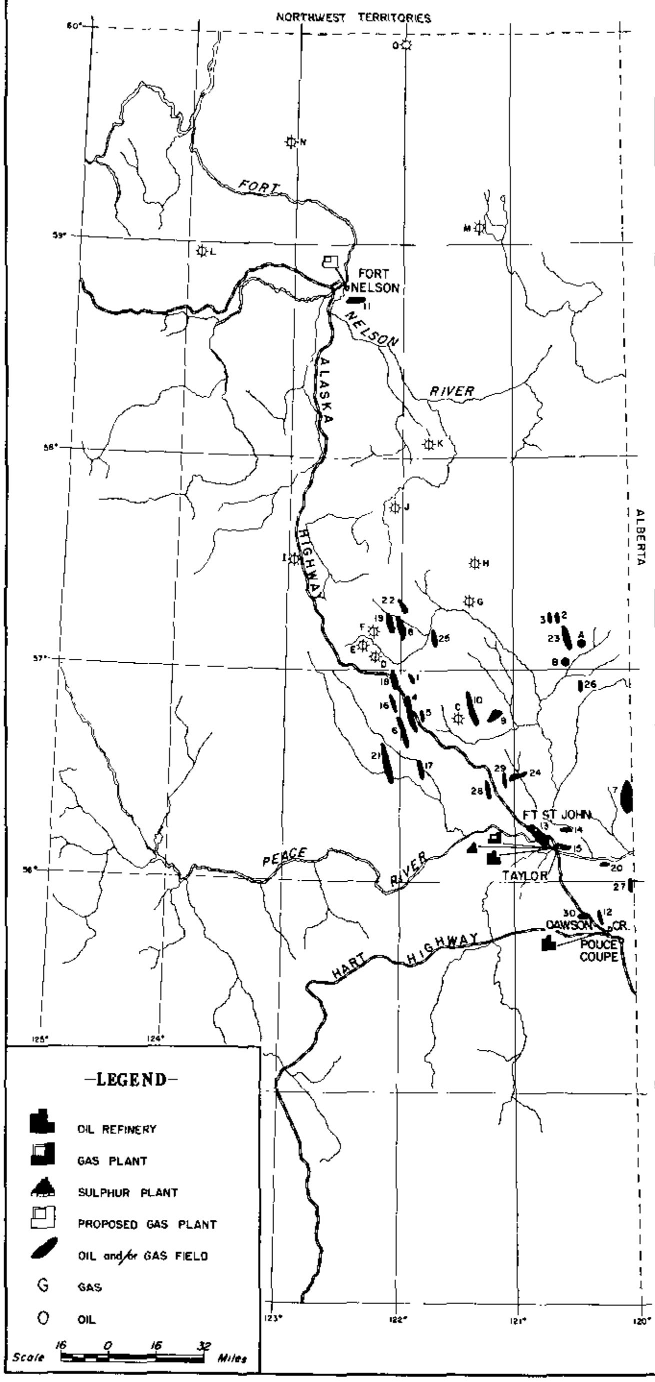
Oil-gathering System

Peace River Oil Pipe Line (B.C.) Ltd. decided against building the oil-gathering system centred on Taylor, and the Government awarded the system to Trans-Prairie Pipelines Ltd., one of the other applicants. Part of the 8-inch line north from Taylor, the 6-inch line from Boundary Lake field, and the 4-inch line to Dawson Creek had been completed by the end of 1960, and Boundary Lake crude was being supplied by pipe-line to the XL refinery at Dawson Creek. The remainder of the system to the Peejay, Milligan Creek, Beatton River, and West Beatton River fields will be completed early in 1961.

* After allowing for lease use, flared, line loss and metering difference, plant fuel, processing, shrinkage, and plant waste and metering difference, net natural gas in British Columbia equals 80,115,399,000 cubic feet.

OIL & GAS FIELDS OF N.E. BRITISH COLUMBIA

SHOWING 1960 DISCOVERY WELLS



FIELDS & POOLS — DEC. 31, 1960

1	Aitken Cr.	G, O	Gething
2	Beatton River	O	Halfway
3	Beatton River West	O	Bluesky-Gething
4	Blueberry	G	Dunlevy
		G	Baldonnel
		G	Charlie Lake
		G, O	Mississippian
5	Blueberry East	G	Baldonnel
		G	Halfway
		G	Mississippian
6	Blueberry West	G	Dunlevy
		G	Baldonnel
7	Boundary Lake	G	Bluesky-Gething
		G	Gething
		G	Baldonnel
		O	Boundary Lake
		O	Halfway
8	Bubbles	G	U C of Schooler Cr.
9	Buick Creek	G	Buick Creek
		G	Charlie Lake
10	Buick Creek West	G	Buick Creek
		G	Baldonnel
		G	Halfway
11	Clarke Lake	G	Devonian Carbonate
12	Dawson Creek	G	Cadotte
13	Fort St. John	O	Gething
		G	Cadomin
		G	Baldonnel
		O	Charlie Lake
		G	Halfway
		G, O	Belloy
14	Fort St. John Airport	G	Cadomin
		G	Baldonnel
		G	Halfway
15	Fort St. John S.E.	G	Cadomin
		G	Baldonnel
		G	Halfway
		G	Belloy
16	Gundy Creek	G	Baldonnel
		G	Charlie Lake
17	Halfway	G	Baldonnel
		G	Halfway
18	Highway	G	Dunlevy
		G	Baldonnel
		G	Mississippian
19	Jedney	G	U.C. of Schooler Cr.
		G	Halfway
20	Kiskatinaw	G	Upper Devonian
21	Kobes-Townsend	G	Dunlevy
		G	Charlie Lake
		G	Halfway
		G	Mississippian
22	Laprise Creek	G	U.C. of Schooler Cr.
23	Milligan Creek	O	Halfway
24	Montney	G	Bluesky-Gething
		G	Charlie Lake
		G	Halfway
25	Nig Creek	G	U.C. of Schooler Cr
26	Peejay	O	Halfway
27	Pouce Coupe	G	Cadotte
28	Red Creek	G	Charlie Lake
		G	Halfway
29	Stoddart	G	Belloy
30	Sunrise	G	Cadotte

DISCOVERY WELLS—1960

A	Union H.B. Woodrush d-74-H	O	Triassic Halfway
B	Union H.B. Wildmint d-46-A	O	Triassic Halfway
C	Sun et al Jeans a-57-A	G	Mississippian Rundle
D	Sin. Pac. W. Beg c-84-C	G	Triassic Schooler Cr.
E	Sin et al Dogrib a-79 F	G	Triassic Schooler Cr.
F	Sin et al Dogrib b 17 K	G	Triassic Schooler Cr.
G	Imp. Pac. Sry Worgen c-58 C	G	L. Cret. Bluesky—Gething
H	Tex N.F.A Silver c 52 K	G	L. Cret. Bluesky—Gething
I	Pac. H.B. Pocketknife c 37 L	G	Mississippian Rundle
J	Calvan Tommy Lakes a-29-A	G	Triassic Halfway
K	Woodley Imp. Bigfoot d 27 C	G	Mississippian Rundle
L	Phillips Kledo Creek c-14 G	G	Devonian Carbonate
M	Pacific N. Kotcho c-93-C	G	Mississippian Rundle
N	Pan Am A-1 Deer L. a-90 I	G	Devonian Carbonate
O	Pan Am A-1 Cam L. a 31-I	G	Devonian Carbonate

Figure 17. Petroleum and natural-gas fields, 1960.

A new refinery unit, consisting of a crude-oil distillation unit, a hydrofluoric alkylation plant, and a fluid catalytic cracking unit, estimated to have a capacity of 2,000 barrels per day, went on stream at Taylor on October 19th, and until the end of 1960 was processing a mixture of crude oil from the Blueberry field, delivered by tank-truck, and condensate from the McMahon plant. This refinery will use Peejay crude instead of Blueberry crude as soon as the oil-gathering system reaches the Peejay field.

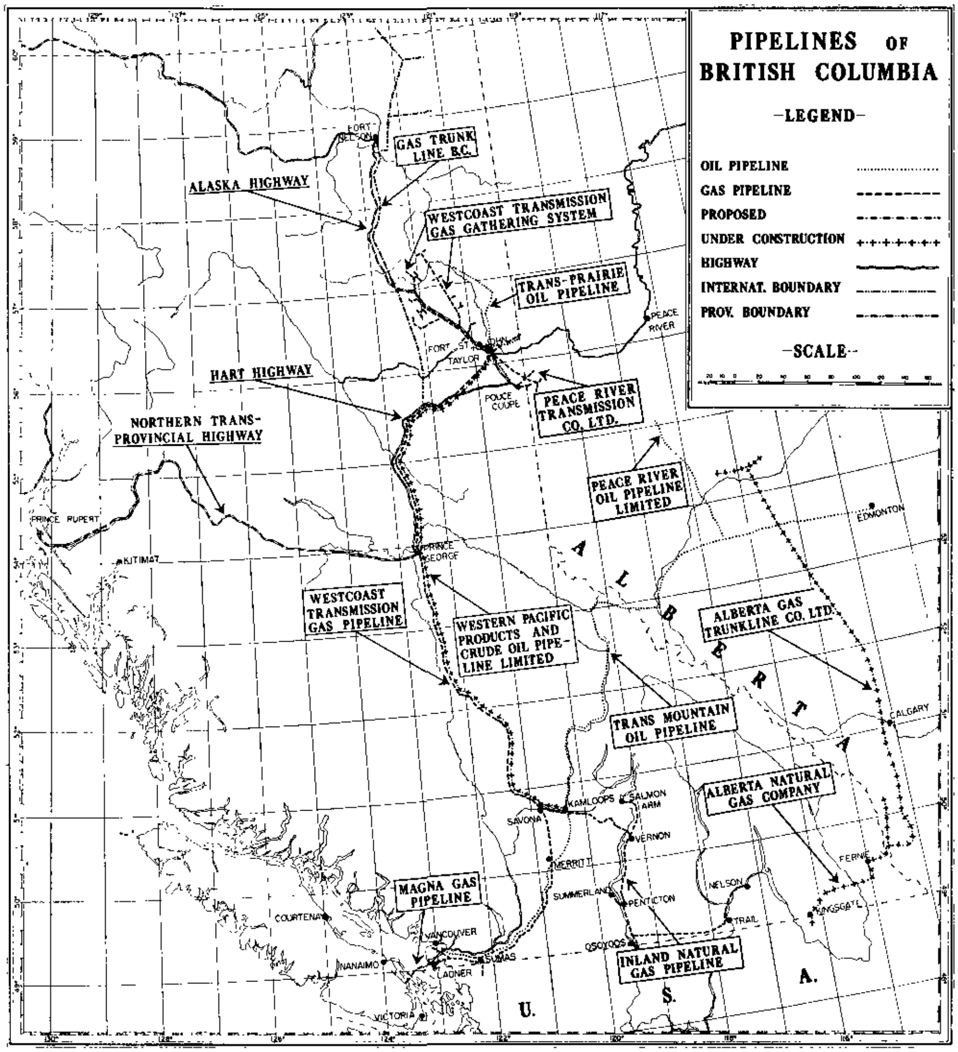


Figure 18. Oil and gas pipe-lines, existing and proposed.

RESERVES

By A. N. Lucie-Smith

Proved recoverable reserves of crude oil and natural gas did not increase in 1960 as much as they did in 1959, although the increases were still substantial, being 16.1 per cent for oil and 21.4 per cent for gas. A summary of these reserves, together with explanatory notes, is given in Table 13.

Development drilling during 1960 in the Boundary Lake field led to a downward revision of 1,710,000 barrels in the reserve for the Boundary Lake zone in this field. On the other hand, development drilling in the West Beatton River, Peejay, and Blueberry fields increased the reserves of these fields appreciably. New discoveries in the Charlie Lake and Halfway formations at Boundary Lake and in the Halfway at Wildmint and Woodrush have not yet been fully appraised, and therefore the reserves added from these discoveries have been small. Oil was also discovered in the Dunlevy formation at Blueberry, but, as testing was still in progress at the end of the year, no reserve has yet been included from this source.

The increase in gas reserves is due mainly to additional drilling in the Petitot River and Kotcho Lake areas, to the development of Laprise and East Laprise fields, and to discoveries in the Mississippian at La Biche (although classified as a 1959 discovery the La Biche reserve was not included until 1960 due to the suspension of the well) and Pocketknife, and in the upper carbonate of the Schooler Creek formation at Dogrib. Other promising gas discoveries were made in the Bluesky-Gething at Wargen and Silver, in the Halfway at Tommy Lakes, in the Schooler Creek upper carbonate at West Beg, and in the Mississippian at Big Foot. At Kotcho a second reef in the Devonian carbonate has been located by seismic surveys east of the main reef, and a well drilled in the syncline between the two reefs encountered a small reserve of gas in the Mississippian. Potential gas discoveries in the Devonian carbonate at Evie Lake (drilled in 1959), Beaver River, Cam Lake, Deer Lake, and Kledo await final completion of the wells for confirmation before any additions from these sources can be made to the reserves. A well drilled on the Jedney trend 2 miles northwest of the field discovered large quantities of gas in both the Schooler Creek upper carbonate and the Halfway and may prove a considerable extension to the Jedney field, since it is structurally higher than any well in the field. In addition, a small gas reserve has been developed in the Charlie Lake formation in the Blueberry field.

At the end of 1960 an extensive winter drilling programme was about to begin in order to appraise the large potential gas reserve in the Clarke Lake, Kotcho Lake, and Petitot River areas. A 30-inch gas trunk line from Fort Nelson 245 miles south to tie into the main gas transmission-line at Chetwynd is under study, and a 12-inch oil-line from Taylor to tie into the Trans-mountain Oil Pipeline at Kamloops is expected to be in operation by the end of 1961. These projected pipe-lines should give great impetus to drilling for additional gas and oil and, in consequence, reserves of both are anticipated to increase materially next year.

STATISTICS AND WELL RECORDS

By T. A. Mackenzie

Information concerning the British Columbia oil and gas industry is collected, classified, and tabulated by the Petroleum and Natural Gas Branch and made available in statistical content and form to all interested parties in accordance with government regulatory practices.

In most instances the dissemination of releasable information follows a similar pattern in the four western Provinces. With the increased activity in the Northwest Territories, it is believed that the Federal agencies will adopt the procedures of collection and tabulation already established by the western provincial agencies and in particular those formulated by the Statistical Subcommittee, and through which a high degree of standardization in data compilation and uniformity in reporting will be achieved.

The *Statistical Subcommittee, a study group representing both industry* and the several provincial authorities, was established in 1955 at the request of the Mines Ministers' Conference and is responsible to the Interprovincial Petroleum and Natural Gas Committee.

All well information submitted to the Branch by oil and gas operators is classified and released to the public in accordance with government regulation. In the case of an exploratory wildcat well, all information is confidential for one year following release of the rotary rig. Field wells are held confidential for thirty days following the release of the rotary rig, providing a year has expired since the release of the rotary rig from the discovery well. Shallow-pool tests and deep-pool tests in a designated field are held confidential for one year following release of the rotary rig.

Generally, information is released by means of publications or by opening the records for examination. More detailed and specific information contained in the Statistics and Well Information Section is open for examination at nominal rates. In certain cases the Branch will reproduce records on request. For this service, cost-defraying charges are made. Confidential well information may be made available to an interested person upon the Branch receiving authorization by letter from the operator to release specific information to a named person. This confidential aspect of well informaton is important. In order to cope with the problem, the well records are divided into two groups—confidential and non-confidential—and a positive control card system is in effect. Branch personnel are fully aware of the high degree of importance attached to the handling of confidential data.

An important aspect of the handling of well information and the preparation of statistics is the establishment of flexible and detailed well records and production records for intramural as well as extramural use. Within the Branch, the records are in daily use by other sections—namely, Reservoir Engineering, Reserves and Evaluation, Development Engineering, Geology, and Administration.

The above-mentioned Statistical Subcommittee was established in 1955 by the Technical Committee of the Interprovincial Petroleum and Natural Gas Committee, Mines Ministers' Conference. Since then the Statistical Subcommittee has recommended the adoption of a number of model reporting forms by governments and industry employing either manual or machine reporting methods.

The basic forms used by the Department, some of which have been adapted from model forms, are as follows:—

Form No.	Form Name
1.	Application for a Drilling Authority.
1A.	Application to Amend a Drilling Authority.
2.	Application to Change a Well Name.
3.	Application to Abandon a Well.
4.	Application to Alter Condition of a Well.
5.	Well Completion Data.
6.	Work-over Report.
7A.	Well Inspection Report.
7B.	Rig Inspection Report.
7C.	Meter Inspection Report.
7D.	Battery Inspection Report.
*8A.	Application to Commingle Production before Measurement.
*8B.	Approval to Commingle Production before Measurement.
*8C.	Application to Amend Approval to Commingle Production before Measurement.

* Adapted from a model form recommended by the Subcommittee.

Form No.	Form Name
9.	Application for M.P.R.-Oil.
*11.	New Oil Well Report.
*12.	New Gas Well Report.
*13.	Battery Test Data Sheet.
16.	Petroleum and Natural Gas Statistics.
*17.	Monthly Proration and Production Report.
*18.	Annual Natural Gas Purchaser and Distribution Report.
*19.	Monthly Refinery Operations Report.
20.	Single Oil Well Production Report.
21.	Single Gas Well Production Report.
**Nil.*	Monthly Gas Gathering System Operations Report.
**Nil.*	Monthly Gas Plant Operations Report.
Nil.	Monthly Sulphur Plant Operations Report.
**Nil.*	Monthly Disposition Report and Crown Royalty Statement.

* Adapted from a model form recommended by the Subcommittee.

Other forms recommended by the Subcommittee but not yet adopted by the Department include:—

Monthly Oil Pipe-line Operations Report.

Monthly Water Receipts and Disposal Report.

Natural Gas Measurements and Casing Pressure Readings.

Monthly Water Flood Operations Report.

Monthly Natural Gas and/or Liquid Petroleum Gas Injection Operations Report.

Statement of Nomination and Estimated Requirements for Crude Oil.

With the recent acceleration of gas export agreements between Canada and the United States, the Branch, through membership on the Statistical Subcommittee, has given assistance to the Federal agencies in designing gas-pipelines forms to be used by industry. These are joint forms which, in the case of gas purchasers and distributors, will be collected in each Province on behalf of the Dominion Bureau of Statistics.

The following publications are available from the Branch:—

Monthly Oil and Gas Report. Subscription, $6 per annum.

Drilling and Land Report. Subscription, $6 per annum.

Schedule of Wells. Price, $7.50 per copy.

Monthly Crude Oil and Natural Gas Production by Field/Area and Pool, 1960. Price, $5 per copy.

List of Released Geological Reports on Oil and Gas Permits. Price, 50 cents.

List of Publications, Services and Maps Available. Free.

Table 1.—Summary of Drilling and Production Statistics, 1960

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Well Data													
Drilling authorities issued	31	31	5	3	6	5	9	5	6	10	18	20	149
Wells spudded	27	29	13	2	2	9	10	6	4	13	10	23	148
Rigs operated during month	45	47	43	24	23	24	27	27	22	22	24	35	....
Rigs operating at end of month	40	39	22	22	18	21	22	19	16	17	19	29	....
Development footage	34,021	33,941	19,056	8,134	20,609	25,557	21,981	17,916	5,063	27,105	49,983	39,590	302,956
Exploratory outpost footage	36,920	27,678	13,638	4,937	2,404	7,747	20,604	5,855	14,535	5,976	6,982	6,849	154,143[1]
Exploratory wildcat footage	62,193	84,960	44,589	10,576	9,103	9,163	11,297	19,939	9,740	9,727	10,661	30,386	312,334
Footage drilled, total	133,134	146,579	77,283	23,647	32,116	42,467	53,882	43,710	29,338	42,808	67,626	76,825	769,433[1]
Wells abandoned	9	15	15	1	2	1	2	2	4	3	3	9[2]	66
Oil Wells													
Completed	5	10	9	....	3	4	5	3	1	2	3	2	47
Capable of production	63	73	82	82	84[3]	88	93	96	97	99	102	104	104
Operated	33	35	41	31	35	39	45	55	52	57	36	52	....
Production (bbl.)	89,713	77,255	81,446	26,036	56,276	74,464	105,097	87,407	88,627	74,904	26,757	79,075	867,057
Average daily production (bbl.)	2,990	2,575	2,715	868	1,876	2,482	3,503	2,914	2,954	2,497	892	2,636	....
Gas Wells													
Completed	3	5	5	2	1	2	2	3	2	5	2	5	37
Capable of production	196	201	206	208	209	211	213	216	218	223	225	230	230
Operated	79	80	81	82	82	81	81	83	87	88	100	104	....
Production (M s.c.f.)[4]	7,387,632	6,942,684	7,327,705	7,199,831	7,067,390	6,878,830	6,746,958	6,770,999	6,696,246	7,007,987	7,308,817	8,181,917	85,516,996
Average daily production (M s.c.f.)	246,254	231,423	244,257	239,994	235,580	229,294	224,899	225,700	223,208	233,600	243,627	272,731	....
Reclassified wells	3	....	....	....	1	....	....	....	....	....	....	....	4
Gas-plant By-products													
Condensate/pentanes plus (bbl.)	72,578	56,328	65,751	62,714	65,916	61,774	53,448	59,053	62,942	64,701	60,054	65,589	750,848
Butane (bbl.)	29,287	26,626	26,031	20,026	19,945	19,845	23,126	24,223	24,757	28,606	25,436	25,460	293,368
Propane (bbl.)	10,623	5,807	7,018	7,215	9,149	8,260	10,391	11,380	10,804	13,632	15,666	15,146	125,091
Sulphur (short tons)	5,420	5,007	5,194	5,152	5,262	4,803	4,597	4,823	4,937	4,699	5,090	5,470	60,454

[1] Amended.
[2] Pacific Fort Nelson No. 2 deepened (reabandoned).
[3] Adjustment due to reclassification.
[4] Excluding solution gas.

Table 2.—Wells Drilled and Drilling, 1960

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1960 Footage	Status at Dec. 31, 1960
590	Amerada Cr BC-B Boundary 14-18-85-13	Feb. 19, 1960	Mar. 6, 1960	4,300	4,300	Triassic Boundary Lake oil well.
628	Amerada Boundary Lake 16-18-85-13	June 29, 1960	July 11, 1960	4,315	4,315	Triassic Boundary Lake oil well.
563	Amerada Cr BC-C Boundary 14-20-85-13	Jan. 16, 1960	Jan. 31, 1960	4,349	4,349	Triassic Boundary Lake oil well.
591	Amerada Cr BC-C Boundary 6-29-85-13	Mar. 22, 1960	June 18, 1960	4,330	4,330	Triassic Boundary Lake oil well.
629	Amerada Boundary Lake 14-13-85-14	July 12, 1960	July 23, 1960	4,260	4,260	Triassic Boundary Lake oil well.
580	Amerada Cr BC-B Boundary 16-13-85-14	Feb. 3, 1960	Feb. 17, 1960	4,270	4,270	Triassic Boundary Lake oil well.
639	Amerada Boundary Lake 6-24-85-14	July 27, 1960	Aug. 10, 1960	4,609	4,609	Triassic Boundary Lake oil well.
608	Amerada Cr BC-D Boundary 8-24-85-14	Mar. 8, 1960	Mar. 20, 1960	4,266	4,266	Triassic Boundary Lake oil well.
692	Amerada Boundary Lake 11-24-85-14	Dec. 25, 1960	———	———	3,855	Drilling.
697	Amerada Pac Ft St John W 11-17-83-19	Dec. 29, 1960	———	———	725	Drilling.
560	Amerada Cr BC-A Milligan d-33-G	Jan. 15, 1960	Jan. 29, 1960	3,761	3,761	Dry and abandoned.
673	Atlantic Pac North Kotcho c-22-F	Nov. 28, 1960	———	———	6,570	Drilling.
570	Calstan Fording Mtn d-61-L	Mar. 15, 1960	Nov. 10, 1960	16,540	16,540	Dry and abandoned.
556	Calvan Antler c-30-I	Jan. 14, 1960	Feb. 12, 1960	3,610	3,610	Dry and abandoned.
566	Calvan Tommy Lakes a-29-A	Feb. 16, 1960	Mar. 21, 1960	3,150	3,150	Triassic Halfway gas well.
624	Dome Boundary Lake 6-21-85-14	June 5, 1960	June 19, 1960	4,253	4,253	Triassic Boundary Lake oil well.
625	Dome Boundary Lake 8-12-85-14	May 19, 1960	May 28, 1960	4,242	4,242	Triassic Boundary Lake oil well.
602	Dome Boundary Lake 16-12-85-14	Mar. 21, 1960	May 22, 1960	4,267	4,267	Triassic Boundary Lake oil well.
603	Dome Boundary Lake 8-13-85-14	June 4, 1960	June 14, 1960	4,253	4,253	Triassic Boundary Lake oil well.
575	Dome Boundary Lake 6-26-85-14	Mar. 10, 1960	Mar. 21, 1960	4,294	4,294	Triassic Boundary Lake oil well.
550	Dome Boundary Lake 8-26-85-14	Jan. 20, 1960	Feb. 10, 1960	4,310	4,310	Triassic Boundary Lake oil well.
573	Dome Boundary Lake 14-26-85-14	Feb. 11, 1960	Feb. 23, 1960	4,352	4,352	Triassic Boundary Lake oil well.
574	Dome Boundary Lake 6-35-85-14	Mar. 23, 1960	May 12, 1960	4,322	4,322	Triassic Boundary Lake oil well.
606	Dome Boundary Lake 16-35-85-14	Feb. 25, 1960	Mar. 9, 1960	4,438	4,438	Triassic Boundary Lake oil well.
642	Dome Boundary Lake 8-2-86-14	Aug. 8, 1960	Aug. 20, 1960	4,443	4,443	Triassic Boundary Lake oil well.
605	Dome Boundary Lake 16-2-86-14	Mar. 3, 1960	Mar. 18, 1960	4,440	4,440	Triassic Boundary Lake oil well.
631	Dome Boundary Lake 6-14-86-14	July 10, 1960	July 24, 1960	4,427	4,427	Dry and abandoned.
526	Dome Provo Bubbles c-20-A[1]	Feb. 2, 1960	Feb. 27, 1960	4,248	4,248	Triassic upper carbonate of Schooler Creek gas well.
696	Dome Prosper Holman Creek b-48-B	Dec. 23, 1960	———	———	62	Drilling.
653	Dome Provo Laprise Creek d-91-A	Oct. 30, 1960	Nov. 12, 1960	4,545	4,545	Triassic upper carbonate of Schooler Creek gas well.
483	Dome Basco Laprise Creek b-2-H[1]	Sept. 23, 1960	Oct. 9, 1960	4,390	4,390	Triassic upper carbonate of Schooler Creek gas well.
654	Dome Provo Laprise Creek a-25-H	Oct. 11, 1960	Oct. 27, 1960	4,530	4,530	Triassic upper carbonate of Schooler Creek gas well.
611	Fraser Valley Chilliwack 19-19-26	Nov. 30, 1959	———	———	1,510	Drilling.
617	FPC Richfield Daiber c-98-D	Mar. 31, 1960	May 28, 1960	5,413	5,413	Dry and abandoned.
587	Gulf States Kathy a-34-E (1)	Feb. 15, 1960	Mar. 28, 1960	7,150	7,150	Dry and abandoned.
634	Honolulu Nazko a-4-L	July 16, 1960	Dec. 21, 1960	10,864	10,864	Dry and abandoned.
554	HB Headstone Creek d-87-I	Feb. 8, 1960	Oct. 19, 1960	11,698	11,698	Dry and abandoned.
553	HB Pan-Am Muskwa a-6-G[1]	Jan. 10, 1960	Mar. 17, 1960	3,862	3,862	Dry and abandoned.
647	HB Pacific Pocketknife c-80-L	Oct. 4, 1960	———	———	3,955	Drilling.
630	HB Redstone c-75-A	June 22, 1960	Aug. 13, 1960	4,290	4,290	Dry and abandoned.
557	Imp Pac Altares c-42-A	Jan. 7, 1960	Feb. 11, 1960	3,863	3,863	Dry and abandoned.
537	Imp Calvan Altares c-14-H	Dec. 17, 1959	Jan. 2, 1960	3,095	———	Dry and abandoned.

Table 2.—Wells Drilled and Drilling, 1960—Continued

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1960 Footage	Status at Dec. 31, 1960
641	Imp Pac Sunray Wargen c-58-C[1]	Aug. 6, 1960	Aug. 31, 1960	4,250	4,250	Lower Cretaceous Bluesky-Gething gas well.
649	Imp Pac Sunray Wargen d-33-D	Sept. 19, 1960	Oct. 7, 1960	4,175	4,175	Dry and abandoned.
669	McCoy Dome Bubbles b-62-B[1]	Nov. 15, 1960	Nov. 24, 1960	568	568	Junked and abandoned.
674	McCoy Dome Bubbles b-A62-B	Nov. 25, 1960	Dec. 16, 1960	4,650	4,650	Triassic upper carbonate of Schooler Creek gas well.
693	McCoy Dome Bubbles c-72-B	Dec. 20, 1960			4,535	Drilling.
685	Mobil W Sahtaneh d-88-I	Dec. 14, 1960			3,872	Drilling.
618	Ohio Boundary Lake Crown 6-19-85-13	June 1, 1960	June 25, 1960	4,300	4,300	Triassic Boundary Lake oil well.
632	Ohio Boundary Lake 8-19-85-13	June 30, 1960	July 15, 1960	4,330	4,330	Triassic Boundary Lake oil well.
635	Ohio Boundary Lake 14-19-85-13	July 16, 1960	July 31, 1960	4,310	4,310	Triassic Boundary Lake oil well.
636	Ohio Boundary Lake 16-19-85-13	Aug. 2, 1960	Aug. 16, 1960	4,335	4,335	Triassic Boundary Lake oil well.
604	Ohio Boundary Lake Crown 14-8-86-13	Mar. 1, 1960	Mar. 24, 1960	4,533	4,533	Triassic Boundary Lake oil well.
655	Pacific Boundary Lake A-16-4-85-14	Oct. 7, 1960	Oct. 16, 1960	3,563	3,563	Lower Cretaceous Gething gas well.
667	Pacific Boundary Lake 11-14-85-14	Nov. 16, 1960	Dec. 17, 1960	4,646	4,646	Triassic Baldonnel gas well.
615	Pacific Dome et al Bubbles d-99-I	June 5, 1960	July 27, 1960	7,200	7,200	Triassic upper carbonate of Schooler Creek gas well.
644	Pacific West Buick Creek a-78-C	Aug. 9, 1960	Sept. 24, 1960	3,995	3,995	Triassic Baldonnel gas well.
354	Pacific Fort Nelson No. 2	Nov. 10, 1960	Dec. 15, 1960	7,480	4,482	Dry and abandoned. (Original hole deepened.)
645	Pac Sry Imp Grewatsch Creek a-46-B	Aug. 31, 1960	Oct. 6, 1960	5,105	5,105	Dry and abandoned.
576	Pacific Sunray Imp Horn c-47-A	Jan. 28, 1960	Feb. 7, 1960	841	841	Junked and abandoned.
592	Pacific Sunray Imp Horn c-A47-A	Feb. 10, 1960	Mar. 25, 1960	4,718	4,718	Dry and abandoned.
691	Pacific Sunray Imp Jedney b-84-C	Dec. 28, 1960			1,620	Drilling.
651	Pacific et al Jedney d-97-C	Sept. 28, 1960	Dec. 18, 1960	7,101	7,101	Triassic upper carbonate of Schooler Creek gas well.
562	Pacific North Kotcho b-44-C	Jan. 13, 1960	Mar. 6, 1960	6,835	6,835	Middle(?) Devonian carbonate gas well.
623	Pacific North Kotcho d-85-C	May 12, 1960	June 23, 1960	7,500	7,500	Dry and abandoned.
579	Pacific North Kotcho c-93-C	Mar. 13, 1960	Apr. 24, 1960	7,000	7,000	Mississippian Rundle gas well.
690	Pacific Sunray Imp E Laprise a-33-E	Dec. 27, 1960			967	Drilling.
659	Pacific Sunray Imp E Laprise b-44-E	Oct. 30, 1960	Nov. 14, 1960	4,265	4,265	Triassic upper carbonate of Schooler Creek gas well.
678	Pacific Sunray Imp E Laprise a-46-E	Dec. 1, 1960	Dec. 16, 1960	4,335	4,335	Triassic upper carbonate of Schooler Creek gas well.
670	Pacific Sunray Imp E Laprise d-55-E	Nov. 17, 1960	Dec. 8, 1960	3,908	3,908	Triassic upper carbonate of Schooler Creek gas well.
650	Pacific Sunray Imp E Laprise c-56-E	Oct. 2, 1960	Oct. 20, 1960	3,993	3,993	Triassic upper carbonate of Schooler Creek gas well.
686	Pacific Sunray Imp E Laprise d-77-E	Dec. 13, 1960	Dec. 31, 1960	3,975	3,975	Dry and abandoned.
551	Pacific Sunray Imp E Laprise c-78-E	Dec. 29, 1959	Jan. 19, 1960	3,860	3,144	Triassic upper carbonate of Schooler Creek gas well.
568	Pacific Sunray Imp E Laprise b-28-I	Jan. 28, 1960	Mar. 17, 1960	4,732	4,732	Dry and abandoned.
468	Pacific H.B. Pocketknife c-37-L	Aug. 30, 1959	June 26, 1960	10,035	5,707	Mississippian Rundle gas well.
529	Pacific Utahn b-83-C[1]	Dec. 15, 1959	Feb. 20, 1960	8,230	4,115	Dry and abandoned.
660	Pacific Sunray Imp Wargen d-77-C	Oct. 22, 1960	Nov. 3, 1960	3,915	3,915	Dry and abandoned.
325	Pan Am A-1 Beaver River b-63-K	Jan. 21, 1958	Dec. 21, 1960	11,752	1,254	Dry and abandoned.
594	Pan Am A-1 Cam Lake a-31-I	Feb. 23, 1960	May 15, 1960	7,500	7,500	Middle(?) Devonian carbonate gas well.
531	Pan Am A-1 Deer Lake a-90-I	Dec. 15, 1959	Aug. 7, 1960	11,056	9,456	Middle(?) Devonian carbonate gas well.
681	Pan Am et al Dilly a-27-K	Dec. 27, 1960			94	Drilling.
548	Pan Am A-1 Kimea Lake a-28-H	Jan. 1, 1960	Mar. 2, 1960	7,257	7,257	Dry and abandoned.
527	Pan Am A-1 Komie a-51-A	Dec. 26, 1959			9,043	Drilling. Whipstocked at 5,405 ft. Original depth 7,434 ft.

683	Pan Am Komie c-94-I	Dec. 27, 1960			314	Drilling.
434	Pan Am East Poplar a-37-F	Jan. 30, 1959	Mar. 16, 1960	8,139	1,177	Dry and abandoned.
499	Phillips-SR-West Cdn-Kledo c-14-G	Dec. 10, 1959	July 24, 1960	10,805	7,045	Middle(?) Devonian carbonate gas well.
489	Phillips Kobes b-24-A	Nov. 22, 1959	Jan. 5, 1960	3,182		Lower Cretaceous Dunlevy gas well.
494	Phillips Minaker a-25-D	Oct. 10, 1959	July 9, 1960	11,361	6,091	Dry and abandoned.
569	Phillips-SR-West Cdn-Peejay d-80-E	Jan. 24, 1960	Feb. 25, 1960	3,860	3,860	Triassic Halfway oil well.
555	Phillips-SR-West Cdn-Peejay d-74-H	Jan. 22, 1960	Feb. 13, 1960	3,890	3,890	Dry and abandoned.
675	Pure Imperial Bull b-67-J	Dec. 11, 1960			3,472	Drilling.
638	Shell Honolulu Flathead d-22-A	July 29, 1960	Dec. 22, 1960	11,888	11,888	Dry and abandoned.
583	Sinclair Pacific Arm d-28-C	Jan. 31, 1960	Feb. 11, 1960	606	606	Junked and abandoned.
600	Sinclair Pacific Arm d-A28-C	Feb. 14, 1960	Apr. 24, 1960	6,296	6,296	Dry and abandoned.
541	Sinclair et al Beg d-10-G	Oct. 26, 1960			5,610	Drilling.
622	Sinclair Pacific West Beg c-84-C	June 15, 1960	Oct. 17, 1960	5,760	5,760	Triassic Baldonnel gas well.
627	Sinclair Pac Chamberlain 9-33-83-20[1]	July 7, 1960	Sept. 10, 1960	6,460	6,460	Dry and abandoned.
420	Sinclair Pac Chinchaga a-34-L (B9-1)	Jan. 24, 1959	Jan. 28, 1960	9,858	762	Dry and abandoned.
679	Sinclair et al N Conroy Creek d-45-K	Dec. 3, 1960			4,072	Drilling.
698	Sinclair et al Datcin b-46-G	Dec. 22, 1960			1,716	Drilling.
620	Sinclair et al Dogrib a-79-F	June 13, 1960	Sept. 12, 1960	5,792	5,792	Triassic upper carbonate of Schooler Creek gas well.
539	Sinclair et al Dogrib b-17-K	Dec. 27, 1959	Feb. 22, 1960	5,306	4,031	Triassic upper carbonate of Schooler Creek gas well.
540	Sinclair et al Dogrib a-22-L	Jan. 26, 1960	Mar. 25, 1960	5,561	5,561	Dry and abandoned.
607	Sinclair et al Dogrib a-37-L	Feb. 27, 1960	Aug. 29, 1960	5,742	5,742	Dry and abandoned.
658	Sinclair Pac Julienne Creek b-39-D	Oct. 24, 1960			6,073	Drilling.
421	Sinclair Pac Klua Ck a-55-L (B11-1)	Jan. 30, 1959			2,674	Suspended.
694	Sinclair Pacific Lichen d-31-A	Dec. 24, 1960			1,481	Drilling.
426	Sinclair Minaker b-34-H (XB20-1)	Jan. 25, 1959	Dec. 19, 1960	4,578	3,256	Dry and abandoned.
612	Sinclair et al Peejay d-18-E	Feb. 27, 1960	Mar. 11, 1960	3,898	3,898	Triassic Halfway oil well.
589	Sinclair et al Peejay d-28-E	Feb. 9, 1960	Feb. 20, 1960	3,935	3,386	Triassic Halfway oil well.
543	Sinclair et al Peejay d-29-E	Dec. 30, 1959	Jan. 23, 1960	3,895	3,895	Triassic Halfway oil well.
578	Sinclair et al Peejay d-38-E	Jan. 25, 1960	Feb. 6, 1960	3,932	3,932	Triassic Halfway oil well.
542	Sinclair et al Peejay d-40-E	Jan. 2, 1960	Jan. 20, 1960	3,895	3,895	Dry and abandoned.
577	Sinclair et al Peejay d-48-E	Jan. 25, 1960	Feb. 8, 1960	3,885	3,885	Triassic Halfway oil well.
588	Sinclair et al Peejay d-49-E	Feb. 9, 1960	Feb. 22, 1960	3,895	3,895	Triassic Halfway oil well.
613	Sinclair et al Peejay d-50-E	Feb. 25, 1960	Mar. 12, 1960	3,880	3,880	Dry and abandoned.
648	Sinclair Pac Robertson Creek d-39-J	Oct. 3, 1960			5,339	Drilling.
601	Sun et al Blueberry b-13-D	Mar. 8, 1960	Aug. 15, 1960	6,943	6,943	Triassic Charlie Lake gas well.
581	Sun et al Blueberry d-97-D	Feb. 28, 1960	Apr. 8, 1960	4,786	4,786	Triassic Baldonnel gas well.
504	Sun et al Blueberry d-99-D	Oct. 22, 1959	Feb. 25, 1960	7,650	891	Dry and abandoned.
549	Sun et al Blueberry c-A29-K	Dec. 14, 1959	Mar. 2, 1960	7,365	3,055	Mississippian Rundle oil well.
525	Sun et al Blueberry a-61-L	Dec. 6, 1959	June 7, 1960	7,082	2,179	Triassic Charlie Lake gas well.
646	Sun Boundary Lake 6-23-85-14	Sept. 11, 1960	Oct. 2, 1960	4,625	4,625	Triassic Halfway oil well.
652	Sun Boundary Lake 8-23-85-14	Oct. 4, 1960	Oct. 20, 1960	4,575	4,575	Triassic Boundary Lake oil well.
643	Sun Boundary Lake 14-23-85-14	Aug. 7, 1960	Sept. 9, 1960	4,435	4,435	Triassic Boundary Lake oil well.
495	Sun et al Halfway 10-2-87-25	Sept. 29, 1959	Jan. 26, 1960	7,293	596	Dry and abandoned.
507	Sun et al Jeans a-57-A	Nov. 3, 1959	Jan. 18, 1960	6,978	290	Mississippian Rundle gas well.
518	Sun Stoddart 7-23-86-20	Nov. 22, 1959	Jan. 12, 1960	6,404	344	Dry and abandoned.
671	TGT Tooga Lake c-27-K	Dec. 28, 1960			605	Drilling.
668	Texaco NFA Black Creek c-15-L	Nov. 17, 1960	Dec. 17, 1960	4,152	4,152	Dry and abandoned.
687	Texaco NFA Boundary Lake 6-25-85-14	Dec. 12, 1960			4,615	Drilling.
656	Texaco NFA Boundary Lake 14-25-85-14	Oct. 18, 1960	Nov. 2, 1960	4,410	4,410	Triassic Boundary Lake oil well.
662	Texaco NFA Boundary Lake 6-36-85-14	Nov. 24, 1960	Dec. 14, 1960	4,478	4,478	Triassic Boundary Lake oil well.
657	Texaco NFA Boundary Lake 14-36-85-14	Nov. 3, 1960	Nov. 22, 1960	4,475	4,475	Triassic Boundary Lake oil well.

Table 2.—Wells Drilled and Drilling, 1960—Continued

Drilling Authority No.	Well Name	Date Spudded	Date Rig Released	Total Depth	1960 Footage	Status at Dec. 31, 1960
663	Texaco NFA Boundary Lake 6-1-86-14	Nov. 26, 1960	Dec. 10, 1960	4,575	4,575	Triassic Boundary Lake oil well.
664	Texaco NFA Boundary Lake 14-1-86-14	Nov. 8, 1960	Nov. 23, 1960	4,380	4,380	Triassic Boundary Lake oil well.
593	Texaco NFA Boundary L 16-12-86-14	Feb. 22, 1960	Mar. 14, 1960	4,320	4,320	Triassic Boundary Lake oil well.
633	Texaco NFA Boundary Lake 14-24-86-14	July 4, 1960	July 22, 1960	4,320	4,320	Triassic Boundary Lake oil well.
614	Texaco NFA Clear a-23-I	Mar. 1, 1960	Mar. 31, 1960	5,340	5,340	Dry and abandoned.
610	Texaco NFA Kahntah R a-89-D	Feb. 28, 1960	Mar. 20, 1960	2,501	2,501	Dry and abandoned.
565	Texaco NFA Maxhamish Lake c-15-L	Jan. 13, 1960	—	—	6,902	Drilling.
572	Texaco NFA North Osborn b-77-L	Jan. 28, 1960	Feb. 25, 1960	4,185	4,185	Dry and abandoned.
571	Texaco NFA Silver c-52-K	Jan. 23, 1960	Feb. 20, 1960	4,100	4,100	Lower Cretaceous Bluesky-Gething gas well.
396	Triad Beatton River d-28-J	Dec. 19, 1959	Jan. 7, 1960	3,810	—	Triassic Halfway oil well.
616	Triad N Beatton R d-3-C	Mar. 10, 1960	Mar. 21, 1960	3,795	3,795	Dry and abandoned.
609	Triad N Beatton R d-4-C	Feb. 25, 1960	Mar. 8, 1960	3,835	3,835	Dry and abandoned.
586	Triad N Beatton R d-6-C	Feb. 9, 1960	Feb. 22, 1960	3,891	3,891	Dry and abandoned.
684	Triad BP N Beatton R d-14-C	Dec. 12, 1960	Dec. 24, 1960	3,839	3,839	Dry and abandoned.
561	Triad North Beatton R d-79-C	Jan. 19, 1960	Feb. 5, 1960	3,920	3,920	Dry and abandoned.
599	Triad N Beatton R d-89-D	Feb. 23, 1960	Mar. 11, 1960	4,185	4,185	Dry and abandoned.
582	Triad N Beatton R a-78-F	Feb. 3, 1960	Feb. 18, 1960	4,236	4,236	Dry and abandoned.
538	Triad West Beatton River d-38-K	Dec. 29, 1959	Jan. 15, 1960	3,440	2,930	Lower Cretaceous Bluesky-Gething oil well.
558	Triad Conroy Creek c-68-A	Feb. 3, 1960	Feb. 18, 1960	3,870	3,870	Dry and abandoned.
595	Triad Conroy Creek d-72-A	Feb. 20, 1960	Mar. 8, 1960	3,682	3,682	Dry and abandoned.
672	Triad BP Conroy Creek c-100-A	Dec. 1, 1960	—	—	4,694	Drilling.
547	Triad North Conroy Creek a-53-F	Jan. 3, 1960	Jan. 21, 1960	3,920	3,920	Dry and abandoned.
552	Triad N Laprise Creek b-57-L	Dec. 31, 1959	Jan. 28, 1960	4,774	4,516	Dry and abandoned.
534	Triad Pickell Creek c-69-I	Jan. 26, 1960	Feb. 16, 1960	4,145	4,145	Dry and abandoned.
695	Triad BP Pickell Creek c-88-I	Dec. 30, 1960	—	—	500	Drilling.
502	Union Aitken Creek d-48-J	Dec. 4, 1959	Jan. 18, 1960	5,187	320	Dry and abandoned.
546	Union HB Peejay d-95-D	Jan. 25, 1960	Feb. 13, 1960	3,850	3,850	Dry and abandoned.
596	Union HB Snowberry d-80-D	Feb. 17, 1960	Feb. 28, 1960	3,667	3,667	Dry and abandoned.
530	Union-HB-Wildmint d-46-A[1]	Dec. 14, 1959	Jan. 7, 1960	3,780	52	Triassic Halfway oil well.
584	Union HB Wildmint d-56-A	Feb. 6, 1960	Feb. 21, 1960	3,763	3,763	Triassic Halfway oil well.
559	Union HB Woodrush d-74-H[1]	Jan. 11, 1960	Feb. 3, 1960	3,715	3,715	Triassic Halfway oil well.
621	West Canadian Lily Lake c-81-F	Apr. 13, 1960	Sept. 16, 1960	8,552	8,552	Dry and abandoned.
640	West Cdn Moberly Lake 11-36-80-25	July 27, 1960	Sept. 27, 1960	4,939	4,939	Dry and abandoned.
585	West Nat Imp Clarke Lake c-100-K	Feb. 7, 1960	Mar. 18, 1960	6,550	6,550	Middle(?) Devonian carbonate gas well.
626	West Nat et al Evie Lake b-89-D	July 8, 1960	Sept. 12, 1960	8,240	8,240	Dry and abandoned.
688	West Nat et al Fort Nelson b-70-I	Dec. 18, 1960	—	—	2,614	Drilling.
661	West Nat et al Fort Nelson c-70-I	Oct. 31, 1960	Dec. 13, 1960	6,950	6,950	Dry and abandoned.
505	West Nat Fort Nelson c-78-I[1]	Dec. 11, 1959	Feb. 3, 1960	6,533	4,293	Middle(?) Devonian carbonate gas well.
619	West Nat et al Fort Nelson d-38-I[1]	Apr. 14, 1960	May 13, 1960	7,103	7,103	Dry and abandoned.
677	West Nat Kathy b-30-F	Dec. 9, 1960	—	—	4,361	Drilling.
532	West Nat Kotcho Lake d-39-J[1]	Dec. 29, 1959	Mar. 3, 1960	8,413	8,001	Middle(?) Devonian carbonate gas well.
533	West Nat Petitot River b-1-D[1]	Dec. 18, 1959	Feb. 2, 1960	6,628	2,628	Middle(?) Devonian carbonate gas well.
676	West Nat Petitot River a-81-L	Dec. 29, 1960	—	—	611	Drilling.
508	Woodley-Imperial Bigfoot d-27-C	Jan. 9, 1960	Mar. 5, 1960	8,470	8,470	Mississippian Rundle gas well.
509	Woodley-Imperial Klua a-27-G	Jan. 10, 1960	Mar. 4, 1960	7,630	7,630	Dry and abandoned.

[1] Name changed during 1960.

Table 3.—Oil and Gas Fields Designated as of December 31st, 1960

Field	Date Designated	Date(s) Revised	Pools	Field Location	Number of Wells	Discovery Well(s)	Pool(s) Discovered
Aitken Creek	Feb. 15, 1960		3	N.T.S. 94-A-13	2	Union Aitken Creek b-42-L, oil Union Aitken Creek a-53-L(3), gas	3 3
Beatton River	Aug. 7, 1959		11	N.T.S. 94-H-2	4	Triad Beatton River b-38-J, oil	11
Beatton River West	Aug. 7, 1959		2	N.T.S. 94-H-2	5	Triad West Beatton River d-39-K, oil	2
Blueberry	Feb. 7, 1958	Dec. 22, 1958 Feb. 15, 1960 May 27, 1960	5, 7, 9, 13	N.T.S. 94-A-12, 94-A-13, Tp. 88, R. 25, W. of 6th M.	15	Sun et al Blueberry c-32-D(2), gas Sun et al Blueberry d-87-D(1), gas Sun et al Blueberry a-61-L, gas Sun et al Blueberry c-82-L(11), oil Sun et al Blueberry a-34-D(10), gas	5 7 9 13 13
Blueberry East	Dec. 22, 1958		7, 11, 13	N.T.S. 94-A-13	2	Sun et al E Blueberry b-38-C(7), gas Sun et al E Blueberry b-36-C(17), gas	7, 11 13
Blueberry West	Feb. 7, 1958		5, 7	N.T.S. 94-A-12, 94-B-9, 94-B-16, Tp. 88, R. 25, W. of 6th M.	3	Sun et al W Blueberry d-82-I(9), gas Sun et al W Blueberry d-19-L(12), gas	5 7
Boundary Lake	Oct. 30, 1956	Feb. 7, 1958 Aug. 7, 1959 Feb. 15, 1960	2, 3, 7, 10, 11	Tp. 84, 85, 86, R. 13, W. of 6th M. Tp. 84, 85, 86, R. 14, W. of 6th M.	65	Pacific Boundary 8-15-85-14, gas Pacific Boundary 12-10-85-14, gas Texaco NFA Boundary L 6-6-86-13(1), oil Sun Boundary Lake 6-23-85-14, oil	2, 7 3 10 11
Bubbles	Nov. 24, 1959	Feb. 15, 1960 May 27, 1960	8	N.T.S. 94-G-1, 94-G-8	10	Pacific Imperial Bubbles b-33-I, gas	8
Buick Creek	Feb. 7, 1958	Aug. 7, 1959	6, 9	N.T.S. 94-A-11, 94-A-14	6	Texaco NFA Buick Creek d-98-I(1), gas Texaco NFA Buick Creek d-83-J(4), gas	6 9
Buick Creek West	Feb. 7, 1958	Jan. 6, 1959 Feb. 15, 1960	6, 7, 11	N.T.S. 94-A-11, 94-A-14	15	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	6 6 7 11
Clarke Lake	Feb. 15, 1960	May 27, 1960	15	N.T.S. 94-J-9, 94-J-16	4	West Nat Imp Clarke Lake d-88-L, gas	15
Dawson Creek	Feb. 7, 1958		1	Tp. 79, R. 15, W. of 6th M.	4	Pacific Sc Dawson Ck 1-15-79-15(1), gas	1
Fort St. John	Aug. 22, 1955	Feb. 7, 1958 Feb. 15, 1960	3, 4, 7, 9, 11, 12	Tp. 83, 84, R. 18, W. of 6th M.	31	Imp Pac Ft St John 13-5-84-18, oil 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	3 4 7 9 11 12 12
Fort St. John Airport	Feb. 7, 1958		4, 7, 11	Tp. 83, R. 17, W. of 6th M.	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 7 11
Fort St. John Southeast	Feb. 7, 1958		4, 7, 11, 12	Tp. 82, 83, R. 17, W. of 6th M.	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 7 11 12
Gundy Creek	Feb. 7, 1958	Jan. 6, 1959	5, 7, 9	N.T.S. 94-B-16	4	West Nat Gundy Creek d-2-C, gas West Nat Gundy Creek c-80-A, gas West Nat Gundy Creek b-69-A, gas	5 7 9

Table 3.—Oil and Gas Fields Designated as of December 31st, 1960—Continued

Field	Date Designated	Date(s) Revised	Pools	Field Location	Number of Wells	Discovery Well(s)	Pool(s) Dis-covered
Halfway	Dec. 22, 1958		7, 11	Tp. 86, 87, R. 25, W. of 6th M.	3	Sun et al Halfway 5-1-87-25, gas Sun et al Halfway 8-11-87-25, gas	7 11
Highway	Feb. 7, 1958		5, 7, 13	N.T.S. 94-B-16	5	Sun et al Highway b-3-I, gas Phillips Highway b-25-I(1), gas Phillips Highway a-90-I(4), gas	5 7 13
Jedney	Aug. 7, 1959	Nov. 24, 1959 Feb. 15, 1960	8, 11	N.T.S. 94-G-1, 94-G-8	10	Pacific et al Jedney b-88-J, gas Pacific Imp Jedney d-99-J, gas	8 11
Kiskatinaw	Feb. 7, 1958		14	Tp. 81, R. 15, W. of 6th M.	1	Pacific Imp Parkland 6-29-81-15, gas	14
Kiskatinaw West	Feb. 7, 1958	Feb. 15, 1960	----	Entire field deleted.	----		----
Kobes Townsend	Dec. 22, 1958	Feb. 15, 1960	5, 9, 11, 13	N.T.S. 94-B-8, 94-B-9	9	Phillips Kobes a-3-A(4), gas Phillips Kobes d-94-I(1), gas Phillips Townsend a-20-H(A-1), gas	5 9, 11 13
Laprise Creek	Feb. 15, 1960		8	N.T.S. 94-G-8, 94-H-5	5	Dome Basco Laprise Ck a-35-H, gas	8
Milligan Creek	Feb. 7, 1958	Aug. 7, 1959 Feb. 15, 1960	11	N.T.S. 94-H-2	10	Union HB Milligan Creek d-73-G, oil Union HB Milligan Creek d-20-H, gas	11 11
Montney	Feb. 7, 1958	Jan. 6, 1959	2, 9, 11	Tp. 87, R. 18, W. of 6th M. Tp. 86, 87, R. 19, W. of 6th M.	3	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 9 11
Nig Creek	Aug. 7, 1959	Feb. 15, 1960	8	N.T.S. 94-H-4	6	Texaco NFA Nig Creek d-12-G(6), gas	8
Peejay	Feb. 15, 1960	May 27, 1960	11	N.T.S. 94-A-16	7	Sinclair Pac Peejay d-39-E(B8-3), oil	11
Pouce Coupe	Aug. 22, 1955	Feb. 7, 1958	1	Tp. 80, R. 13, W. of 6th M.	2	Westcoast Pouce Coupe 6-30-80-13(1), gas	1
Red Creek	Feb. 7, 1958	Aug. 7, 1959 Feb. 15, 1960	9, 11	Tp. 85, R. 21, W. of 6th M.	1	Pacific Red Creek 5-27-85-21(36), gas	9, 11
Stoddart	Jan. 6, 1959	Feb. 15, 1960	12	Tp. 86, R. 20, W. of 6th M.	2	Pacific Stoddart 4-24-86-20(85), gas	12
Sunrise	Feb. 7, 1958		1	Tp. 78, 79, R. 16, W. of 6th M.	3	Pacific Sunrise 10-7-79-16(3), gas	1

Numerical list of pools based on revised nomenclature of December, 1960:—

1. Lower Cretaceous Cadotte sandstone.
2. Lower Cretaceous Bluesky-Gething sandstone.
3. Lower Cretaceous Gething sandstone (Bluesky-Gething).*
4. Lower Cretaceous Cadomin sandstone.
5. Lower Cretaceous Dunlevy sandstone (Cadomin and Nikanassin).*
6. Lower Cretaceous Buick Creek sandstone.
7. Triassic Baldonnel carbonate (includes Triassic "A" and "B" of Fort St. John area).
8. Triassic upper carbonate of Schooler Creek (includes " Baldonnel " of Jedney-Laprise area.)*
9. Triassic Charlie Lake sandstone and carbonate (includes Triassic "C" of Fort St. John area).
10. Triassic Boundary Lake carbonate.
11. Triassic Halfway sandstone (includes Triassic "D" of Fort St. John area).
12. Permian Belloy carbonate (Permo Penn).*
13. Mississippian Rundle carbonate (Mississippian).*
14. Upper Devonian Wabamun carbonate (Devonian).*
15. Middle(?) Devonian carbonate.

* The names shown in parentheses are those used previously for the quotation of production—*see* Tables 4, 5, 6, and 7. The formation names in these tables coincide with those used on the production cards maintained by the Branch. The production data will be amended early in 1961 to conform with revised nomenclature.

Table 4.—Yearly Crude-oil Production, 1956–60

Field and Pool	1956 Oil (Bbl.)	1956 Gas (M S.C.F.)	1956 Water (Bbl.)	1957 Oil (Bbl.)	1957 Gas (M S.C.F.)	1957 Water (Bbl.)	1958 Oil (Bbl.)	1958 Gas (M S.C.F.)	1958 Water (Bbl.)	1959 Oil (Bbl.)	1959 Gas (M S.C.F.)	1959 Water (Bbl.)	1960 Oil (Bbl.)	1960 Gas (M S.C.F.)	1960 Water (Bbl.)
Aitken Creek															
Bluesky-Gething	....	....	....	....	....	....	....	....	....	**4,396** 4,396	**2,836** 2,836	....	**12,830** 17,226	**8,584** 9,420	....
Field totals	....	....	....	....	....	....	....	....	....	**4,396** 4,396	**2,836** 2,836	....	**12,830** 17,226	**8,584** 9,420	....
Beatton River															
Halfway	....	....	....	....	....	....	**1,601** 1,601	**2,701** 3,701	....	**5,447** 7,048	**5,192** 7,893	....	**1,719** 8,767	**2,654** 10,547	....
Field totals	....	....	....	....	....	....	**1,601** 1,601	**2,701** 2,701	....	**5,447** 7,048	**5,192** 7,893	....	**1,719** 8,767	**2,654** 10,547	....
Beatton River West															
Bluesky-Gething	....	....	....	....	....	....	....	....	....	**1,069** 1,069	**398** 398	....	**1,020** 2,089	**204** 602	....
Field totals	....	....	....	....	....	....	....	....	....	**1,069** 1,069	**398** 398	....	**1,020** 2,089	**204** 602	....
Blueberry															
Nikanassin[1]	....	....	....	....	....	....	....	....	....	....	....	....	**1,613** 1,613	**80,611** 80,611	....
Mississippian	....	....	....	**4,375** 4,375	**8,614** 8,614	....	**2,964** 7,339	**4,273** 12,887	....	**2,850** 10,189	**2,407** 15,294	....	**51,040** 61,229	**50,988** 66,282	....
Field totals	....	....	....	**4,375** 4,375	**8,614** 8,614	....	**2,964** 7,339	**4,273** 12,887	....	**2,850** 10,189	**2,407** 15,294	....	**52,653** 62,842	**131,599** 146,893	....
Boundary Lake															
Charlie Lake (excluding Boundary Lake)	....	....	....	....	....	....	....	....	....	....	....	....	**819** 819	**835** 835	....
Boundary Lake	**107,439** 108,021	**53,215** 53,512	**261** 261	**199,220** 307,241	**124,446** 177,957	**205** 466	**354,388** 661,629	**219,558** 397,515	**232** 698	**688,821** 1,350,450	**484,931** 882,446	**79** 777	**682,361** 2,032,811	**482,211** 1,364,657	**185** 962
Halfway	....	....	....	....	....	....	....	....	....	....	....	....	**495** 495	**191** 191	....
Field totals	**107,439** 108,021	**53,215** 53,512	**261** 261	**199,220** 307,241	**124,445** 177,957	**205** 466	**354,388** 661,629	**219,558** 397,515	**232** 698	**688,821** 1,350,450	**484,931** 882,446	**79** 777	**683,675** 2,034,125	**483,237** 1,365,683	**185** 962

Table 4.—Yearly Crude-oil Production, 1956–60—Continued

Field and Pool	1956			1957			1958			1959			1960		
	Oil (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Oil (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Oil (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Oil (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Oil (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)
Buick Creek West															
Buick Creek	....	....	....	**3,086**	**2,123**	**25**	**4,762**	**1,412**	**492**	....	....	....	....	....	....
	....	....	....	3,086	2,123	25	7,848	3,535	517	7,848	3,535	517	7,848	3,535	517
Field totals	....	....	....	**3,086**	**2,123**	**25**	**4,762**	**1,412**	**492**	....	....	....	....	....	....
	....	....	....	3,086	2,123	25	7,848	3,535	517	7,848	3,535	517	7,848	3,535	517
Fort St. John															
Bluesky-Gething	....	....	....	**3,997**	**2,355**	**5**	**10,441**	**8,130**	**8**	**7,010**	**10,121**	....	**2,091**	**3,815**	....
	....	....	....	3,997	2,355	5	14,438	10,485	13	21,448	20,606	13	23,539	24,421	13
Triassic "C"	**31,919**	**16,979**	**72**	**126,776**	**93,285**	**158**	**119,977**	**134,255**	**27**	**100,601**	**182,515**	....	**97,569**	**218,059**	....
	31,919	16,979	72	158,695	110,264	230	278,672	244,519	257	379,273	427,034	257	476,842	645,093	257
Permo-Penn	**9,096**	**11,696**	**21**	**7,866**	**41,336**	**7**	**6,705**	**41,943**	....	**9,234**	**129,774**	....	**132**	**1,330**	....
	9,096	11,696	21	16,962	53,032	28	23,667	94,975	28	32,901	224,749	28	33,033	226,079	28
Field totals	**41,015**	**28,675**	**93**	**138,639**	**136,976**	**170**	**137,123**	**184,328**	**35**	**116,845**	**322,410**	....	**99,792**	**223,204**	....
	41,015	28,675	93	179,654	165,651	263	316,777	349,979	298	433,622	672,389	298	533,414	895,593	298
Milligan Creek															
Halfway	....	....	....	....	....	....	**12,880**	**1,826**	....	**44,277**	**8,624**	....	**7,722**	**2,689**	**37**
	....	....	....	....	....	....	12,880	1,826	....	57,157	10,450	....	64,879	13,139	37
Field totals	....	....	....	....	....	....	**12,880**	**1,826**	....	**44,277**	**8,624**	....	**7,722**	**2,689**	**37**
	....	....	....	....	....	....	12,880	1,826	....	57,157	10,450	....	64,879	13,139	37
Peejay															
Halfway	....	....	....	....	....	....	....	....	....	**1,045**	**302**	....	**5,519**	**1,389**	....
	....	....	....	....	....	....	....	....	....	1,045	302	....	6,564	1,691	....
Field totals	....	....	....	....	....	....	....	....	....	**1,045**	**302**	....	**5,519**	**1,389**	....
	....	....	....	....	....	....	....	....	....	1,045	302	....	6,564	1,691	....
Other Areas															
Halfway	....	....	....	....	....	....	....	....	....	....	....	....	**2,127**	**7,771**	....
	....	....	....	....	....	....	....	....	....	....	....	....	2,127	7,771	....
Areas totals	....	....	....	....	....	....	....	....	....	....	....	....	**2,127**	**7,771**	....
	....	....	....	....	....	....	....	....	....	....	....	....	2,127	7,771	....
Totals for year	**148,454**	**81,890**	**354**	**345,320**	**272,158**	**400**	**513,718**	**414,098**	**759**	**864,750**	**827,100**	**79**	**867,057**	**859,331**	**222**
Totals, cumulative	149,036	82,187	354	494,356	354,345	754	1,008,074	768,443	1,513	1,872,824	1,595,543	1,592	2,739,881	2,454,874	1,814

[1] Test production on Sun et al Blueberry d-97-D.
NOTE.—Field totals for the year in bold-face type; cumulative totals in light-face type.

Table 5.—Yearly Natural-gas Production, 1956–60

Field and Pool	1956		1957		1958		1959		1960	
	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)
Blueberry										
Nikanassin	...	...	...	...	**71,672**	...	**566,952**	**153**	**967,490**	**262**
	...	...	...	...	71,672	...	638,624	153	1,606,114	415
Baldonnel	...	...	...	...	**262,152**	**585**	**1,477,849**	**6,856**	**1,241,369**	**13,519**
	...	...	...	...	262,152	585	1,740,001	7,441	2,981,370	20,960
Field totals	...	...	...	...	**333,824**	**585**	**2,044,801**	**7,009**	**2,208,859**	**13,781**
	...	...	...	...	333,824	585	2,378,625	7,594	4,587,484	21,375
Blueberry East										
Baldonnel	...	...	...	...	**153,713**	**132**	**391,109**	**335**	...	...
	...	...	...	...	153,713	132	544,822	467	544,822	467
Halfway	...	...	...	...	**87,963**	**861**	**217,457**	**2,137**	...	...
	...	...	...	...	87,963	861	305,420	2,998	305,420	2,998
Mississippian	...	...	...	...	**143,071**	**3,845**	**131,994**	**4,318**	...	...
	...	...	...	...	143,071	3,845	275,065	8,163	275,065	8,163
Field totals	...	...	...	...	**384,747**	**4,838**	**740,560**	**6,790**	...	...
	...	...	...	...	384,747	4,838	1,125,307	11,628	1,125,307	11,628
Blueberry West										
Nikanassin	...	...	...	...	**45,558**	**3**	**184,635**	...	**125,664**	...
	...	...	...	...	45,558	3	230,193	3	355,857	3
Baldonnel	...	...	...	...	**115,148**	**1,099**	**459,752**	**4,748**	**254,274**	**5,558**
	...	...	...	...	115,148	1,099	574,900	5,847	829,174	11,405
Field totals	...	...	...	...	**160,706**	**1,102**	**644,387**	**4,748**	**379,938**	**5,558**
	...	...	...	...	160,706	1,102	805,093	5,850	1,185,031	11,408
Boundary Lake										
Bluesky-Gething	...	...	...	...	...	...	...	...	**195,453**	...
	...	...	...	...	...	...	...	...	195,453	...
Baldonnel	...	...	...	...	...	...	...	...	**48,618**	...
	...	...	...	...	...	...	...	...	48,618	...
Field totals	...	...	...	...	...	...	...	...	**244,071**	...
	...	...	...	...	...	...	...	...	244,071	...
Bubbles										
S.C.-upper carbonate	...	...	...	...	...	...	**1,152,499**	...	**8,427,918**	...
	...	...	...	...	...	...	1,152,499	...	9,580,417	...
Field totals	...	...	...	...	...	...	**1,152,499**	...	**8,427,918**	...
	...	...	...	...	...	...	1,152,499	...	9,580,417	...

Table 5.—Yearly Natural-gas Production, 1956–60—Continued

Field and Pool	1956		1957		1958		1959		1960	
	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)
Buick Creek										
Buick Creek	......	......	......	......	......	......	**22,278**	......	**1,205,309**	......
	......	......	......	......	......	......	22,278	......	1,227,587	......
Field totals	......	......	......	......	......	......	**22,278**	......	**1,205,309**	......
	......	......	......	......	......	......	22,278	......	1,227,587	......
Buick Creek West										
Buick Creek	......	......	**629,522**	......	**7,475,506**	......	**12,316,669**	......	**13,017,158**	......
	......	......	629,522	......	8,105,028	......	20,421,697	......	33,428,855	......
Baldonnel	......	......	......	......	**16,590**	......	......	......	**122,132**	......
	......	......	......	......	16,590	......	16,590	......	138,722	......
Halfway	......	......	**1,234**	......	**2,085,810**	......	**1,547,060**	**510**	**1,034,126**	**764**
	......	......	1,234	......	2,087,044	......	3,634,104	510	4,668,230	1,274
Field totals	......	......	**630,756**	......	**9,577,906**	......	**13,863,729**	**510**	**14,173,416**	**764**
	......	......	630,756	......	10,208,662	......	24,072,391	510	38,245,807	1,274
Dawson Creek										
Cadotte	......	......	......	......	**879,224**	......	**820,704**	**1,761**	**1,019,397**	**1,316**
	......	......	......	......	879,224	......	1,699,928	1,761	2,719,325	3,077
Field totals	......	......	......	......	**879,224**	......	**820,704**	**1,761**	**1,019,397**	**1,316**
	......	......	......	......	879,224	......	1,699,928	1,761	2,719,325	3,077
Fort St. John										
Cadomin	**25,330**	......	**69,493**	......	......	......	**16,693**	......	......	......
	43,692	......	113,185	......	113,185	......	129,878	......	129,878	......
Triassic "A"	**162,516**	......	**543,850**	......	**3,021,202**	**79**	**2,010,069**	**1,205**	**2,157,613**	**2,605**
	373,688	......	917,538	......	3,938,740	79	5,948,809	1,284	8,106,422	3,889
Triassic "A/B"	......	......	**1,142,154**	......	**7,761,641**	**67**	**5,459,849**	**704**	**5,174,274**	**4,132**
	......	......	1,142,154	......	8,903,795	67	14,363,644	771	19,537,918	4,903
Triassic "D"	......	......	**1,931,032**	......	**12,203,733**	**570**	**7,747,474**	**3,909**	**6,002,529**	**2,355**
	......	......	1,931,032	......	14,134,765	570	21,882,239	4,479	27,884,768	6,834
Permo-Penn	......	......	**713,327**	......	**2,987,885**	**88**	**1,366,130**	**653**	**968,010**	**654**
	......	......	713,327	......	3,701,212	88	5,067,342	741	6,035,352	1,395
Field totals	**187,846**	......	**4,399,856**	......	**25,974,461**	**804**	**16,600,215**	**6,471**	**14,302,426**	**9,746**
	417,380	......	4,817,236	......	30,791,697	804	47,391,912	7,275	61,694,338	17,021

Fort St John Southeast										
Cadomin	......	......	**13,046**	......	**172,095**	......	**323,715**	......	**603,447**	......
	......	......	13,046	......	185,141	......	508,856	......	1,112,303	......
Triassic "A"	......	......	**185,208**	......	**1,269,930**	......	**854,018**	......	**785,804**	......
	......	......	185,208	......	1,455,138	......	2,309,156	......	3,094,960	......
Triassic "D"	......	......	**351,101**	......	**2,750,928**	**58**	**2,083,389**	**1,650**	**3,927,039**	**2,856**
	......	......	351,101	......	3,102,029	58	5,185,418	1,708	9,112,457	4,564
Permo-Penn	......	......	**1,361,374**	......	**9,521,470**	**287**	**7,759,092**	**6,554**	**7,142,814**	**11,460**
	......	......	1,361,374	......	10,882,844	287	18,641,936	6,841	25,784,750	18,301
Field totals	......	......	**1,910,729**	......	**13,714,423**	**345**	**11,020,214**	**8,204**	**12,459,104**	**14,316**
	......	......	1,910,729	......	15,625,152	345	26,645,366	8,549	39,104,470	22,865
Gundy Creek										
Baldonnel	......	......	......	......	**14,920**	......	**100,489**	......	**390,983**	**58**
	......	......	......	......	14,920	......	115,409	......	506,392	58
Baldonnel-Charlie Lake	......	......	......	......	**164,966**	......	**994,660**	**30**	**420,275**	**553**
	......	......	......	......	164,966	......	1,159,626	30	1,579,901	583
Field totals	......	......	......	......	**179,886**	......	**1,095,149**	**30**	**811,258**	**611**
	......	......	......	......	179,886	......	1,275,035	30	2,086,293	641
Halfway										
Baldonnel	......	......	......	......	**696,185**	**3,151**	**2,186,727**	**19,744**	**552,654**	**3,164**
	......	......	......	......	696,185	3,151	2,882,912	22,895	3,435,566	26,059
Halfway	......	......	......	......	**172,622**	**7**	**529,001**	......	**407,342**	**143**
	......	......	......	......	172,622	7	701,623	7	1,108,965	150
Field totals	......	......	......	......	**868,807**	**3,158**	**2,715,728**	**19,744**	**959,998**	**3,307**
	......	......	......	......	868,807	3,158	3,584,535	22,902	4,544,531	26,209
Highway										
Nikanassin	......	......	......	......	......	......	**112,975**	**65**	**171,513**	**21**
	......	......	......	......	......	......	112,975	65	284,488	86
Baldonnel	......	......	......	......	**153,431**	**210**	**881,652**	**10,673**	**310,747**	**26,913**
	......	......	......	......	153,431	210	1,035,083	10,883	1,345,830	37,796
Mississippian	......	......	......	......	**543,787**	**512**	**1,653,052**	**7,431**	**974,502**	**7,045**
	......	......	......	......	543,787	512	2,196,839	7,943	3,171,341	14,988
Field totals	......	......	......	......	**697,218**	**722**	**2,647,679**	**18,169**	**1,456,762**	**33,979**
	......	......	......	......	697,218	722	3,344,897	18,891	6,516,238	52,870
Jedney										
S.C.-upper carbonate	......	......	......	......	......	......	**524,694**	......	**8,023,038**	**238**
	......	......	......	......	......	......	524,694	......	8,547,732	238
Halfway	......	......	......	......	......	......	**182,918**	......	**3,363,109**	**6,368**
	......	......	......	......	......	......	182,918	......	3,546,027	6,368
Field totals	......	......	......	......	......	......	**707,612**	......	**11,386,147**	**6,606**
	......	......	......	......	......	......	707,612	......	12,093,759	6,606

Table 5.—Yearly Natural-gas Production, 1956–60—Continued

Field and Pool	1956		1957		1958		1959		1960	
	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)	Gas (M S.C.F.)	Water (Bbl.)
Kiskatinaw										
Devonian	....	....	**623,544** 623,544	....	**1,679,539** 2,303,083	....	**1,813,524** 4,116,607	....	**2,283,830** 6,400,437	....
Field totals	....	....	**623,544** 623,544	....	**1,679,539** 2,303,083	....	**1,813,524** 4,116,607	....	**2,283,830** 6,400,437	....
Kobes-Townsend										
Cadomin	....	....	....	....	....	....	**474,202** 474,202	**30** 30	**741,577** 1,215,779	**104** 134
Charlie Lake	....	....	....	....	**237,735** 237,735	**135** 135	**1,025,106** 1,262,841	**556** 691	**1,159,718** 2,422,559	**803** 1,494
Halfway	....	....	....	....	**347,656** 347,656	**125** 125	**1,819,326** 2,166,982	**592** 717	**1,742,674** 3,909,656	**633** 1,350
Mississippian	....	....	....	....	**1,364,204** 1,364,204	**516** 516	**3,694,522** 5,058,726	**19,118** 19,634	**2,716,029** 7,774,755	**51,696** 71,330
Field totals	....	....	....	....	**1,949,595** 1,949,595	**776** 776	**7,013,156** 8,962,751	**20,296** 21,072	**6,359,998** 15,322,749	**53,236** 74,308
Laprise Creek										
S.C.-upper carbonate	....	....	....	....	....	....	....	....	**681,598** 681,598	....
Field totals	....	....	....	....	....	....	....	....	**681,598** 681,598	....
Montney										
Bluesky-Gething	....	....	....	....	**87,084** 87,084	....	 87,084	....	**59,916** 147,000	....
Charlie Lake	....	....	....	....	**271,356** 271,356	....	 271,356	....	**12,842** 284,198	....
Halfway	....	....	**94,117** 94,117	....	**1,284,892** 1,379,009	**52** 52	**833,773** 2,212,782	**508** 560	**822,545** 3,035,327	**545** 1,105
Field totals	....	....	**94,117** 94,117	....	**1,643,332** 1,737,449	**52** 52	**833,773** 2,571,222	**508** 560	**895,303** 3,466,525	**545** 1,105
Red Creek										
Charlie Lake	....	....	....	....	....	....	....	....	**233,669** 233,669	....
Halfway	....	....	....	....	**377,371** 377,371	....	**254,145** 631,516	**4,717** 4,717	**335,328** 589,473	**9,670** 14,387
Field totals	....	....	....	....	**377,371** 377,371	....	**254,145** 631,516	**4,717** 4,717	**568,997** 1,200,513	**9,670** 14,387

Stoddart										
Permo-Penn	....	....	**448,851**	....	**5,217,258**	....	**5,138,555**	....	**5,342,266**	**490**
	....	....	448,851	....	5,666,119	....	10,804,664	....	16,146,930	490
Field totals	....	....	**448,851**	....	**5,217,258**	....	**5,138,555**	....	**5,342,266**	**490**
	....	....	448,851	....	5,666,119	....	10,804,664	....	16,146,930	490
Other Areas										
Triassic "C"	....	....	**167,089**	....	....	....	....	....	....	....
	....	....	167,089	....	167,089	....	167,089	....	167,089	....
S.C.-upper carbonate	....	....	....	....	....	....	....	....	**350,403**	....
	....	....	....	....	....	....	....	....	350,403	....
Areas totals	....	....	**167,089**	....	....	....	....	....	**350,403**	....
	....	....	167,089	....	167,089	....	167,089	....	517,492	....
Totals for year	**187,846**	....	**8,274,942**	....	**63,638,297**	**12,382**	**69,128,708**	**98,957**	**85,516,996**	**153,925**
Totals, cumulative	417,380	....	8,692,322	....	72,330,619	12,382	141,459,327	111,339	226,976,323	265,264

NOTE.—Field totals for the year in bold-face type; cumulative totals in light-face type.

Table 6.—Monthly Crude-oil Production by Fields/Areas and Pools, 1959 and 1960

(Quantities in barrels.)

Field	Pool	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Aitken Creek	Lower Cretaceous Bluesky-Gething	1959											2,005	2,391	4,396
		1960	**2,344**	**2,405**	**1,618**	**267**			**606**			**450**	**2,558**	**2,582**	**12,830**
Beatton River	Triassic Halfway	1959	892	3,437	284									884	5,447
		1960	**536**	**337**	**846**										**1,719**
Beatton River West	Lower Cretaceous Bluesky-Gething	1959			382									687	1,069
		1960		**657**	**363**										**1,020**
Blueberry	Lower Cretaceous Nikanassin[1]	1959													
		1960						**223**			**61**	**645**	**256**	**426**	**1,613**
	Mississippian Rundle	1959	108	44	285	41		224		99		108	861	1,080	2,850
		1960	**2,451**	**2,039**	**3,382**	**707**				**2,905**	**2,990**	**539**	**9,637**	**26,390**	**51,040**
Boundary Lake	Triassic Charlie Lake (excluding Boundary Lake)	1959													
		1960		**78**		**86**	**273**	**382**							**819**
	Triassic Boundary Lake	1959	60,094	40,080	57,890	81,731	56,628	61,193	56,046	46,211	67,647	61,055	76,054	75,192	688,821
		1960	**74,171**	**62,182**	**60,127**	**16,168**	**48,139**	**65,013**	**95,722**	**75,882**	**77,880**	**65,344**	**6,238**	**35,495**	**682,361**
	Triassic Halfway	1959													
		1960											**110**	**385**	**495**
Fort St. John	Lower Cretaceous Bluesky-Gething	1959	775	620	748	263	414	731	585	450	398	752	658	621	7,010
		1960	**534**							**529**	**400**	**384**	**244**		**2,091**
	Triassic Charlie Lake	1959	9,574	7,687	8,660	8,302	8,725	8,743	7,801	6,464	9,534	8,951	7,838	8,322	100,601
		1960	**8,201**	**7,476**	**8,006**	**8,808**	**7,864**	**8,846**	**8,637**	**8,091**	**7,296**	**7,542**	**7,712**	**9,090**	**97,569**
	Permo-Pennsylvanian	1959						2,071	1,706	1,409	2,190	800	966	92	9,234
		1960							**132**						**132**
Milligan Creek	Triassic Halfway	1959	13,305	17,575	4,905								4,423	4,069	44,277
		1960		**1,891**	**5,831**										**7,722**
Peejay	Triassic Halfway	1959			1,045										1,045
		1960	**812**											**4,707**	**5,519**
Other areas	Triassic Halfway	1959													
		1960	**664**	**190**	**1,273**										**2,127**
Totals		1959	84,748	69,443	74,149	40,337	64,767	72,962	66,188	54,633	79,764	71,666	92,805	93,338	864,750
		1960	**89,713**	**77,255**	**81,446**	**26,036**	**56,276**	**74,464**	**105,097**	**87,407**	**88,627**	**74,904**	**26,757**	**79,075**	**867,057**

[1] Test production on Sun et al Blueberry d-97-D.

NOTE.—Field totals for the year in bold-face type; cumulative totals in light-face type.

Table 7.—Monthly Natural-gas Production by Fields/Areas and Pools, 1959 and 1960

(Quantities in M s.c.f.)

Field	Pool	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Aitken Creek	Lower Cretaceous Bluesky-Gething	1959	......	......	......	......	......	......	......	......	......	......	(947)	(1,889)	(2,836)
		1960	(1,096)	(1,179)	(1,261)	(123)	......	......	(297)	......	......	(278)	(1,190)	(1,160)	(6,584)
Beatton River	Triassic Halfway	1959	(368)	(3,517)	(550)	......	......	......	......	......	......	......	......	(757)	(5,192)
		1960	(735)	(462)	(1,457)	......	......	......	......	......	......	......	......	......	(2,654)
Beatton River West	Lower Cretaceous Bluesky-Gething	1959	......	......	(134)	......	......	......	......	......	......	......	......	(264)	(398)
		1960	......	(131)	(73)	......	......	......	......	......	......	......	......	......	(204)
Blueberry	Lower Cretaceous Nikanassin	1959	32,050	40,726	46,813	42,863	40,686	43,766	41,613	41,683	48,867	54,634	62,800	70,451	566,952
		1960	83,766	85,921	87,221	86,045	87,050	80,362	76,294	81,407	77,202	80,548	72,161	69,513	967,490
	Lower Cretaceous Nikanassin[1]	1959	......	......	......	......	......	......	......	......	......	......	......	......	......
		1960	......	......	......	......	......	(4,455)	......	......	(562)	(18,393)	(20,374)	(36,827)	(80,611)
	Triassic Baldonnel	1959	143,164	101,727	81,537	87,315	147,574	135,649	133,180	118,830	125,416	137,096	131,111	135,250	1,477,849
		1960	138,311	129,161	139,614	128,046	129,936	79,000	69,302	65,484	70,594	134,162	74,790	82,969	1,241,369
	Mississippian Rundle	1959	(49)	(20)	(128)	(18)	......	(100)	......	(56)	......	(75)	(714)	(1,247)	(2,407)
		1960	(1,637)	(2,047)	(4,634)	(916)	......	......	......	(6,818)	(6,283)	(594)	(9,794)	(18,265)	(50,988)
Blueberry East	Triassic Baldonnel	1959	68,191	73,034	78,903	69,852	68,197	32,932	......	......	......	......	......	......	391,109
		1960	......	......	......	......	......	......	......	......	......	......	......	......	......
	Triassic Halfway	1959	42,018	34,157	40,143	44,085	44,120	12,934	......	......	......	......	......	......	217,457
		1960	......	......	......	......	......	......	......	......	......	......	......	......	......
	Mississippian Rundle	1959	37,672	24,067	17,516	14,282	10,745	1,214	9,578	6,513	4,439	3,340	2,222	406	131,994
		1960	......	......	......	......	......	......	......	......	......	......	......	......	......
Blueberry West	Lower Cretaceous Nikanassin	1959	19,639	19,079	18,834	17,270	15,231	14,873	15,642	14,099	14,441	11,297	13,465	10,765	184,635
		1960	8,694	12,638	10,975	11,601	11,941	9,661	12,371	11,623	9,291	9,557	8,560	8,752	125,664
	Triassic Baldonnel	1959	56,135	49,163	52,289	49,629	50,393	39,597	25,547	21,224	22,599	28,368	23,450	41,358	459,752
		1960	32,488	42,455	39,254	41,218	40,756	41,146	53	888	4,331	4,598	6,644	443	254,274
Boundary Lake	Lower Cretaceous Bluesky-Gething	1959	......	......	......	......	......	......	......	......	......	......	......	......	......
		1960	......	......	......	......	......	......	......	......	......	......	40,856	154,597	195,453
	Triassic Baldonnel	1959	......	......	......	......	......	......	......	......	......	......	......	......	......
		1960	......	......	......	......	......	......	......	......	......	......	4,000	44,618	48,618
	Triassic Charlie Lake (excluding Boundary Lake)	1959	......	......	......	......	......	......	......	......	......	......	......	......	......
		1960	......	(91)	......	(36)	(437)	(271)	......	......	......	......	......	......	(835)
	Triassic Boundary Lake	1959	(29,828)	(26,141)	(35,225)	(21,676)	(34,539)	(42,545)	(42,134)	(35,745)	(48,894)	(41,991)	(58,193)	(68,020)	(484,931)
		1960	(62,892)	(58,532)	(39,136)	(9,215)	(26,720)	(40,287)	(60,018)	(48,290)	(55,490)	(55,324)	(5,355)	(20,952)	(482,211)
	Triassic Halfway	1959	......	......	......	......	......	......	......	......	......	......	......	......	......
		1960	......	......	......	......	......	......	......	......	......	......	(41)	(150)	(191)
Bubbles	Triassic upper carbonate of Schooler Creek	1959	......	......	......	......	......	......	......	......	......	18,309	469,567	664,623	1,152,499
		1960	674,494	693,479	710,519	680,810	784,773	685,338	680,489	643,252	686,264	732,281	674,451	781,768	8,427,918
Buick Creek	Lower Cretaceous Buick Creek	1959	......	......	......	......	......	......	......	......	......	......	......	22,278	22,278
		1960	65,579	58,611	61,804	76,359	123,258	104,954	119,098	118,357	114,403	120,140	119,149	123,597	1,205,309
Buick Creek West	Lower Cretaceous Buick Creek	1959	1,269,677	978,003	1,088,308	1,077,765	1,125,329	827,665	889,047	857,698	924,395	1,087,181	1,005,413	1,186,188	12,316,669
		1960	1,244,778	1,167,092	1,193,046	1,141,607	1,182,358	1,078,138	1,054,628	1,029,958	977,737	963,363	1,007,743	976,710	13,017,158
	Triassic Baldonnel	1959	......	......	......	......	......	......	......	......	......	......	......	......	......
		1960	......	......	......	......	......	......	......	......	......	6,859	47,457	67,816	122,132

Table 7.—Monthly Natural-gas Production by Fields/Areas and Pools, 1959 and 1960—Continued

(Quantities in M s.c.f.)

Field	Pool	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Dawson Creek Fort St. John	Triassic Halfway	1959	176,946	103,780	135,104	125,571	150,208	98,791	105,118	137,239	118,604	139,988	120,115	135,596	1,547,060
		1960	128,670	103,816	75,798	117,960	89,919	64,383	68,317	99,705	86,595	73,643	61,152	64,166	1,034,126
	Lower Cretaceous Cadotte	1959	2,067	......	......	91,730	84,860	86,896	99,777	92,801	90,951	91,106	82,758	97,758	820,704
		1960	93,127	87,167	91,042	87,296	88,918	84,889	71,579	82,801	79,583	83,591	84,819	84,779	1,019,397
	Lower Cretaceous Bluesky-Gething	1959	(892)	(1,070)	(1,051)	(491)	(582)	(898)	(962)	(593)	(584)	(1,060)	(953)	(990)	(10,121)
		1960	(1,044)	......	......	......	......	......	......	(1,107)	(697)	(600)	(467)	......	(3,815)
	Lower Cretaceous Cadomin	1959	......	......	......	......	......	......	......	......	14,047	2,646	......	......	16,693
		1960	......	......	......	......	......	......	......	......	......	......	......	......	......
	Triassic Baldonnel "A" Zone	1959	192,944	166,939	176,317	169,471	150,678	163,242	173,207	155,221	160,023	172,611	160,151	169,205	2,010,069
		1960	168,486	163,926	173,287	168,610	167,037	163,258	155,884	161,474	148,373	169,809	189,625	327,744	2,157,613
	Triassic Baldonnel "A/B" Zone	1959	523,256	449,043	517,387	508,361	397,499	379,368	418,824	390,032	367,511	528,540	484,344	492,184	5,459,849
		1960	489,355	449,431	468,568	406,862	429,934	405,037	399,318	419,318	385,054	429,772	452,476	439,149	5,174,274
	Triassic Charlie Lake	1959	(13,724)	(10,870)	(13,893)	(13,400)	(13,774)	(14,851)	(14,118)	(13,626)	(18,843)	(18,748)	(18,646)	(18,522)	(182,515)
		1960	(18,633)	(17,996)	(18,559)	(20,318)	(16,870)	(19,859)	(14,215)	(16,683)	(18,318)	(18,219)	(18,328)	(20,061)	(218,059)
	Triassic Halfway	1959	763,804	675,007	731,620	738,379	632,439	535,740	534,669	633,706	546,412	676,524	630,980	648,194	7,747,474
		1960	614,354	566,823	590,326	540,253	499,237	467,256	403,866	423,048	403,509	458,699	514,970	520,188	6,002,529
	Permo-Pennsylvanian	1959	160,288	129,577	135,922	129,090	107,318	95,106	81,016	105,178	92,802	124,721	104,484	100,678	1,366,130
		1960	88,060	69,348	75,758	93,079	64,041	72,499	78,818	80,237	71,391	91,894	88,992	93,893	968,010
	Permo-Pennsylvanian	1959	......	......	......	......	......	(6,370)	(12,734)	(19,245)	(35,960)	(30,346)	(21,689)	(3,430)	(129,774)
		1960	......	......	......	......	......	......	(1,330)	......	......	......	......	......	(1,330)
Fort St. John Southeast	Lower Cretaceous Cadomin	1959	12,396	36,958	41,443	40,443	33,797	10,841	......	228	13,816	49,123	45,636	39,129	323,715
		1960	45,713	42,938	46,364	46,257	40,426	51,569	47,354	54,469	53,213	60,848	53,017	61,279	603,447
	Triassic Baldonnel "A" Zone	1959	92,072	76,137	82,387	77,707	55,208	65,725	67,938	65,168	59,716	74,115	75,925	61,920	854,018
		1960	68,541	64,016	66,829	62,140	53,675	63,604	58,698	62,449	75,787	64,702	75,007	70,386	785,804
	Triassic Halfway	1959	116,652	128,157	102,186	117,409	123,943	28,073	50,053	197,115	162,402	326,288	383,669	348,342	2,083,389
		1960	336,978	298,251	336,810	329,209	326,140	343,987	320,807	318,997	302,576	318,621	323,686	371,207	3,927,039
	Permo-Pennsylvanian	1959	695,958	648,771	711,437	674,279	655,760	665,962	549,388	631,570	598,642	631,254	672,056	623,120	7,759,692
		1960	617,337	569,494	604,139	603,630	594,208	641,134	582,008	586,821	567,457	595,392	601,210	580,984	7,142,814
Gundy Creek	Triassic Baldonnel	1959	18,011	8,981	6,400	......	3,500	......	......	......	5,019	25,308	29,529	3,746	100,489
		1960	30,477	40,409	8,239	33,987	38,034	51,654	52,590	42,552	39,446	22,735	13,441	17,419	390,983
	Triassic Baldonnel-Charlie Lake	1959	94,116	53,354	106,685	97,192	107,322	85,008	86,276	79,983	66,043	70,143	58,777	88,761	994,660
		1960	62,062	64,595	56,169	31,654	54,408	47,918	38,854	40,948	11,890	10,284	1,553	......	420,275
Halfway	Triassic Baldonnel	1959	288,600	255,319	237,816	216,496	225,976	193,797	177,088	163,220	122,818	115,526	126,653	63,418	2,186,727
		1960	46,548	43,274	45,585	78,589	41,621	40,258	41,962	44,421	40,951	43,562	42,912	42,973	552,654
	Triassic Halfway	1959	48,747	43,311	59,084	47,673	50,627	46,403	45,118	43,099	49,316	42,547	48,464	13,606	529,001
		1960	......	......	......	......	11,603	56,657	54,532	55,795	57,721	60,815	56,333	53,886	407,342
Highway	Lower Cretaceous Nikanassin	1959	3,631	4,859	7,353	7,178	9,512	9,883	11,118	11,883	10,596	10,450	11,597	14,920	112,975
		1960	15,522	14,682	14,719	14,227	14,914	12,851	14,968	14,282	12,829	13,994	14,410	14,117	171,513
	Triassic Baldonnel	1959	48,752	102,459	124,503	98,422	113,988	108,528	97,605	57,357	39,427	38,866	25,096	26,649	881,652
		1960	21,353	18,351	13,490	14,899	19,896	36,605	42,391	37,814	32,095	29,227	25,707	20,819	310,747
	Mississippian Rundle	1959	172,265	154,440	165,340	155,719	138,163	135,369	129,386	130,842	125,699	121,526	113,690	110,613	1,658,052
		1960	104,262	89,734	80,858	85,416	88,174	81,183	81,932	80,495	73,180	73,945	67,417	67,906	974,502

Jedney	Triassic upper carbonate	1959	...	...	...	...	...	...	...	...	...	...	76,922	447,772	524,694
	of Schooler Creek	**1960**	**601,682**	**551,519**	**684,185**	**669,281**	**670,915**	**631,300**	**675,915**	**688,189**	**708,236**	**711,772**	**699,544**	**730,500**	**8,023,038**
	Triassic Halfway	1959	...	...	...	...	...	...	...	...	...	...	46,538	136,380	182,918
Kiskatinaw	Upper Devonian Waba-	**1960**	**156,825**	**157,254**	**241,524**	**285,915**	**292,024**	**251,983**	**270,675**	**282,629**	**370,224**	**371,909**	**301,412**	**380,735**	**3,363,109**
	mun	1959	81,310	97,914	98,072	145,323	140,119	123,644	112,874	163,223	175,088	177,433	189,878	308,646	1,813,524
		1960	**269,466**	**291,785**	**224,471**	**316,708**	**1,211**	**138,176**	**199,127**	**184,694**	**177,821**	**166,723**	**182,347**	**131,301**	**2,283,830**
Kobes-Townsend	Lower Cretaceous Cado-	1959	...	7,585	43,552	51,261	42,334	49,457	38,781	14,726	52,982	57,541	64,533	51,450	474,202
	min	**1960**	**65,243**	**63,845**	**57,813**	**59,302**	**63,311**	**60,439**	**60,215**	**63,047**	**49,769**	**64,187**	**65,418**	**68,988**	**741,577**
	Triassic Charlie Lake	1959	94,485	108,067	109,479	107,377	73,572	98,088	78,682	68,252	68,378	77,418	73,486	67,822	1,025,106
		1960	**91,379**	**84,830**	**91,543**	**89,999**	**105,933**	**110,649**	**107,514**	**102,596**	**87,744**	**100,542**	**95,276**	**91,713**	**1,159,718**
	Triassic Halfway	1959	129,865	154,550	171,205	168,731	159,793	163,032	175,447	165,299	124,734	136,124	107,022	163,524	1,819,326
		1960	**199,861**	**144,811**	**177,972**	**147,273**	**125,731**	**129,641**	**140,471**	**149,430**	**132,821**	**119,477**	**133,993**	**141,193**	**1,742,674**
	Mississippian Rundle	1959	530,188	417,455	413,601	324,120	263,249	185,424	235,512	298,364	262,096	280,142	248,465	235,906	3,694,522
		1960	**258,997**	**257,437**	**307,590**	**243,020**	**235,307**	**192,853**	**216,723**	**214,646**	**195,104**	**179,953**	**195,178**	**219,221**	**2,716,029**
Laprise Creek	Triassic upper carbonate	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
	of Schooler Creek	**1960**	...	...	...	...	...	...	...	...	...	...	**205,520**	**476,078**	**681,598**
Milligan Creek	Triassic Halfway	1959	(2,393)	(3,016)	(980)	...	...	...	...	...	...	...	(1,135)	(1,100)	(8,624)
		1960	...	**(676)**	**(2,013)**	...	...	...	...	...	...	...	...	...	**(2,689)**
Montney	Lower Cretaceous Bluesky-	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
	Gething	**1960**	**10,965**	**5,316**	**5,910**	**3,912**	**5,905**	**5,676**	**6,416**	**6,187**	**5,214**	**4,415**	...	...	**59,916**
	Triassic Charlie Lake	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
		1960	...	**6,457**	**6,385**	...	...	...	...	...	...	...	...	...	**12,842**
	Triassic Halfway	1959	65,652	64,515	76,846	73,108	76,363	72,237	70,236	55,820	61,924	73,062	75,468	68,542	833,773
		1960	**69,673**	**69,141**	**75,287**	**73,245**	**77,023**	**72,946**	**61,864**	**77,761**	**63,909**	**64,795**	**64,433**	**52,468**	**822,545**
Peejay	Triassic Halfway	1959	...	...	(302)	...	...	...	...	...	...	...	...	...	(302)
		1960	**(196)**	...	...	...	...	...	...	...	...	...	...	**(1,193)**	**(1,389)**
Red Creek	Triassic Charlie Lake	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
		1960	...	...	...	...	...	...	...	**6,533**	**52,017**	**56,447**	**58,517**	**60,155**	**233,669**
	Triassic Halfway	1959	...	...	...	...	...	...	25,829	47,734	43,539	49,314	40,403	47,326	254,145
		1960	**44,107**	**27,158**	**17,057**	**1,042**	**34,882**	**40,145**	**17,827**	**12,340**	**31,228**	**35,115**	**36,779**	**37,648**	**335,328**
Stoddart	Permo-Pennsylvanian	1959	509,385	435,571	465,411	438,705	426,397	405,667	392,289	413,435	315,610	450,279	453,471	432,335	5,138,555
		1960	**440,481**	**410,517**	**447,614**	**430,280**	**472,891**	**481,901**	**464,030**	**426,362**	**440,681**	**479,811**	**463,298**	**384,400**	**5,342,266**
Other areas	Triassic upper carbonate	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
	of Schooler Creek	**1960**	...	...	...	...	...	...	...	...	...	...	**84,564**	**265,839**	**350,403**
	Triassic Halfway	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
		1960	**(178)**	**(1,037)**	**(6,556)**	...	...	...	...	...	...	...	...	...	**(7,771)**
Monthly totals	Natural gas	1959	6,489,841	5,642,760	6,134,493	6,006,812	5,724,000	4,914,911	4,870,333	5,190,542	4,888,352	5,877,815	6,259,988	7,128,861	69,128,708
		1960	**7,387,632**	**6,942,684**	**7,327,705**	**7,199,831**	**7,067,390**	**6,878,830**	**6,746,958**	**6,770,999**	**6,696,246**	**7,007,987**	**7,308,817**	**8,181,917**	**85,516,996**
	(Solution gas, oil wells)	1959	(47,254)	(44,634)	(52,263)	(35,585)	(48,895)	(64,759)	(69,948)	(69,265)	(103,781)	(92,220)	(102,277)	(96,219)	(827,100)
		1960	**(86,411)**	**(82,151)**	**(73,689)**	**(30,608)**	**(44,027)**	**(64,872)**	**(75,860)**	**(72,898)**	**(81,250)**	**(93,408)**	**(55,549)**	**(98,608)**	**(859,331)**
	Totals, gas	1959	6,537,095	5,687,394	6,186,756	6,042,397	5,772,895	4,979,670	4,940,281	5,259,807	4,992,133	5,970,035	6,362,265	7,225,080	69,955,808
		1960	**7,474,043**	**7,024,835**	**7,401,394**	**7,230,439**	**7,111,417**	**6,943,702**	**6,822,818**	**6,843,897**	**6,777,496**	**7,101,395**	**7,364,366**	**8,280,525**	**86,376,327**

[1] Test production on Sun et al Blueberry d-97-D.

( ) Oil-well solution gas.

Table 8.—Monthly Natural-gas Liquids and Sulphur Production, 1959 and 1960

	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Condensate/pentanes plus (bbl.)	1959	59,237	41,268	37,590	40,658	42,028	41,575	39,061	31,813	40,044	43,885	48,972	46,820	512,951
	1960	**72,578**	**56,328**	**65,751**	**62,714**	**65,916**	**61,774**	**53,448**	**59,053**	**62,942**	**64,701**	**60,054**	**65,589**	**750,848**
Butane (bbl.)	1959	17,304	19,676	15,755	13,810	14,635	15,104	15,122	16,196	17,165	17,455	17,574	27,233	207,029
	1960	**29,287**	**26,626**	**26,031**	**20,026**	**19,945**	**19,845**	**23,126**	**24,223**	**24,757**	**28,606**	**25,436**	**25,460**	**293,368**
Propane (bbl.)	1959	10,753	10,045	8,742	7,123	6,136	5,429	5,122	6,112	7,244	8,750	10,735	10,734	96,925
	1960	**10,623**	**5,807**	**7,018**	**7,215**	**9,149**	**8,260**	**10,391**	**11,380**	**10,804**	**13,632**	**15,666**	**15,146**	**125,091**
Sulphur (short tons)	1959	5,127	4,281	4,847	4,639	4,326	3,475	3,772	4,275	3,806	4,892	4,805	5,448	53,693
	1960	**5,420**	**5,007**	**5,194**	**5,152**	**5,262**	**4,803**	**4,597**	**4,823**	**4,937**	**4,699**	**5,090**	**5,470**	**60,454**

Table 9.—Monthly Crude-oil Disposition, 1959 and 1960

(Quantities in barrels.)

Month	Year	Production	Opening Inventory	Receipts	Transfers	Losses and Adjustments	Closing Inventory	Sales		
								B.C. Refineries	Miscellaneous	Total
January	1959	84,748	12,543	215	130	....	17,341	63,083	16,952	80,035
	1960	**89,713**	**14,441**	**1,047**	**1,512**	**1,277**	**17,191**	**79,594**	**5,627**	**85,221**
February	1959	69,443	17,341	920	31	6	13,103	51,130	23,434	74,564
	1960	**77,255**	**17,191**	**1,525**	**2,385**	**181**	**19,910**	**63,401**	**10,094**	**73,495**
March	1959	74,149	13,103	2,103	1,773	994	9,075	66,804	10,709	77,513
	1960	**81,446**	**19,910**	**1,370**	**4,225**	**3**	**20,057**	**67,291**	**11,150**	**78,441**
April	1959	40,337	9,075	....	....	260	15,043	33,644	465	34,109
	1960	**26,036**	**20,057**	**65**	**74**	**760**	**20,398**	**24,447**	**479**	**24,926**
May	1959	64,767	15,043	1,322	1,322	....	12,965	66,449	396	66,845
	1960	**56,276**	**20,398**	....	**202**	....	**23,670**	**52,802**	....	**52,802**
June	1959	72,962	12,965	....	....	909	11,344	71,688	1,986	73,674
	1960	**74,464**	**23,670**	**109**	**657**	**29**	**17,800**	**78,299**	**1,458**	**79,757**
July	1959	66,138	11,344	....	386	....	12,891	62,160	2,045	64,205
	1960	**105,097**	**17,800**	**379**	**253**	....	**21,072**	**100,378**	**1,573**	**101,951**
August	1959	54,683	12,891	....	246	....	15,683	49,455	2,140	51,595
	1960	**87,407**	**21,072**	**234**	**314**	....	**28,328**	**78,383**	**1,188**	**79,571**
September	1959	79,764	15,683	467	135	....	16,377	76,270	3,132	79,402
	1960	**88,627**	**28,328**	**943**	**308**	**343**	**22,422**	**94,606**	**219**	**94,825**
October	1959	71,666	16,377	29	109	....	15,978	69,872	2,113	71,985
	1960	**74,904**	**22,422**	**688**	**494**	**174**	**26,859**	**69,835**	**652**	**70,487**
November	1959	92,805	15,978	112	238	75	14,799	85,826	7,957	93,783
	1960	**26,757**	**26,859**	**368**	**1,805**	**533**	**27,756**	**20,328**	**3,562**	**23,890**
December	1959	93,338	14,799	376	717	....	14,441	81,879	11,476	93,455
	1960	**79,075**	**27,756**	**756**	**811**	**398**	**33,150**	**69,158**	**4,074**	**73,232**
Totals	1959	864,750	12,543	5,544	5,087	2,244	14,441	778,260	82,805	861,165
	1960	**867,057**	**14,441**	**7,486**	**13,540**	**3,696**	**33,150**	**798,522**	**40,076**	**838,598**

Table 10.—Monthly Natural-gas Disposition, 1959 and 1960

(Quantities in M s.c.f.)

Field

Month	Year	Total B.C. Production: Wet Gas	Total B.C. Production: Dry Gas	Total B.C. Production: Solution Gas	Flared	Lease Fuel	Delivered to G.G.S.
January	1959	6,406,464	83,377	47,254	47,254	24,050	6,465,791
	1960	**7,025,039**	**362,593**	**86,411**	**86,411**	**51,616**	**7,336,016**
February	1959	5,544,846	97,914	44,634	44,634	25,164	5,617,596
	1960	**6,563,732**	**378,952**	**82,151**	**82,151**	**40,117**	**6,902,567**
March	1959	6,036,421	98,072	52,263	52,263	27,677	6,106,816
	1960	**7,012,192**	**315,513**	**73,689**	**73,689**	**41,542**	**7,286,163**
April	1959	5,769,759	237,053	35,585	35,585	27,559	5,979,253
	1960	**6,795,827**	**404,004**	**30,608**	**30,608**	**79,198**	**7,120,633**
May	1959	5,499,021	224,979	48,895	48,895	27,960	5,696,040
	1960	**6,977,261**	**90,129**	**44,027**	**44,027**	**38,484**	**7,028,906**
June	1959	4,704,371	210,540	64,759	64,759	23,158	4,891,753
	1960	**6,655,965**	**222,865**	**64,872**	**64,872**	**41,215**	**6,837,615**
July	1959	4,657,682	212,651	69,948	69,948	24,022	4,846,311
	1960	**6,476,252**	**270,706**	**75,860**	**75,860**	**77,438**	**6,669,520**
August	1959	4,934,518	256,024	69,265	69,265	25,569	5,164,973
	1960	**6,503,504**	**267,495**	**72,898**	**72,898**	**56,566**	**6,714,433**
September	1959	4,622,313	266,039	103,781	103,781	24,916	4,863,436
	1960	**6,438,836**	**257,410**	**81,250**	**82,601**	**42,677**	**6,652,218**
October	1959	5,609,276	268,539	92,220	92,220	31,737	5,846,078
	1960	**6,757,673**	**250,314**	**93,408**	**75,015**	**46,841**	**6,979,539**
November	1959	5,987,352	272,636	102,277	102,277	43,792	6,216,196
	1960	**7,041,651**	**267,166**	**55,549**	**35,175**	**213,010**	**7,116,181**
December	1959	6,722,457	406,404	96,219	96,219	67,183	7,061,678
	1960	**7,965,837**	**216,080**	**98,608**	**60.854**	**42,375**	**8,177,296**
Totals	1959	66,494,480	2,634,228	827,100	827,100	372,787	68,755,921
	1960	**82,213,769**	**3,303,227**	**859,331**	**784,161**	**771,079**	**84,821,087**

Gas-gathering System and **Gas Plant**

Month	Year	Gas-gathering System: Received from B.C. Producers	Line Loss and Metering Difference[1]	Delivered to—Westcoast Transmission (Dry Gas)	Delivered to—Gas Plant (Wet Gas)	Gas Plant: B.C. Wet Gas Received from G.G.S.	Plant Fuel	Processing Shrinkage	Plant Waste and Metering Difference	Marketable Residue Gas
January	1959	6,465,791	−54,397	82,551	6,437,637	6,437,637	189,918	324,780	22,433	5,900,506
	1960	**7,336,016**	**−162,131**	**360,758**	**7,137,389**	**7,137,389**	**278,320**	**385,192**	**−37,979**	**6,511,856**
February	1959	5,617,596	−141,330	96,915	5,662,011	5,662,011	174,511	286,634	83,312	5,117,554
	1960	**6,902,567**	**−133,276**	**377,030**	**6,658,813**	**6,658,813**	**239,901**	**359,521**	**−20,914**	**6,080,305**
March	1959	6,106,816	−154,779	96,999	6,164,596	6,164,596	186,206	296,841	−30,332	5,711,881
	1960	**7,286,163**	**−165,438**	**314,790**	**7,136,811**	**7,136,811**	**226,415**	**370,142**	**−67,622**	**6,607,876**
April	1959	5,979,253	−169,210	236,142	5,912,321	5,912,321	187,453	279,893	−6,135	5,451,110
	1960	**7,120,633**	**−153,797**	**402,769**	**6,871,661**	**6,871,661**	**205,139**	**348,198**	**−34,429**	**6,352,753**
May	1959	5,696,040	−72,145	224,261	5,543,924	5,543,924	176,507	268,347	−59,346	5,158,416
	1960	**7,028,906**	**−161,405**	**92,694**	**7,097,617**	**7,097,617**	**205,649**	**365,481**	**−51,485**	**6,577,972**
June	1959	4,891,753	−4,957	210,013	4,686,697	4,686,697	169,671	224,634	−91,589	4,383,981
	1960	**6,837,615**	**−133,886**	**222,480**	**6,749,021**	**6,749,021**	**213,722**	**347,352**	**−76,277**	**6,264,224**
July	1959	4,846,311	−83,856	211,886	4,718,281	4,718,281	162,224	231,718	−55,367	4,379,706
	1960	**6,669,520**	**−122,979**	**270,432**	**6,522,067**	**6,522,067**	**213,995**	**342,668**	**−69,614**	**6,035,018**
August	1959	5,164,973	−100,130	255,246	5,009,857	5,009,857	173,148	258,886	10,970	4,566,853
	1960	**6,714,433**	**−223,091**	**265,977**	**6,671,547**	**6,671,547**	**246,763**	**359,771**	**−53,535**	**6,118,548**
September	1959	4,863,436	−87,904	265,237	4,686,103	4,686,103	158,518	235,770	−10,482	4,302,297
	1960	**6,652,218**	**−167,617**	**255,477**	**6,564,358**	**6,564,358**	**225,644**	**387,064**	**−146,380**	**6,098,030**
October	1959	5,846,078	−23,665	267,060	5,602,683	5,602,683	182,252	292,485	−34,833	5,162,779
	1960	**6,979,539**	**−222,662**	**249,561**	**6,952,640**	**6,952,640**	**281,349**	**408,608**	**−113,560**	**6,376,243**
November	1959	6,216,196	−23,185	271,726	5,967,655	5,967,655	245,935	317,397	−116,290	5,520,613
	1960	**7,116,181**	**−203,046**	**267,841**	**7,051,386**	**7,051,386**	**283,463**	**402,144**	**−7,289**	**6,373,068**
December	1959	7,061,678	−122,306	404,209	6,779,775	6,779,775	259,375	389,782	−117,074	6,247,692
	1960	**8,177,296**	**−72,869**	**216,637**	**8,033,528**	**8,033,528**	**301.805**	**440,470**	**−131,807**	**7,423,060**
Totals	1959	68,755,921	−1,037,864	2,622,245	67,171,540	67,171,540	2,265,718	3,407,167	−404,733	61,903,388
	1960	**84,821,087**	**−1,922,197**	**3,296,446**	**83,446,838**	**83,446,838**	**2,922,165**	**4,516,611**	**−810,891**	**76,818,953**

Transporters

Month	Year	Receipts: Marketable Residue Gas from Plant	Receipts: B.C. Dry Gas from G.G.S.	Receipts: Alberta Dry Gas Imports	Line Loss and Metering Difference[1]	Sales to Purchasers and Distributors: British Columbia—North-east	British Columbia—Interior	British Columbia—Lower Mainland	United States	Total Sales
January	1959	5,900,506	82,551	3,001,787	92,448	249,925	426,202	1,427,263	6,789,006	8,892,396
	1960	**6,511,856**	**360,758**	**2,926,141**	**230,669**	**194,590**	**612,302**	**2,064,077**	**6,697,117**	**9,568,036**
February	1959	5,117,554	96,915	2,615,049	99,250	175,150	370,395	1,284,023	5,900,700	7,730,268
	1960	**6,080,305**	**377,030**	**2,647,499**	**59,793**	**164,979**	**503,859**	**1,866,257**	**6,509,946**	**9,045,041**
March	1959	5,711,881	96,999	2,702,635	150,247	147,113	341,210	1,306,039	6,566,906	8,361,268
	1960	**6,607,876**	**314,790**	**2,747,590**	**236,919**	**173,252**	**569,636**	**1,899,016**	**6,791,233**	**9,433,337**
April	1959	5,451,110	236,142	2,612,150	178,732	114,810	253,188	1,105,646	6,647,026	8,120,670
	1960	**6,352,753**	**402,769**	**2,515,534**	**196,188**	**97,109**	**450,208**	**1,404,944**	**7,122,607**	**9,074,868**
May	1959	5,158,416	224,261	1,972,798	155,735	85,130	260,698	881,861	5,972,051	7,199,740
	1960	**6,577,972**	**92,694**	**2,492,742**	**162,344**	**94,676**	**406,937**	**1,262,444**	**7,237,007**	**9,001,064**
June	1959	4,383,981	210,013	1,375,574	30,466	63,854	210,628	741,570	4,923,050	5,939,102
	1960	**6,264,224**	**222,480**	**2,291,943**	**146,996**	**78,664**	**337,473**	**969,045**	**7,246,469**	**8,631,651**
July	1959	4,379,706	211,886	1,454,440	64,027	50,262	186,806	625,385	5,119,552	5,982,005
	1960	**6,035,018**	**270,432**	**2,351,783**	**207,787**	**61,373**	**328,179**	**791,704**	**7,268,193**	**8,449,449**
August	1959	4,566,853	255,246	1,606,329	118,605	61,898	263,337	700,009	5,284,579	6,309,823
	1960	**6,118,548**	**265,977**	**2,452,888**	**122,278**	**69,361**	**372,378**	**902,214**	**7,371,182**	**8,715,135**
September	1959	4,302,297	265,237	1,857,290	51,565	85,625	356,173	867,914	5,063,547	6,373,259
	1960	**6,098,030**	**255,477**	**2,007,115**	**218,960**	**87,310**	**408,538**	**1,092,490**	**6,553,324**	**8,141,662**
October	1959	5,162,779	267,060	2,313,010	55,640	122,329	419,008	1,286,615	5,859,257	7,687,209
	1960	**6,376,243**	**249,561**	**2,446,452**	**52,501**	**126,019**	**493,275**	**1,489,952**	**6,910,509**	**9,019,755**
November	1959	5,520,613	271,726	2,254,159	146,021	157,018	523,227	1,706,589	5,513,643	7,900,477
	1960	**6,373,068**	**267,841**	**2,524,124**	**223,397**	**170,561**	**753,164**	**2,058,396**	**5,959,525**	**8,941,636**
December	1959	6,247,692	404,209	2,709,123	51,962	163,872	529,523	1,940,330	6,675,337	9,309,062
	1960	**7,423,060**	**216,637**	**2,545,752**	**263.436**	**192,533**	**872,850**	**2,319,578**	**6,537,052**	**9,922,013**
Totals	1959	61,903,388	2,622,245	26,474,344	1,194,698	1,476,986	4,140,395	13,873,244	70,314,654	89,805,279
	1960	**76,818,953**	**3,296,446**	**29,949,566**	**2,121,268**	**1,510,417**	**6,108,999**	**18,120,117**	**82,204,164**	**107,943,697**

[1] Differences in metered volumes necessitate adjustments between metering stations. The total of metering difference and line loss (or plant waste) is subtracted algebraically from the appropriate total; thus a minus figure represents an actual gain.

Table 11.—Monthly Natural-gas Liquids and Sulphur Disposition, 1959 and 1960

	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Condensate/pentanes plus (bbl.)—														
Gas-plant recovery	1959	59,237	41,268	37,590	40,658	42,028	41,575	39,061	31,813	40,044	43,885	48,972	46,820	512,951
	1960	72,578	56,328	65,751	62,714	65,916	61,774	53,448	59,053	62,942	64,701	60,054	65,589	750,848
Flared and fuel	1959	20,148	4,888	...	...	8,920	12,055	11,732	8,160	15,268	9,885	6,989	17,780	115,825
	1960	28,900	25,400	32,488	20,631	26,316	36,433	26,850	15,023	31,720	18,233	...	...	261,994
Transfers to refineries	1959	39,089	36,380	37,590	40,658	33,108	29,520	27,329	23,653	24,776	34,000	41,983	29,040	397,126
	1960	43,678	30,928	33,263	42,083	39,600	25,341	26,598	44,030	31,222	46,468	60,054	65,589	488,854
Butane (bbl.)—														
Production	1959	17,304	19,676	15,755	13,810	14,635	15,104	15,122	16,196	17,165	17,455	17,574	27,233	207,029
	1960	29,287	26,626	26,031	20,026	19,945	18,845	23,126	24,223	24,757	28,606	25,436	25,460	293,398
Opening inventory	1959	2,880	3,583	2,728	2,490	3,739	1,684	2,279	862	2,521	2,660	2,972	7,175	2,880
	1960	5,434	5,664	2,838	2,289	2,418	1,766	1,756	1,476	1,310	1,509	2,260	2,727	5,434
Purchases/receipts	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
	1960	...	...	...	...	...	...	...	...	...	539	818[1]	28[1]	1,385
Losses, transferred, consumed	1959	8,907	9,963	15,545	12,223	16,690	14,337	16,209	14,537	16,764	16,315	2,230	8,137	151,857
	1960	9,493	3,854	13,125	16,410	15,787	14,494	15,756	7,997	8,475	9,630	7,739	9,554	131,314
Sales to others	1959	7,894	10,568	448	338	...	172	330	...	262	828	11,141	20,837	52,618
	1960	19,564	25,598	13,455	3,487	4,810	5,361	7,850	16,392	16,083	18,764	18,048	18,451	167,663
Closing inventory	1959	3,583	2,728	2,490	3,749	1,684	2,279	862	2,521	2,660	2,972	7,175	5,434	5,434
	1960	5,664	2,838	2,289	2,418	1,766	1,756	1,476	1,310	1,509	2,260	2,727	1,210	1,210
Propane (bbl.)—														
Production	1959	10,753	10,045	8,742	7,123	6,136	5,429	5,122	6,112	7,244	8,750	10,735	10,734	96,925
	1960	10,623	5,807	7,018	7,215	9,149	8,260	10,391	11,380	10,804	13,832	15,666	15,146	125,091
Opening inventory	1959	2,796	1,097	3,043	1,936	1,667	1,564	1,918	1,582	1,884	1,338	3,165	2,291	2,796
	1960	1,336	2,726	1,762	2,628	1,118	2,669	426	1,318	1,808	452	2,102	809	1,336
Purchases/receipts	1959	...	...	...	...	...	...	...	...	...	...	...	...	...
	1960	...	...	...	...	...	...	...	...	...	500	486[1]	1,560[1]	2,546
Losses, transferred, consumed	1959	...	...	3,887	5,197	1,891	488	1,817	567	...	...	698	79	14,619
	1960	...	763	...	...	...	1,063	107	...	...	...	...	...	1,933
Sales to others	1959	12,452	8,099	5,962	2,195	4,348	4,592	3,641	5,243	7,795	6,918	10,911	11,610	83,766
	1960	9,233	6,008	6,152	8,725	7,598	9,440	9,392	10,860	12,160	12,482	17,445	15,680	125,205
Closing inventory	1959	1,097	3,043	1,936	1,667	1,564	1,918	1,582	1,884	1,333	3,165	2,291	1,336	1,336
	1960	2,726	1,762	2,628	1,118	2,669	426	1,318	1,808	452	2,102	809	1,835	1,835
Sulphur (short tons)—														
Production	1959	5,127	4,281	4,847	4,639	4,326	3,475	3,772	4,275	3,806	4,892	4,805	5,448	53,693
	1960	5,420	5,007	5,194	5,152	5,262	4,803	4,597	4,823	4,937	4,699	5,090	5,470	60,454
Opening inventory	1959	66,496	68,582	68,503	68,371	68,838	68,824	69,729	69,091	70,955	70,783	72,732	73,027	66,496
	1960	74,734	76,958	78,937	81,039	82,551	84,501	86,738	86,683	90,934	92,494	94,359	95,070	74,734
Losses and adjustments	1959	...	...	2	...	...	249	...	...	...	...	1	—2	250
	1960	...	...	...	1	...	—1	...	—334	...	...	...	...	—334
Sales	1959	3,041	4,360	4,977	4,172	4,340	2,321	4,410	2,411	3,978	2,943	4,509	3,743	45,205
	1960	3,196	3,328	2,792	3,639	3,312	2,567	2,652	2,906	3,377	2,834	4,379	2,738	37,720
Closing inventory	1959	68,582	68,503	68,371	68,838	68,824	69,729	69,091	70,955	70,783	72,732	73,027	74,734	74,734
	1960	76,958	78,367	81,039	82,551	84,501	86,738	88,683	90,934	92,494	94,359	95,070	97,802	97,802

[1] Estimated.

Table 12.—Monthly Value of Crude Oil, Natural Gas, Natural-gas Liquids, and Sulphur to Producer, 1959 and 1960

(Dollars.)

	Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Crude oil	1959	145,667	131,560	149,864	63,899	123,904	135,748	118,374	95,578	146,676	132,800	166,372	162,786	1,573,228
	1960	**152,245**	**128,406**	**137,596**	**48,259**	**97,742**	**147,277**	**185,802**	**146,919**	**174,807**	**129,345**	**44,588**	**138,063**	**1,531,049**
Natural gas	1959	358,387	312,348	347,953	340,737	322,423	275,183	275,037	288,844	273,596	325,238	371,419	430,418	3,921,583
	1960	**609,272**	**572,457**	**613,051**	**598,892**	**591,368**	**575,060**	**558,991**	**566,051**	**563,254**	**587,393**	**588,743**	**677,417**	**7,101,949**
Natural-gas liquids	1959	48,049	46,288	40,920	49,330	38,900	32,847	32,109	26,304	28,572	40,096	44,259	37,389	465,063
	1960	**54,878**	**38,159**	**36,521**	**44,729**	**42,352**	**27,555**	**29,409**	**56,342**	**41,198**	**60,726**	**77,652**	**84,127**	**593,848**
Sulphur	1959	10,793	9,111	10,105	5,393	5,021	3,876	4,302	4,957	4,837	5,225	4,523	5,969	74,112
	1960	**6,110**	**5,438**	**5,114**	**4,457**	**4,701**	**4,431**	**3,958**	**4.747**	**4,996**	**5,677**	**5,517**	**6,029**	**61,175**
Totals	1959	562,896	499,307	548,842	459,359	490.248	447,654	429,822	415,683	453,681	503,359	586,573	636,562	6,033,986
	1960	**822,505**	**744,460**	**792,282**	**696,337**	**736,163**	**754,323**	**778,160**	**774,059**	**784,255**	**783,141**	**716,500**	**905,636**	**9,287,821**

Table 13.—Proved Reserves of Recoverable Oil, Gas, and Gas Products at December 31st, 1960

	Crude Oil (Bbl.)	Raw Gas[1] (Million Cu. Ft.)	Disposable Gas (Million Cu. Ft.)	Gas Liquids (Bbl.)	Sulphur (Short Tons)
Reserves remaining at end 1959	57,215,776	2,767,940	2,461,800	61,921,171	2,041,721
Production during 1960	867,057	85,517	75,999[2]	2,120,566[2]	63,118[2]
Adjustments made during 1960[3]	−1,710,000	+3,701	−401	+4,261,047	−110,360
Reserves discovered during 1960	13,520,058	675,700	601,800	10,244,182	194,378
Reserves remaining at end 1960	68,158,777	3,361,824	2,987,200	74,305,834	2,062,621

[1] Excludes solution gas and gas in gas-caps of oil reservoirs while still in the stage of primary recovery.

[2] The production of residue gas, gas liquids, and sulphur are the quantities calculated from gas analyses to have been produced with the raw gas, both sweet and sour, and are not the quantities actually extracted. The actual quantity of gas delivered to the transmission-line during 1960 was 80,115 million cubic feet, and the amounts of gas liquids and sulphur actually extracted were 1,169,307 barrels and 60,454 short tons respectively.

[3] Reserves are continually under revision as data are provided by additional drilling and production.

Inspection of Lode Mines, Placer Mines, and Quarries

By J. W. Peck, Chief Inspector of Mines

CONTENTS

PRODUCTION

The output of metal mines for 1960 was 8,242,703 tons. This tonnage was produced from sixty-seven mines, of which thirty-one produced 100 tons or more.

FATAL ACCIDENTS

During 1960 there were twelve fatal accidents connected with lode mines, placer mines, and quarries. This was six less than in 1959.

Tonnage mined per fatal accident during the last ten-year period was 856,150 tons.

The following table shows the mines at which fatal accidents occurred during 1960, with comparative figures for 1959:—

Mine	Mining Division	Number of Fatal Accidents	
		1960	1959
Beale Quarry	Nanaimo	....	1
Bralorne	Lillooet	2	2
Britannia	Vancouver	1	1
Canam	New Westminster	1	....
Cariboo Gold Quartz	Cariboo	....	2
Cassiar	Liard	1	2
Duncan	Slocan	1	....
Empire	Nanaimo	....	1
Ford Iron	Alberni	....	1
Highland-Bell	Greenwood	1	....
Mastodon	Revelstoke	1	....
Mineral King	Golden	....	1
Paradise	Golden	1	....
Pioneer	Lillooet	....	1
Quarry Bay	Nanaimo	....	1
Reeves MacDonald	Nelson	2	....
Routledge Gravel Quarry	Vancouver	1	....
Sullivan	Fort Steele	....	1
Torbrit	Skeena	....	1
Vimy Exploration	Nanaimo	....	1
West Columbia Gold Placers	Revelstoke	....	1
Western Nickel (now Giant Nickel)	Vancouver	....	1
Totals		12	18

The following table classifies fatal accidents as to cause and location:—

Cause	Number	Location
Falls of ground	2	Underground.
Haulage	4	Underground.
Explosives	1	Surface.
Falls	2	Underground.
Air blast	1	Underground.
Collapse of stockpile	1	Surface.
Drowning	1	Surface.
Total	12	

A description of all fatal accidents follows.

Gerald Bennett Cumming, aged 29, married, with four children, and employed as a pipe-fitter at the Duncan mine of The Consolidated Mining and Smelting Company of Canada, Limited, near Howser, was fatally injured on January 3rd while transporting pipe into the mine.

The Duncan mine is a development adit 8 by 8 feet in cross-section, which had been driven about 2,000 feet from the portal at the time of the accident. Cumming and his helper were detailed to extend the fan pipe and the air and water lines. At the time of the accident, they were transporting one 10-foot length of 24-inch-diameter fan pipe, two 20-foot lengths of 4-inch-diameter air pipe, and one 20-foot length of 2-inch-diameter water pipe on the tops of three V-dump cars ahead of a diesel locomotive. Cumming was standing in the cab of the locomotive holding on to the fan pipe while his helper was at the controls of the locomotive. At a point in the adit about 1,250 feet from the portal, the fan pipe apparently bounced on the car and caught in a joint of the fan pipe in place along the adit. This forced the 10-foot section of fan pipe Cumming was holding back against his chest, pinning him against the motor cover. The motorman immediately stopped, released Cumming, and then obtained help, but it was later established that death occurred within twenty seconds due to internal bleeding.

Both men should have been aware that the proper way to transport pipe into the mine was on a flat car towed behind the locomotive. A flat car for this purpose was provided.

The inquest into the death found no direct blame attached to anyone, but the verdict added a rider that if safety regulations had been more strictly adhered to, this accident might have been avoided. It was further recommended that the company should make sure in the future that all men going underground are familiar with safety regulations as to transportation. *See* Prosecutions.

Mario Giacobbo, aged 24, single, and employed as a mill labourer at Cassiar Asbestos Corporation Limited, was asphyxiated in the collapse of a stockpile at 12.40 a.m. on February 4th.

This stockpile was composed of crushed ore which was stored in a large building built in the shape of an inverted V. The peak of the V was about 70 feet above the floor, and it is at this point the ore is brought in by conveyor to spill out in a long pile, with an angle of repose similar to the roof angle of 40 degrees. The ore can be removed by underground conveyor, but freezing conditions hamper this, and for some time previous to the accident the ore was being handled by a tractor loader working at one end of the pile. As the ore was removed at the base of the pile a steep face would sometimes develop, a situation which would necessitate the use of explosives to bring down the slope to a normal safe angle. On the day of the accident, Giacobbo and another workman were instructed by the shiftboss to dig short holes, preparatory to blasting, in a location about 30 feet above the floor. At this point the slope of the pile changed from 45 degrees to 60 degrees and extended another 30 feet higher. The two workmen were about 20 feet apart in this area. A slide suddenly occurred which carried Giacobbo down the slope and buried him. The shiftboss and loader operator, who were both at the base of the pile, started digging immediately and more help was summoned. Giacobbo was uncovered in twenty minutes, but unfortunately half this time was spent digging in the wrong place as no one actually saw the accident happen. Artificial respiration was immediately rendered, and a doctor was on the scene shortly after, but Giacobbo could not be revived. It was later ascertained he had been covered by 3 to 4 feet of ore, and the total amount of material involved in the slide was estimated to be between 15 and 20 tons.

The jury of the inquest, held at Cassiar on February 8th, determined that death was due to traumatic asphyxia, but added no recommendation. *See* Prosecutions.

John Fodchuk, aged 40, married, with two children, and employed as a motorman trammer, was fatally injured on April 9th at about 3.30 a.m. when crushed between a battery locomotive and a chute lip on the 2600 level of the Victoria section of the Britannia mine of the Howe Sound Company.

There were no witnesses to the accident. Fodchuk was found at 4.25 a.m. in a standing position in the cab of the locomotive, leaning face downwards across the battery box, with the chute lip pressed into his back. The locomotive control was in full reverse position and the circuit breaker out. There was no sign of life. Help was immediately obtained and artificial respiration with oxygen performed until rigor mortis set in. Death was later established as due to large internal hæmorrhage from injuries to liver, spleen, and kidneys.

Investigation revealed that the small 1.7-ton locomotive had become derailed, possibly because of spillage along the track. The deceased appeared to have attempted to re-rail the locomotive by placing pieces of rock under the wheels and reversing the motor. Instead of accomplishing this, the motor was thrown off the track an approximate distance of 10 inches toward the chute timbers. While doing this, Fodchuk must have stood in the locomotive cockpit in the control side, opposite the seat, and was not looking in the direction in which the locomotive moved. The locomotive must have moved back rapidly so as to pin Fodchuk across the back and between the chute lip and battery box.

The verdict of the Coroner's jury held on April 14th was that the death was accidental, but it was recommended that there be two men to re-rail motors or cars.

Eugene Hoyt, aged 52, married, with one son, and employed as a winch operator at Routledge Gravel Ltd., was presumed drowned at noon April 12th when a Michigan loader he was operating was suddenly driven into Lynn Creek near Vancouver.

Previous to the accident, Hoyt was operating a scraper to remove gravel from underwater at the mouth of Lynn Creek. About noon he stopped scraping and left the bucket at the toe of the stockpile. At this time it was usual for him to examine and service the scraper bucket. To do this it was necessary to turn the bucket on its side, and the Michigan front-end loader was used for this purpose. Hoyt drove the loader around the stockpile and rolled the scraper bucket over with the loader bucket. The road between the stockpile and river was about 10 feet wide. Hoyt had completed the servicing and started backing with the loader. Approximately 40 feet from the scraper bucket, he turned outward suddenly, driving the loader over the bank. A fellow workman, working a short distance away, observed the incident and ran to the water's edge. He threw a piece of 2-by-4 lumber to Hoyt, who appeared on the surface swimming toward shore. Hoyt was unable to reach it, and then sank from sight at the time a piece of hose was thrown to him. Another workman dived into the water fully clothed, but this rescue attempt was also unsuccessful.

No inquest has been held as the body has not been recovered. The Michigan loader was retrieved and no defects were found which would have caused the accident.

John Kozar, aged 38, married, with four children, and employed as mine foreman at the Reeves MacDonald mine, was killed instantly when three cases of explosives which he was transporting on a truck exploded at about 2 p.m., May 13th.

The accident occurred on surface at about the 2,800-foot level in the vicinity of the open pit which is connected by raise to the upper mine workings. On the day of the accident, Kozar, assisted by two miners, carried three cases of 70 per cent Cilgel 2½- by 24-inch powder from the 2700 level of the mine up the raise and deposited them in the back of a 1-ton four-wheeled-drive International truck. Kozar got into the cab, while the two miners descended into the mine. The miners had just reached their working place on the 2700 level in an elapsed time of two to three minutes when they heard an explosion. They went to the surface and found the truck had been moved 120 feet and demolished at that point. There was a crater in the road 3 feet deep. The metal box of the truck, the rear end, and the transmission were nearby, while the engine was 50 feet ahead. The main part of Kozar's body was found about 300 feet ahead also, indicating that the explosion had come from behind the cab with Kozar in the cab at the time.

There is no satisfactory explanation for this accident. The explosive was made the 8th or 11th of April, 1960. One case remained on the 2700 level and it was examined, but there were no signs of deterioration. It had been raining previous to the accident and lightning had occurred about two hours before, but none was reported around the time of the accident. The inside of the body of the truck was lined with wood, and, while the condition of the road could cause some jarring, it is extremely unlikely this could detonate the explosive. Rifle bullet, static electricity, and explosion of gas tank were all investigated and held to be improbable. Pieces of the wire leads from a short-period-delay electric blasting-cap were found in the wreckage, and this might indicate that a blasting-cap was involved.

The inquest was held on May 26th. The jury returned a verdict of accidental death with no blame attached to anyone.

Constantino Pilu, aged 33, single, and employed as a miner, received fatal injuries in a fall into a chute at Bralorne on May 13th.

The accident occurred in a cut-and-fill stope in the 77 vein on the 3300 level. The stope was 130 feet long and the back was 40 to 50 feet above the level. The vein is about 9 feet wide and dips almost vertically. Entrance to the stope is by manways at each end. The accident occurred in a 4- by 4-foot cribbed chute adjacent to the west manway. Previous to the accident, the muck in this chute had been drawn down 18 feet to allow Pilu's partner to muck off the bulkhead above the manway. Pilu was drilling in the stope about 12 feet away from the chute. After about an hour's drilling, or 9 p.m., one of Pilu's steels broke. His partner went down to the level to fetch another steel and was returning when he heard a call for help. Pilu had fallen about 14 feet down the chute and was partially buried in muck. Rescue was difficult, and it was about 1 a.m., May 14th, before he was admitted to the Bralorne hospital. He remained conscious the whole time, but was in a state of shock and complained of pain in the abdominal area. He was to be flown to Vancouver, but emergency surgery became necessary. He died at 4.45 p.m. while the operation was being completed. Cause of death was irreversible shock due to internal injuries. Ribs four and five were fractured, and there was some damage to the pleural membrane and one lung. The small intestine was punctured in three places and a condition of peritonitis developed.

It is not known how Pilu came to fall into the chute. His partner had placed a plank across the chute before going to fetch the steel. The muck pile was rather steep above the chute, and possibly the deceased slipped or the muck pile started to slide. Pilu was regarded as an experienced miner.

The inquest was held on May 17th. The jury returned a verdict of accidental death with no blame attached to any person or persons.

Massie M. Schutz, aged 37, married, with three children, and employed as a miner at the Highland-Bell mine, was killed almost instantly by a fall of rock at about 9.30 a.m., August 2nd.

The accident took place in the 29-11 stope, which is in a narrow vertically dipping segment of ore located between two faults. These fault faces were fairly strong, but the back, consisting largely of silver-lead ore, was weak and blocky. The stope was worked on a one-shift basis by Schutz and a partner. They had spent the previous shift barring and blasting down loose rock. On August 2nd the mine superintendent visited the stope at 9 a.m., and while some loose was visible, the back sounded stronger. The men were instructed to carry on scaling, and the mine superintendent then left. Shortly after, while both men were scaling, standing back to back, there was a sudden crash and Schutz's partner felt rock falling around him. He himself suffered a compound fracture to his right leg but was able to summon help from a nearby working-place. Schutz sustained a severely fractured skull and must have died quickly. His hard hat was found badly crushed.

Examination of the working-place after the accident indicated that the scaling released a large piece of rock, weighing several hundred pounds, from a concealed slip. Probably the thickness of the rock caused it to sound solid. Both miners and the mine superintendent had considerable experience with this type of ground.

The inquest was adjourned until September 9th, at which time Schutz's partner had been discharged from hospital. A verdict of accidental death with no blame attached to any person was returned.

Harold Jessome, aged 36, single, and employed as a shaft leader by Patrick Harrison and Co., was fatally injured from a fall in the Queen shaft at the Bralorne mine at about 8.15 p.m. on August 8th.

The Queen shaft is a vertical four-compartment shaft which was being deepened on a contract basis. Mucking out of the shaft was done by means of a Cryderman mucker, the working parts of which are mounted on a welded steel frame 25 feet long, the whole apparatus weighing about 3½ tons. The frame was suspended in one compartment of the shaft by means of a double block with a ½-inch rope which passed twice around the block pulleys and down to a tugger hoist by means of which the frame was raised and lowered in the shaft. The upper block was secured to a shaft timber by a ⅝-inch clevis and wire rope. In addition, the Cryderman frame had been secured previous to the accident to the shaft timbers by a ¾-inch safety chain. The controls of the Cryderman are mounted in the lower part of the frame and operate the boom and its clam bucket. The boom is in two sections, one telescoping within the other for a total stroke length of 14 feet 7 inches.

Previous to the accident the Cryderman mucker had been removed from the shaft for repairs. On August 8th it was again installed in the shaft and prepared for operation by Jessome, the shaft leader, and three other men. The machine was suspended so that the control platform was two sets above the blasting set and 50 feet above the shaft bottom. The air-hoses were then connected. The telescopic section of the boom was at the top of the stroke and held in place by two ½-inch chains which are used for this purpose. At the time of the accident all four men were standing on the shaft timbers. The machine operator had just leaned over to check the controls when there was a tremendous crash and the whole machine fell down the shaft. The machine operator fell to the blasting set and received an impacted fracture of the right femur; Jessome fell to the shaft bottom, while the other two men were uninjured. Jessome's body was recovered from the shaft bottom, where it was submerged in water. Artificial respiration was attempted without success. The autopsy revealed death was due to shock and hæmorrhage from multiple injuries which included two severe fractures and ruptured spleen.

After the accident the two ½-inch chains which hold the boom in place were found broken and the boom extended. It seems evident that the boom must have descended, broken the chains, and dropped to the bottom of the stroke. The boom and bucket weigh some 1,500 pounds, and the impact must have been such as to break both the clevis and the safety chain. All various metallic parts were examined, and there was no evidence of defective material prior to the breaks. What caused the boom to drop so suddenly has not been determined.

An inquest was held on August 16th. The verdict was accidental death with no blame attached to persons involved. It was recommended that two safety chains be used in addition to the main attachment. Such safety chains were in general use during the mucking cycle.

Allan Stanley Lambert, aged 34, married, with three children, and employed as a shiftboss at the Mastodon mine, died in the Revelstoke Hospital at 8 p.m. on August 31st from injuries received from a fall of rock in the mine at about 3 p.m.

The accident occurred in a scraper drift at the bottom of an open stope. This stope had been carried up on a vein 8 to 10 feet wide dipping 42 degrees to 45 degrees. The footwall is schist and presents a smooth clean surface. On the day of the accident, Lambert had visited this working-place and was talking to the scraperman at a point in the drift where an eyebolt was to be placed. There was a fall of rock without warning. The scraperman was uninjured and was able to obtain help for Lambert, who was pinned by several slabs of rock. Lambert did not lose consciousness and was in good spirits. He received first-aid treatment and was taken to the Revelstoke Hospital, arriving at about 6 p.m. He did not respond to shock treatment and died at 8 p.m. from what was determined to be crushing injuries to the pelvic region.

Examination of the stope after the accident revealed that a large slab, 30 feet long, 30 feet wide, and 1 foot thick, had suddenly moved down the footwall to break into pieces and strike the workmen. The scraper drift cuts into the footwall at this location, and this undercut would have removed support for the slab. However, the flat nature of the footwall and the large size of slab made the accident difficult to foresee.

The inquest attached no blame to anyone. There were two recommendations: (1) Closer inspection be made as routine, in older workings particularly, and (2) that stretcher and safety equipment be made available closer to scene of mining activities.

Roy Kenneth Clark, employed as a motorman at the Paradise mine of Sheep Creek Mines Limited, received fatal head injuries when crushed between a chute and a locomotive on August 31st at about 11.15 a.m.

The Paradise mine had been closed for several years, but rehabilitation was in progress at the time of the accident. Clark, assisted by another workman, had loaded a timber-truck with timber outside the mine portal, and he then proceeded to tow the truck into the mine using a 15-horsepower Atlas battery locomotive. The delivery point was the 7860 raise, and it was at that chute that he was found by the other workman who followed into the mine on foot. The deceased apparently failed to notice or avoid the chute lip which protruded into the drift and was caught between the chute lip and the locomotive. The upper part of the deceased's body was found wedged between the chute lip and top of the car, with the controls of the motor full on, and the wheels skidding. There was no sign of life, and it was later determined the deceased had died instantly from extensive fracturing to the skull and spine with transection of the spinal cord.

An inquest was held at Invermere on September 7th. The verdict was accidental death with the recommendation that such locomotives " should have a light on the rear end as well as forward and if this is not possible some type of light on the chute area."

In regard to the jury's recommendation, there was a light on the locomotive but it was in a fixed position and was only used when the locomotive was travelling in a forward direction. It was thus of no assistance in this instance because the motor was travelling in reverse. If the motor had been turned end-for-end, the light would have shone in the right direction.

Amendments to the *Metalliferous Mines Regulation Act* passed at the last session of the Legislature prohibit construction of projecting chutes such as the one involved in this accident. This chute was constructed before May, 1960, the effective date of the amendment.

Menno Simon Reimer, aged 33, married, with three dependents, and employed as a miner by Intermountain Construction Company Limited at the Canam mine near Hope, received fatal injuries at about 6.30 p.m. on October 15th when crushed beneath a loaded 2-ton muck-car which overturned while an attempt was being made to re-rail it.

The accident occurred on No. 15 adit level of the Canam mine. Immediately prior to the accident the crew was employed mucking a drift round. A California switch had been installed, close to the drift face and approximately 4,800 feet from the portal. The switch was being used during mucking operations to transfer loaded and empty cars, but when the train was backed off the inner end of the switch, an empty and a loaded car were derailed. Reimer and three other crew members re-railed the empty car and then jacked the loaded car while placing what appeared to be adequate blocking under the outer end of the car. Reimer went to one side of the car and the other three men remained on the other side. It was intended to bar the outer wheels over on the raised end. Instead of barring, Reimer apparently tried to raise the wheels manually. While this was being done, the loaded car, being a side-dump car with a high centre of gravity, was apparently unstable and toppled, pinning Reimer beneath it.

A " come-along " winch was immediately available and was used to raise the car off Reimer, but when he was removed fifteen minutes later no sign of life was evident. He was taken to the surface and examined by the doctor and pronounced dead. The autopsy revealed that the injuries were contusion of skull, fracture of four left ribs, rupture of liver, rupture of kidney, fracture of fourth and fifth lumbar vertebræ, and compression of chest cavity due to confined position. The immediate cause of death was the ruptured liver and asphyxia.

An inquest was held at Chilliwack on October 27th. The Coroner's jury returned a verdict of accidental death with no blame attached to anyone, and with no recommendations.

Axel Augustine, aged 57, married, and employed as a timberman at the Reeves MacDonald mine near Nelway, was fatally injured at 9.15 a.m. on November 23rd as a result of being caught in an air blast in the 2350 portal of the O'Donnell section of the mine.

Augustine and his helper were moving a mucking-machine on the 2350 level to the portal. Augustine was operating a battery locomotive which towed a 4-ton Granby car followed by the mucking-machine. The helper was at the rear of the train. The train had reached a point about 90 feet from the portal when a large stope in the nearby O'Donnell workings caved through to surface. The air displaced in the stope rushed out the various entries from the stope and was funnelled out the 2350 portal with violent force. The two men got off the train when they heard the " bump," but the air blast then caught them and blew them and the equipment out the portal. The helper was rolled and carried 80 feet outside the portal while Augustine probably struck some object, as he was found 35 feet outside the portal with a crushed rib cage and severe head wounds. The helper received multiple abrasions and bruises. There were three other men in the mine in the vicinity of the blast, but while they felt the effect of the blast, they were not injured.

The cause of death was determined as internal bleeding from severe lacerations of the liver, and from this it was concluded that death occurred within minutes of the accident. An inquest was held in Nelson on November 30th, and the verdict was that death was accidental.

FATAL ACCIDENTS AND ACCIDENTS INVOLVING LOSS OF TIME

Twelve fatal accidents and 158 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 ten-year period and relates these accidents to the number of persons employed and tons mined.

Accidents Causing Death or Injury Classified as to Cause

Cause	Number of Accidents	Percentage of Total
Explosives	1	0.6
Falls of ground	30	17.6
Falls of material	18	10.6
Falls from ladders, stagings, etc.	6	3.5
Slipping and falling	27	15.9
Lifting and handling material, etc.	28	16.5
Machinery and tools	41	24.1
Run of ore or waste	4	2.4
Transportation	8	4.7
Burns and shock	2	1.2
Miscellaneous	5	2.9
Totals	170	100.0

Accidents Causing Death or Injury Classified as to the Occupation of Those Injured

Occupation	Number of Accidents	Percentage of Total
Underground—		
Chutemen	6	3.5
Haulagemen	17	10.0
Miners	64	37.7
Muckers	7	4.1
Timbermen	5	2.9
Repairmen	6	3.5
Trackmen and pipe-fitters	6	3.5
Skip-tenders	2	1.2
Supervisors and staff	4	2.4
Miscellaneous	29	17.1
Surface—		
Shops	3	1.8
Mill	14	8.2
Quarries	1	0.6
Surface, general	6	3.5
Totals	170	100.0

Accidents Causing Death or Injury Classified as to Parts of the Body Injured

Location	Number of Accidents	Percentage of Total
Head and neck	13	7.6
Eyes	7	4.1
Trunk	24	14.1
Back (including shoulders)	25	14.7
Arms (including wrists)	20	11.8
Hands and fingers	28	16.5
Legs and ankles	34	20.0
Feet	17	10.1
Lungs	2	1.2
Totals	170	100.0

Compensable Non-fatal Accidents Related to Tons Mined and Men Employed

Year	Number of Accidents	Number of Persons Employed	Frequency per 1,000 Persons	Tons Mined	Tons Mined per Accident
1951	1,131	8,787	129	6,972,400	6,170
1952	1,327	9,610	139	9,174,617	6,910
1953	899	7,105	125	9,660,281	10,750
1954	718	6,293	114	8,513,865	11,850
1955	679	6,208	109	9,126,902	13,450
1956	615	6,507	94	8,827,037	14,350
1957	535	5,678	94	7,282,436	13,600
1958	396	4,353	91	6,402,198	16,200
1959	310	4,316	72	6,990,985	22,550
1960	384	4,389	87	8,242,703	21,470

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 the eighteen reported for 1959.

Of these occurrences, five were connected with hoisting; five with transportation; four with explosives; six with fires (three underground); two with subsidence; one with rock-burst; and one with machinery.

On January 12th, 1960, at the Sullivan mine, two miners were overcome by blasting fumes and required one and seven days' hospitalization respectively. They had entered a raise in which miners of the preceding shift had blasted but had neglected to turn on the atomizer. The miners responsible had their blasting certificates suspended for a period of two months.

On January 21st, 1960, at Pioneer, the change-house was completely destroyed by fire. A discarded cigarette may have been the cause.

On January 23rd, 1960, at Rexspar near Birch Island, fire destroyed a small power-house and equipment.

On February 2nd, 1960, at the Giant Nickel mine, two miners nearly collapsed from the effects of blasting fumes. They had extended a compressed-air hose to the bottom of a hung-up raise where blasting had been done on the previous shift, but they did not allow sufficient time for the blasting gases to be diluted by the compressed air. Fortunately, a shiftboss was nearby and was able to provide rescue.

From early February, 1960, through several following months at the Sullivan mine the ore drawn from a number of slusher drifts was of a very high temperature due to the oxidation of a large quantity of ore broken in a diamond-drill blast above the slusher drifts in July, 1959. Temperatures ranged as high as 600 degrees Fahrenheit, and in addition more difficulties were caused by quantities of dust, sulphur dioxide fumes, and low oxygen atmospheres. Special blasting precautions were taken, considerable air sampling was done, the ventilation was increased, and protective equipment was worn where necessary.

On February 3rd, 1960, at the Woodgreen open-pit mine, the occupant of a vehicle was slightly injured due to fly rock from a blast 1,000 feet away. A siren has been installed as additional warning.

On February 17th, 1960, at Cassiar, a TD-24 tractor slid off the road to the open-pit mine and travelled a distance of 700 feet. The operator was able to jump clear.

On March 23rd, 1960, at Britannia, two lining planks in the No. 8 shaft came loose and projected into a hoisting compartment. An ascending cage was buckled, but two skip-tenders riding inside were not injured.

On April 8th, 1960, at the Sullivan concentrator, a loaded train crashed into the rotary dump causing extensive damage. No one was injured. Disciplinary action was taken by the management against the train crew.

On May 18th, 1960, at Britannia, a power-cable supplying a hoist shorted and started a fire in timber sets in a manway. The fire was confined to a small area.

On May 28th, 1960, at Pioneer, the machine-shop was totally destroyed by fire. Hot particles from welding done some time previously were a probable cause of the fire.

On May 28th, 1960, a wheel on the skip in the inclined shaft at the Giant Nickel mine failed, the tread breaking away from the flange. There was no other damage and no injury to personnel.

On June 1st, 1960, at the Golden Contact mine, two miners were trapped for thirty-one hours when the portal of the adit in which they were timbering caved through to surface. The Inspection Branch accepted responsibility for the rescue, which involved the use of aeroplanes, a helicopter, a mine-rescue team, and other workers. The miners were recovered little the worse for their ordeal.

On June 16th, 1960, at Britannia, the cage hung up in the Victoria shaft because a broken shaft guide allowed the cage to catch on a wall plate while the cage was descending. A shiftboss was riding in the cage at the time, and he was able to signal the hoistman by use of an emergency wire which hung in the shaft. About 100 feet of rope was run out which kinked on being hoisted up again. The hoisting-rope was shortened to remove the damaged section.

On July 12th, 1960, at the Empire mine, the surface-tram hoistman did not apply his brakes sufficiently to stop the empty south skip as it approached the loading-chute. The skip struck the chute with enough force to strip the cable through the cable clamps. This released the skip, which rolled back down the tram-line, and after striking the overhead rollers approximately 300 feet below the hoistroom it left the track and overturned, coming to rest approximately 500 feet below the hoistroom.

On July 22nd, 1960, at Britannia, a mechanic suffered a fractured skull when struck by a V-belt as it came loose from a pulley of a large ventilation fan.

On August 31st, 1960, at Britannia, a fire occurred in a telephone box at a station of No. 8 shaft. The probable cause was the ignition of a roll of thermolite igniter cord by the light bulb used to heat the telephone box. The fire was quickly located and extinguished by good fire-fighting procedure before much damage was done.

On September 17th, 1960, at the Craigmont mine, the driver of a self-propelled scraper sustained severe head injuries when the vehicle became unbalanced near the shoulder of the road and turned over, coming to rest on its wheels.

On October 12th, 1960, at Britannia, a large volume of water that had backed up in an ore-pass broke loose, spilled down a shaft, and flooded the main level to a depth of 2 feet. The shaft fan motor was damagd but no one was injured.

On October 31st, 1960, at Britannia, a miner was trapped for eight hours in a cave caused by a rock-burst. His left forearm was removed during the rescue operation.

On November 16th, 1960, at Britannia, a length of thermolite igniter cord, which was attached to a bulldoze charge, was presumed ignited by a blow from a moving rock. The blaster was unaware of this and was returning to the scene, after warning nearby workmen, when the charge detonated. He was uninjured. Igniter cord should not be hooked up to any charge until it is ready for immediate blasting.

On November 16th, 1960, at the Reeves MacDonald mine, a weld on the bale of a skip in No. 3 shaft failed while hoisting was in progress. The skip derailed and the overload relay on the hoist motor applied the auxiliary brake. No one was riding the skip.

On November 29th, 1960, at Cassiar, a truck left the mine road and slid and rolled approximately 400 feet down the slope in the snow. The driver remained with the vehicle and suffered minor injuries.

On December 12th, 1960, at Cassiar, a truck had been backed into position for dumping waste when a portion of the dump broke away. The driver jumped clear and suffered only slight injury. The truck rolled end-over-end for approximately 600 feet.

PROSECUTIONS

Five prosecutions were instituted under the *Metalliferous Mines Regulation Act,* as follows:—

The superintendent of the Duncan mine was charged under section 29 (*a*) for failure to post the General Rules. Court was held in Kaslo on January 21st, 1960, and the case was dismissed on the grounds that section 29 did not apply to mines employing less than fifty men, as was the situation at the Duncan mine.

A shiftboss at Cassiar was charged under section 38 (1) in that he failed to enforce General Rule 255, which requires that a person shall wear a safety belt and line when working on a stockpile when the material may move by gravity. The charge was dismissed at the hearing held on March 8th, 1960, at Cassiar, when the Magistrate ruled that the stockpile in question was not one that may ordinarily move by gravity. An appeal was taken to the County Court of Prince Rupert on June 13th, 1960. The Judge upheld the Crown's contention that the stockpile was one that the material may move by gravity, but the appeal was dismissed on the grounds that section 38 (1) does not put any responsibility on a shiftboss of a metallurgical works to see that it is obeyed.

The general manager of Bralorne Pioneer Mines Limited was charged under section 38 (2) for failing to see that an unauthorized person did not operate the shaft signals at the Crown shaft at Bralorne mine. The case was dismissed when heard at Lillooet on March 11th, 1960.

The president of Cariboo Quarrying Limited, which company operates a limestone quarry at Blind Bay on Nelson Island, was charged on two counts: (1) That under section 10 he failed to notify the District Inspector of the quarry operation, and (2) that under section 20, Rule 40 (*b*), he failed to obtain permission to store explosives at a shut-down quarry. He pleaded guilty on both charges at a hearing in Vancouver on March 21st, 1960, and was assessed a fine of $10 and $5 costs on the first charge and $10 and $3 costs on the second.

The president of Cassiar Copperfields Limited was charged under section 10 in that he failed to notify the Inspector of Mines of the commencement of work at the Golden Contact mine. He was found guilty and fined $10 when the case was heard at North Vancouver on August 12th, 1960.

BLASTING CERTIFICATE SUSPENSIONS

There were violations of the provisions of the *Metalliferous Mines Regulation Act* in regard to the use of explosives and blasting procedure. Two miners had their blasting certificates suspended for six and two months respectively, in two separate offences, for drilling into sockets of holes which had been blasted. Two other miners had their certificates suspended for three and two months respectively in two separate offences for failing to properly guard a blast.

EXPLOSIVES USED IN MINES

The table below shows the quantities of explosives and blasting accessories used in metal mines and quarries in British Columbia in 1956, 1957, 1958, 1959, and 1960:—

	1956 Total	1957 Total	1958 Total	1959 Total	1960 Total	1960	
						Mines	Quarries
High explosives (lb.)	8,560,000	7,103,000	5,485,000	6,319,000	7,188,000	6,256,000	932,000
Blasting-caps	2,184,000	1,676,000	1,244,000	1,587,000	1,320,000	1,219,000	101,000
Electric blasting-caps	52,000	64,000	84,000	46,000	124,000	115,000	9,000
Delay electric blasting-caps (short period)	205,000	160,000	129,000	157,000	146,000	138,000	8,000
Delay electric blasting-caps (sure-fire delays and X107 delays)	263,000	127,000	128,000	153,000	146,000	139,000	7,000
Primacord (ft.)	226,000	261,000	574,000	592,000	1,690,000	933,000	757,000
B-line detonating fuse (ft.)	2,436,000	2,049,000	2,197,000	1,972,000	2,311,000	2,143,000	168,000
Safety fuse (ft.)	17,218,000	13,367,000	11,272,000	11,411,000	10,288,000	9,637,000	651,000
Ignitercord (ft.)	498,000	639,000	469,000	775,000	555,000	550,000	5,000
Ignitercord connectors	563,000	750,000	610,000	865,000	623,000	623,000	....
Ammonium nitrate	....	5,000	190,000	872,000	1,641,000	920,000	721,000
" Hydromex "	....	....	....	325,000	862,000	515,000	347,000
" Amex "	....	....	....	20,000	....	....	....
" Nitrone " S-1	....	....	....	....	6,000	6,000	....
" Nitrone " S-1 primers	....	....	....	....	1,150	1,150	....

The quantity of high explosives used increased 7 per cent over that used in 1959, but it is significant that most of this increase can be attributed to the quarry industry, which increased its use of explosives three fold over that used in 1959. The use of ammonium nitrate, first introduced in 1957, continued its spectacular rise in annual consumption. The amount used in 1960 was double that used in 1959. This compound, when sensitized with fuel-oil, constitutes a powerful explosive. As such the preparation comes under the control of the Chief Inspector of Explosives at Ottawa. Written permission first must be obtained from him before the blasting agent can be mixed or used. Permission must also be obtained from the Chief Inspector of Mines, Victoria, when the blasting agent is used in mines and quarries in British Columbia. Permits issued in 1960 brought the total to six open-pit mines and nine quarries. In addition, two permits were issued for the use of ammonium nitrate and fuel oil underground on a trial basis. The main condition of the permits was that the blending of the ingredients takes place on site as they are being loaded into the bore-hole, or within ninety-six hours of their use.

DUST CONTROL AND VENTILATION

Problems in dust control and ventilation have continued to receive the attention of mine operators and Government departments. Dust counts and ventilation surveys were made by the staff of the Chief Inspector, Silicosis Branch of the Workmen's Compensation Board, and the results of these surveys made available to the Inspectors of Mines. The following information is taken from his report, " Summary of Dust Conditions at British Columbia Metalliferous Mines during the Year 1960 ":—

" 1. Seventy-seven surveys on dust control were made at forty-six metalliferous mines during 1960.

" 2. The main object in this inspection work is to determine the concentrations of dust present in the atmospheres and, where necessary, give recommendations to apply measures for dust control which will lower the amount of dust to which the workmen are subjected.

" 3. It is not known what concentration of silica dust is considered safe to breathe without producing silicosis. Other factors besides the dust concentration must be taken into consideration. The figure of 300 particles per c.c. of air has been chosen as an objective to work towards. When this figure is attained, it indicates a very great improvement over conditions existing several years ago.

" 4. Stoper drilling operations underground consistently produce the highest concentrations of dust during the time men are working. The dust counts at these operations used to be 2,000 or more particles per c.c. of air. Eighty-two per cent of the surveys made in 1960 gave averages of less than 1,000 particles.

" 5. At leyner, jackleg and plugger drilling operations underground the dust concentrations are lower than at stoper drilling operations. Fifty-four per cent of the surveys gave averages of less than 500 particles per c.c. of air.

" 6. The averages for 'All Other Underground Locations' are quite satisfactory. Eighty-six per cent of the surveys made in 1960 gave averages of less than 300 particles. This condition is particularly satisfactory when considering the fact that the great majority of the men work in atmospheres containing this lower dust concentration. The percentage of mines having less than 300 particles has remained fairly constant during the past eleven years, varying between seventy-six per cent and ninety-three per cent.

" 7. Some other operations underground produce denser dust concentrations than the operations mentioned above. One of these is blasting operations, but the workmen are generally not subjected to this dust or subjected to it for short periods of time only. Most of the blasting operations can be arranged to occur at the ends of the shifts and allow sufficient time for ventilation to remove the dust from the workings before the following shift goes to work. A certain amount of these operations, such as blasting in chutes, may be considered necessary so that the production of ore is not interfered with but this should be reduced to the very minimum. If such operations are carried on during the shift, the dust produced is sampled in our routine surveys and included in our averages.

" 8. Drilling in open pit mining operations give average dust concentrations that are very similar to those obtained at underground drilling operations. Also the average of the dust counts obtained at all other operations in the open pit are similar to those obtained underground.

" 9. The averages at some of the crushing plants were not as satisfactory as that obtained during the previous five years. Forty-seven per cent of the surveys in 1960 gave average of 300 or less particles compared to sixty or more per cent in the previous years.

" 10. Seventy-eight per cent of the surveys made in assay grinding rooms gave averages of less than 300 particles. This compares quite similarly with results obtained during immediate past years.

" 11. The percentage of certificates of fitness in good standing held by the employers for their workmen who require medical examination was ninety-six and a half per cent.

" 12. Aluminum powder prophylaxis treatments for the prevention of silicosis were given at three mines during the year. No aluminum powder therapy treatments were given at the Rehabilitation Clinic of the Workmen's Compensation Board in Vancouver, to men who have silicosis.

" 13. The main measures for dust prevention, suppression and elimination are receiving good attention at the metalliferous mines. The more important of these measures are: good ventilation; thorough wetting of the rock before it is handled in any manner; not subjecting the workmen to dust, fume and gases from blasting operations; using good exhaust systems in crushing plants, assay grinding rooms, etc. Full application of all measures at all times have not been obtained but the results have been quite satisfactory in most cases."

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. A Board of Examiners was appointed in May, 1960, and this consisted of R. B. Bonar, Deputy Chief Inspector of Mines, chairman; A. R. C. James, member; and J. E. Merrett, member.

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.

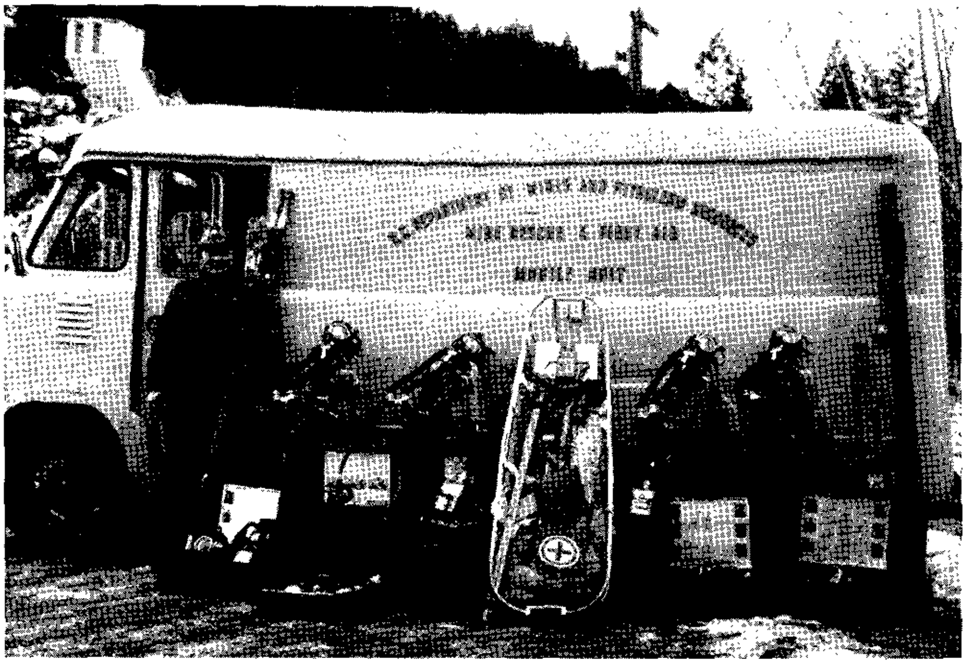
The Board may grant provisional certificates under such conditions as the Board considers advisable. During 1960 a total of 243 provisional certificates, good for two years, was issued. The first examination for permanent certificates was held at Vancouver on November 21st, 1960. In 1960 eight men received these certificates, as follows:—

Certificate No.	Date	Name	Mine
1	12-12-60	Albert M. Heath	Empire Development.
3	12-12-60	Gordon M. Begon	Britannia.
4	12-12-60	Luke T. Kirby	Britannia.
5	12-12-60	Albert R. Wells	Britannia.
6	12-12-60	John A. Dyck	Britannia.
7	12-12-60	James C. MacCulloch	Britannia.
9	12-12-60	Leslie R. Archibald	Britannia.
10	12-12-60	John Welter	Britannia.

METALLIFEROUS MINES REGULATION ACT

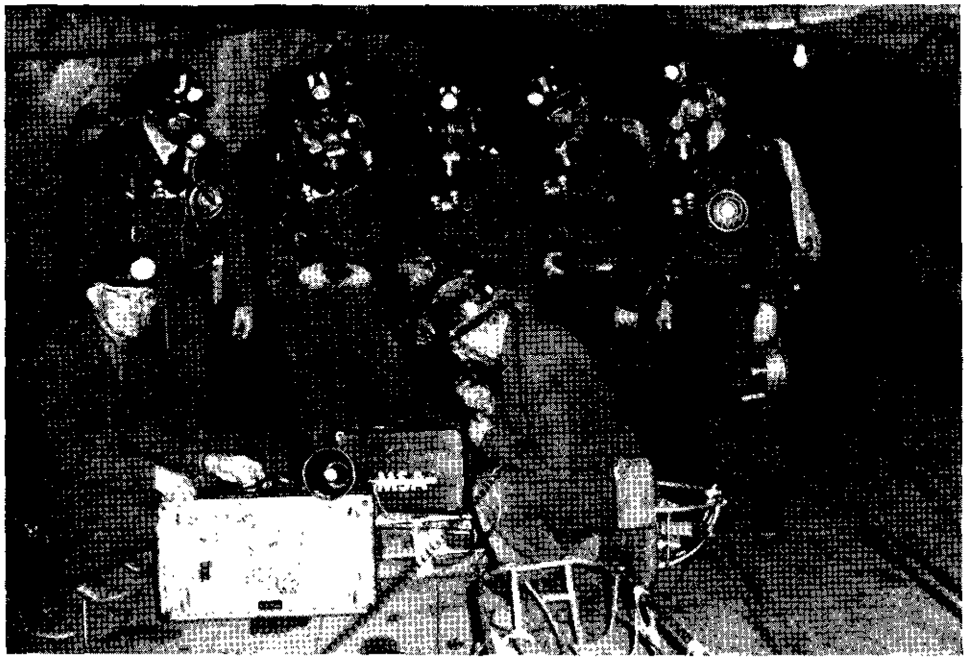
This Act had its first major amendment in 1960 since it was rewritten in 1948. Progress in mining procedures was recognized by making changes to permit the use of raise machines and the application of ammonium nitrate blasting agents underground. The first-aid requirements were altered to conform with those issued by the Workmen's Compensation Board, with the added proviso that the larger mines must have suitable means of communication by which the services of a physician can quickly be obtained. Changes were made in the procedure for the reporting of accidents, the make-up of inquest juries, the filing of mine plans, the fencing of closed-down mine workings, the notification of starting or stopping work, the disposal of explosives or chemicals, the construction of fuse-houses, the use of electrical apparatus, the testing of hoisting-ropes, the implementation of special rules, the operation of machinery, and the entering of storage bins. New rules were introduced covering chute construction, mechanical haulage, and the guarding of manways in shafts or raises.

One new section was added to the Act which dealt with the certification of certain mine officials for the first time in the metalliferous-mining industry. All underground supervisors who are directly in charge of personnel are now required to hold either a permanent or provisional shiftboss certificate as issued by the Department of Mines and Petroleum Resources (*see* above).



(Oliver Kenig photo.)

Nelson mobile mine-rescue and first-aid unit at the Bluebell mine.



(Oliver Kenig photo.)

Mine-rescue team, Bluebell mine, equipped with McCaa apparatus.
Testing communication system.

MINE RESCUE, SAFETY, AND FIRST AID

During 1960 the mine-rescue stations at Cumberland, Fernie, Nelson, and Princeton were fully maintained, and an instructor, qualified in mine rescue and first aid, was on duty at each station. On December 31st, 1960, J. J. Haile, instructor at Fernie, retired, and A. Williams was transferred from Cumberland. A replacement was obtained for Cumberland, but on a part-time basis. Each station is equipped with sufficient self-contained oxygen breathing apparatus to maintain at least two mine-rescue teams of six men each should any emergency in nearby mines arise. There are also sets of mine-rescue equipment maintained at various mines, either on loan from the Government or owned by the mine. In 1960 Government-owned equipment totalled forty-six McCaa two-hour apparatus and fifty-one Chemox three-quarter-hour apparatus, while that owned by mining companies totalled thirty-six McCaa's and forty-five Chemox's. Each station also has auxiliary equipment such as all-service gas 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 Cumberland was maintained to serve the Tsable River coal mine. There were no emergency calls for the apparatus during 1960, but oxygen was supplied on request to the local fire department for inhalator use. A truck is kept at the station for emergency purposes.

The station at Princeton still provides assistance to the community, but a mobile unit was obtained in 1957 to give service over a wider area. Mine-rescue training was given at Bralorne, Cariboo Gold Quartz, Britannia, Highland-Bell, Phoenix, Craigmont, Canam, Giant Nickel, and Clayburn-Harbison mines. First-aid classes were conducted at Hope, Princeton, and Merritt. Seventy-eight men received mine-rescue certificates, thirteen received industrial first-aid certificates, and 116 received St. John Ambulance certificates. The mobile rescue unit was of service to the general public in that it was used for six emergency calls—one drowning, two road accidents, one woods accident, and two illnesses where oxygen was required. A display of mine-rescue equipment, both ancient and modern, was made at the Pacific National Exhibition at Vancouver. Travelling during 1960 amounted to 12,000 miles.

The mobile mine-rescue unit stationed at Nelson continued to be of assistance in promoting and giving instruction in mine rescue and first aid at mines in the East and West Kootenay areas. Mine-rescue courses were held at the Bluebell, Canadian Exploration, H.B., Mineral King, and Reeves MacDonald mines. Mine-rescue practices and short refresher courses were also held at most of the mines. First-aid classes were given at the larger mines or at nearby villages. Fire departments at New Denver, Salmo, and Nelson received instruction in the use and care of breathing apparatus. Help was given in one highway accident. The main addition to the rescue equipment was a communication set which will allow rescue teams to be able to communicate verbally with the base and members of the team. All teams in the district received instruction and used this equipment.

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 mine at Kimberley. The training of new men for mine-rescue work in coal and metal mines continued in 1960, as well as the maintenance of monthly practices for teams. Assistance was given in the first-aid classes at Fernie.

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 of Mines and Petroleum Resources. During 1960, in addition to the regular teams in training, 110 men took the course and were granted certificates, as follows:—

Certificate No.	Name	Where Trained	Certificate No.	Name	Where Trained
3143	Allan E. Nord	Salmo.	3200	George Gordon Addie	Bralorne.
3144	Kelvin James Erne	Salmo.	3201	William H. Peter	Salmo.
3145	John Walter Jewitt	Kimberley.	3202	George Allen Murray	Salmo.
3146	Roy William West	Kimberley.	3203	Leo Patrick Gormley	Salmo.
3147	William Hogg Graham	Kimberley.	3204	Alexander Gillis	Salmo.
3148	Cyril Alec George	Kimberley.	3205	Andrew Burgess	Salmo.
3149	Bernard Malchelosse	Kimberley.	3206	John Francis Ablett	Salmo.
3150	John Frederick Hanke	Kimberley.	3207	Raymond Clifford Rowe	Salmo.
3151	James Allen Byrne	Kimberley.	3208	Robert E. Oakes	Britannia Beach.
3152	Joseph Edward Cassavant	Britannia Beach.	3209	Roy Clark	Britannia Beach.
3153	Albe Sevigny	Britannia Beach.	3210	Marven R. Arkinstall	Britannia Beach.
3154	John C. McIntosh	Britannia Beach.	3211	Waldemar Krzanowski	Britannia Beach.
3155	William W. White	Britannia Beach.	3212	Erwin E. These	Britannia Beach.
3156	Douglas P. Cripps	Britannia Beach.	3213	Leslie Archibald	Britannia Beach.
3157	Cancelled.		3214	Melvin L. Buckmaster	Britannia Beach.
3158	Ulrich A. Buthge	Britannia Beach.	3215	Harvey M. Ingram	Britannia Beach.
3159	Donald Clifford Shavela	Britannia Beach.	3216	John Welter	Britannia Beach.
3160	John Dyck	Britannia Beach.	3217	Edward H. Partridge	Britannia Beach.
3161	Karl Johan Bruun	Britannia Beach.	3218	John Nedokus	Grand Forks.
3162	Lee E. Isaacson	Britannia Beach.	3219	Edwin H. P. Paulett	Grand Forks.
3163	Trevor Sims	Britannia Beach.	3220	Kenneth G. McCord	Grand Forks.
3164	Svend Trost Thomsen	Britannia Beach.	3221	George W. Hingley	Grand Forks.
3165	George Stregger	Hope.	3222	George W. Popoff	Grand Forks.
3166	Kurt Frederick Dahlke	Hope.	3223	George F. Rezanoff	Grand Forks.
3167	Wilfred A. Gionet	Hope.	3224	George R. Clare	Grand Forks.
3168	Charles L. Koll	Hope.	3225	Thomas E. James	Grand Forks.
3169	Roy Kenneth Clark	Hope.	3226	Thomas D. Wilkinson	Grand Forks.
3170	Harold Eldon Wright	Hope.	3227	Peter Robert Matthew	Grand Forks.
3171	Aldin Gordon Ratzloff	Hope.	3228	Theodor Selmer Romo	Grand Forks.
3172	Henry Philip Boudier	Toby Creek.	3229	Howard Graham	Merritt.
3173	Angelo Minelli	Toby Creek.	3230	Harold Ross Chenoweth	Merritt.
3174	Thomas John Allen	Toby Creek.	3231	Ernest Grams	Merritt.
3175	George Oxley Stewart	Toby Creek.	3232	Fritz A. Westman	Merritt.
3176	William Robert Kelly	Toby Creek.	3233	Wallace G. Ryder	Merritt.
3177	George Archibald Jameson	Toby Creek.	3234	Roy W. Aseltine	Merritt.
3178	Edwin Barrington	Toby Creek.	3235	Allan H. Caron	Merritt.
3179	Kenneth Kildaw	Wells.	3236	Robert J. Young	Merritt.
3180	Steve Pacholuk	Wells.	3237	Wilbert S. Pentland	Merritt.
3181	Stanley McRae	Wells.	3238	Clifford C. Rennie	Merritt.
3182	Robert Bitner	Wells.	3239	Gerald W. Klein	Merritt.
3183	Earl Menhinick	Wells.	3240	Edwin O. Fitch	Merritt.
3184	Robert J. Dealy	Wells.	3241	Olaf A. Mathers	Merritt.
3185	Lemuel Perrot	Wells.	3242	Robert E. Hallbauer	Merritt.
3186	Karl Klein	Bralorne.	3243	Harry Thomas Cole	Merritt.
3187	Theodore Jas. Hryciuk	Fernie.	3244	John M. Anderson	Merritt.
3188	Marvin Eugene Neidig	Fernie.	3245	John Ehlers	Hope.
3189	Dennis Owen Corrigan	Fernie.	3246	Harold Lloyd Dickie	Hope.
3190	Stanley R. Broster	Fernie.	3247	William K. Wilson	Hope.
3191	William Morris L. Milburn	Fernie.	3248	Gordon Venasse	Hope.
3192	Frank Charles Parks	Salmo.	3249	Peter Leontowicz	Hope.
3193	William Lange	Salmo.	3250	Brian T. Stephens	Abbotsford.
3194	Roderick R. Williams	Beaverdell.	3251	Henry Corrigan (substitute for 2808)	Fernie.
3195	Martin Rassmussen	Beaverdell.			
3196	William Edwin Hyde	Bralorne.	3252	George Allan Peebles	Wells.
3197	Roger J. Robert	Bralorne.	3253	Charles McNeil	Wells.
3198	Paul E. Robert	Bralorne.	3254	Archibald H. White	Wells.
3199	Charles E. Gobert	Bralorne.			

The mine safety associations 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 Vancouver Island Mine Safety Association held its forty-sixth annual competition in Cumberland on May 28th, 1960. Three teams competed—two from the Tsable River mine and a visiting team from the Bralorne mine. The winning team was from the Tsable River mine and was captained by W. High.

The Central British Columbia Mine Safety Association held its twelfth annual competition at Kamloops on June 4th, 1960. Six teams took part in the mine-rescue competition. They represented Bralorne (two teams), Cariboo Gold Quartz, Britannia, Giant Nickel, and Highland-Bell. A Bralorne team, captained by S. Greer, took first place.

The East Kootenay Mine Safety Association held its annual competition at Kimberley on June 11th, 1960. Five teams took part on the mine-rescue competition—two from Kimberley, and one each from Fernie, Michel, and Mineral King. First place was won by the Fernie team, captained by A. Littler.

The West Kootenay Mine Safety Association held its fourteenth annual competition at Trail on June 18th, 1960. Four teams took part in the mine-rescue competition—two from the Bluebell mine, one from Canadian Exploration Limited, and one from the H.B. mine. A Bluebell team, captained by P. Rowan, took first place.

At all meets, competitions were held in first aid as well as mine-rescue work. In these competitions, events were held for women and juniors. There were entries in these competitions from industries and organizations not necessarily connected with mining.

The fifth Provincial mine-rescue competition was held at Cranbrook on June 25th, 1960. The winning teams from the Cumberland, Kamloops, Trail, and Kimberley events competed for a trophy and silver trays. The event was won for the second time in a row by the Fernie team captained by A. Littler. The winning team also received an award from the International Union of Mine, Mill and Smelter Workers. In conjunction with this competition, the Workmen's Compensation Board sponsored the fourth Provincial men's first-aid competition and St. John Ambulance sponsored the second Provincial ladies' first-aid competition. Teams competed which had won local events at Cumberland, Vancouver, Kamloops, Trail, Kimberley, and Victoria. The men's winning team was the MacMillan and Bloedel team captained by J. B. Gammie. The ladies' winning team was from Riondel and was captained by Mrs. D. Harrison.

JOHN T. RYAN TROPHY

The John T. Ryan Regional Safety Award for the metal mine with the lowest accident frequency record for 1960 was won by Canadian Exploration Limited at Salmo. To win this trophy the mine completed the year with only one compensable accident. This enviable record is consistent with the past safety record of Canadian Exploration Limited, and commendation is due the company's safety organization, officials, and employees.

The 1960 Regional Safety Award for coal mines was won by the Michel Colliery of The Crow's Nest Pass Coal Company Limited. An excellent reduction in the frequency and severity of accidents was evident for 1960.

WEST KOOTENAY MINE SAFETY ASSOCIATION TROPHY

The West Kootenay Mine Safety Association in 1951 donated a safety trophy for annual competition in order to encourage and promote safety in small mines not eligible for the John T. Ryan awards. At first the trophy was restricted to mines in the West Kootenay area, but in 1956 this restriction was removed.

The award is made to the mine having the lowest accident rate and working a total of from 2,500 to 30,000 shifts per year, one-third of these having been worked underground. An accident is taken as one which involved more than three days' loss of time.

In 1960 the award was won jointly by the Craigmont and French mines. Both mines completed the year without a single compensable accident. This is a most commendable record—for Craigmont in that it was in the throes of a large development programme and for the French mine in that it was the second time it had won the award. The trophy was presented at a joint meeting of the association and the Nelson branch of the Canadian Institute of Mining and Metallurgy in Nelson on March 25th, 1960.

BRITISH COLUMBIA MINING ASSOCIATION, SAFETY DIVISION

The Safety Division of this association, which was inaugurated in 1955, continued to promote the establishment and maintenance of an effective safety programme at mines of member companies. The lost-time accident frequency for reporting companies has been steadily reduced from 71.2 in 1950 to a low of 28.0 lost-time injuries per million man-hours of exposure in 1960. There was a reduction of 6.7 per cent in this frequency from 1959. Of twelve fatal accidents in the mining industry for 1960, only seven occurred at properties of reporting companies.

With the assistance of all mines, through pooling of ideas and observations, safe working procedures and methods are being evolved and progress is being made in the difficult task of injury prevention.

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 1960 was 844,500 tons, an increase of 86,872 tons or 11.4 per cent over 1959. A total of 77,919 tons came from strip mines at Michel and Tent Mountain.

The Vancouver Island District produced 91,404 tons, a decrease of 58,264 tons or 38.3 per cent from 1959.

The Northern District production was 7,710 tons, a decrease of 1,133 tons or 12.8 per cent from 1959.

The Nicola-Princeton District production was 1,407 tons, a decrease of 170 tons or 10.8 per cent from 1959.

The East Kootenay District production was 743,979 tons, an increase of 146,439 tons or 24.5 per cent over 1959.

Output and per Capita Production, 1960

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 mine, Canadian Collieries Resources Ltd.[1]	39,386	58	248	2.74	159	180	3.77	209
Tsable River mine, Comox Mining Company[2]	49,378	160	106	2.91	465	96	3.21	514
Chambers No. 5 mine	47	8	2	2.93	23	2	2.93	23
Loudon No. 6 mine	612	114	3	1.79	204	3	1.79	204
Lewis mine (Timberlands)	831	172	3	1.61	277	3	1.61	277
Carruthers and Wakelem No. 3 mine	464	168	2	1.38	233	2	1.38	232
Stronach mine	326	122	2	1.33	163	2	1.33	163
Undun mines (No. 2 and 3)	360	114	2	1.55	180	2	1.55	180
Princeton Blue Flame No. 3 mine	1,194	250	2	2.39	597	2	2.39	597
Coldwater mine	213	64	2	1.66	106	2	1.66	106
Bulkley Valley Collieries	5,417	191	16	1.77	338	12	2.36	451
Reschke mine	149	25	2	2.98	74	1	5.96	149
Gething No. 3 mine	2,144	169	6	2.11	357	4	3.17	536
Michel Colliery (underground)	666,060	223	760	3.97	887	583	5.13	1,142
Michel Colliery (strip)	65,321	223	13	22.50	5,002	......	......	......
Coleman Collieries (strip)	12,598	48	13	20.08	968	......	......	......

[1] Canadian Collieries Resources Ltd. ceased operation at Tsable River mine on April 14th, 1960.

[2] Comox Mining Company commenced operating the Tsable River mine on May 9th, 1960, under lease from Canadian Collieries Resources Ltd.

District Output and per Capita Production, Underground Mines, 1960

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	91,404	368	248	290	315
Nicola-Princeton	1,407	4	351	4	351
Northern	7,710	24	321	17	453
East Kootenay	666,060	760	876	583	1,146
Whole Province	766,581	1,156	663	894	857

Output per Man-shift, Underground Mines, 1951–60

Year	Man-shifts[1]	Tonnage	Average per Man-shift (Tons)
1951	442,170	1,434,974	3.24
1952	383,422	1,388,732	3.62
1953	333,922	1,171,932	3.51
1954	280,353	1,064,023	3.79
1955	304,139	1,157,813	3.86
1956	307,821	1,100,434	3.57
1957	226,536	945,848	4.17
1958	204,148	728,722	3.56
1959	171,608	646,788	3.77
1960	210,254	766,581	3.66

[1] Includes both surface and underground workers.

COLLIERIES OF BRITISH COLUMBIA, 1960—PRODUCTION AND DISTRIBUTION, BY COLLIERIES AND BY DISTRICTS (IN SHORT TONS)

Mine	Gross Output	Washery Refuse	Net Output	Used Under Companies' Boilers, etc.	Used in Making Coke	Stocks				Sales				Total Coal Sold and Used[1]
						On Hand First of Year	On Hand Last of Year	Added To	Taken From	In Canada	In U.S.A.	Elsewhere	Total Sales	
Vancouver Island District														
Canadian Collieries Resources Ltd.—Tsable River Colliery	39,386	3,274	36,112	268	—	24,939[2]	—	—	24,939	60,783	—	—	60,783	61,051
Comox Mining Company Ltd.—Tsable River Colliery	49,378	173	49,205	—	—	1,747	9,144	7,397	—	41,808	—	—	41,808	41,808
Chambers No. 5 mine	47	—	47	—	—	—	—	—	—	47	—	—	47	47
Loudon No. 6 mine	612	—	612	—	—	—	—	—	—	612	—	—	612	612
Lewis mine (Timberlands)	831	—	831	—	—	—	—	—	—	831	—	—	831	831
Carruthers and Wakelem No. 3 mine	464	—	464	—	—	—	—	—	—	464	—	—	464	464
Stronach mine	326	—	326	—	—	—	—	—	—	326	—	—	326	326
Undun mines	360	—	360	—	—	—	—	—	—	360	—	—	360	360
Totals, Vancouver Island District	91,404	3,447	87,957	268	—	26,686	9,144	7,397	24,939	105,231	—	—	105,231	105,499
Nicola-Princeton District														
Princeton Blue Flame No. 3	1,194	—	1,194	—	—	—	—	—	—	1,194	—	—	1,194	1,194
Coldwater mine	213	—	213	—	—	—	—	—	—	213	—	—	213	213
Totals, Nicola-Princeton District	1,407	—	1,407	—	—	—	—	—	—	1,407	—	—	1,407	1,407
Northern District														
Bulkley Valley Collieries	5,417	—	5,417	—	—	—	—	—	—	5,417	—	—	5,417	5,417
Reschke mine	149	—	149	—	—	—	—	—	—	149	—	—	149	149
Gething No. 3 mine	2,144	—	2,144	—	—	—	—	—	—	2,144	—	—	2,144	2,144
Totals, Northern District	7,710	—	7,710	—	—	—	—	—	—	7,710	—	—	7,710	7,710
East Kootenay District														
The Crow's Nest Pass Coal Co. Ltd.—Michel Colliery (underground and strip)	731,381	58,676	672,705	13,800	187,460	4,529	14,760	10,231	—	168,357	20,128	272,729	461,214	662,474
Coleman Collieries (strip)	12,598	1,030	11,568	—	—	—	—	—	—	11,568	—	—	11,568	11,568
Totals, East Kootenay District	743,979	59,706	684,273	13,800	187,460	4,529	14,760	10,231	—	179,925	20,128	272,729	472,782	674,042
Coal														
Grand totals for Province	844,500	63,153	781,347	14,068	187,460	31,215	23,904	17,628	24,939	294,273	20,128	272,729	587,130	788,658
Coke														
The Crow's Nest Pass Coal Co. Ltd.—Michel Colliery	146,260	—	146,260	—	—	28,726	35,945	7,219	—	72,304	66,737	—	139,041	—

[1] Includes coal used in making coke and coal used under company stationary and locomotive boilers, etc.

[2] Includes an overrun of 2,502 tons.

Collieries of British Columbia, 1960—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																		
Canadian Collieries Resources Ltd.—																		
Tsable River Colliery	14	9	23	109	—	109	—	—	—	46	39	85	11	20	31	180	68	248
Comox Mining Company Ltd.—																		
Tsable River Colliery	8	2	10	76	—	76	—	—	—	10	6	16	2	2	4	96	10	106
Chambers No. 5 mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Loudon No. 6 mine	1	—	1	2	—	2	—	—	—	—	—	—	—	—	—	3	—	3
Lewis mine (Timberlands)	1	—	1	2	—	2	—	—	—	—	—	—	—	—	—	3	—	3
Carruthers and Wakelem No. 3 mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Stronach mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Undun mines	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Totals, Vancouver Island District	28	11	39	193	—	193	—	—	—	56	45	101	13	22	35	290	78	368
Nicola-Princeton District																		
Princeton Blue Flame No. 3	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Coldwater mine	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	2	—	2
Totals, Nicola-Princeton District	2	—	2	2	—	2	—	—	—	—	—	—	—	—	—	4	—	4
Northern District																		
Bulkley Valley Collieries	2	2	4	6	—	6	3	—	3	1	—	1	—	2	2	12	4	16
Reschke mine	1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2
Gething No. 3 mine	1	—	1	2	—	2	1	—	1	—	1	1	—	1	1	4	2	6
Totals, Northern District	4	3	7	8	—	8	4	—	4	1	1	2	—	3	3	17	7	24
East Kootenay District																		
The Crow's Nest Pass Coal Co. Ltd.—																		
Michel Colliery (underground)	33	17	50	294	—	294	119	—	119	55	98	153	82	62	144	583	177	760
Michel Colliery (strip)	—	1	1	—	—	—	—	—	—	—	—	—	—	12	12	—	13	13
Coleman Collieries (strip)	—	1	1	—	—	—	—	—	—	—	—	—	—	12	12	—	13	13
Totals, East Kootenay District	33	19	52	294	—	294	119	—	119	55	98	153	82	86	168	583	203	786
Grand totals for Province	67	33	100	497	—	497	123	—	123	112	144	256	95	111	206	894	288	1,182

NOTE.—U.=underground; A.=above ground; T.=totals.

Coal-preparation Plants

There were no additions or extensive alterations made to existing plants in 1960. On April 14th, 1960, Canadian Collieries Resources Ltd. ceased operation at its Tsable River mine. The coal-preparation plant at Union Bay was subsequently dismantled. For full details of plants *see* 1954 Annual Report.

Coke-making

Coke is made at only one plant in the Province, that of the Michel Colliery, The Crow's Nest Pass Coal Company Limited, Fernie. Construction of the new drying plant, started in August, 1959, for the purpose of reducing the moisture content of the coke breeze from approximately 16 per cent to 3 per cent, was completed early in June, 1960.

Briquetting

Briquettes were made at only one plant in the Province, that of the Michel Colliery, The Crow's Nest Pass Coal Company Limited, Fernie. This plant was closed in May, 1960, due to a lack of orders for this type of fuel. For full details of this plant *see* 1954 Annual Report.

LABOUR AND EMPLOYMENT

In 1960, 1,182 persons were employed in and about the coal mines of the Province, an increase of 126 over 1959. Because of the five-day week in force throughout the Province at the larger mines and the legal holidays, the maximum number of working-days was 241. In the Vancouver Island District the one large mine, the Tsable River mine, worked 218 days. In the East Kootenay District the Michel Colliery worked 223 days.

COMPETITION FROM COAL PRODUCED OUTSIDE OF BRITISH COLUMBIA

In 1960 the shipment of Alberta coal and briquettes to British Columbia totalled 379,668 and 12,136 tons respectively.

The following table shows the amount of Alberta coal brought into British Columbia during the past ten years:—

Year	Short Tons	Year	Short Tons
1951	898,533	1956	860,329
1952	1,021,484	1957	672,527
1953	859,385	1958	532,911
1954	891,194	1959	437,118
1955	932,764	1960	379,668

Of the 587,130 tons of British Columbia coal marketed, 144,379 tons was sold for domestic and industrial use in Alberta, Saskatchewan, Manitoba, and Ontario; 2,322 tons was sold for railroad use in Canada; 20,128 tons was exported to the United States; and 272,729 tons was exported to Japan.

The amount sold for domestic and industrial use in the Province was 147,572 tons.

ACCIDENTS IN AND AROUND COAL MINES

In 1960 there were no fatal accidents, as compared with two in 1959. The number of fatal accidents per 1,000 persons (underground and strip-mine personnel) employed was 0.00, compared with 1.89 in 1959, 0.00 in 1958, 1.45 in 1957, 4.39 in 1956, 3.38 in 1955, 0.69 in 1954, 3.22 in 1953, 1.78 in 1952, and 3.11 in 1951.

The number of fatal accidents per 1,000,000 gross tons of coal (underground and strip-mine coal) produced in 1960 was 0.00, compared with 2.64 in 1959.

The following table shows comparative figures for fatal accidents for 1959 and 1960:—

Company	Colliery	1960	1959
The Crow's Nest Pass Coal Co. Ltd.	Michel	....	1
Canadian Collieries Resources Ltd.	Tsable River	....	1
Totals		..	2

The following two tables classify the fatal accidents in coal mines as to cause and quantity of coal per accident:—

Fatal Accidents Classified as to Cause

Cause	1960		1959	
	Number	Per Cent	Number	Per Cent
Fall of roof coal	....	..	1	50.00
Crushed between tram and motor	....	....	1	50.00
Totals	....	....	2	100.00

Fatal Accidents, Underground Mines, Classified as to Quantity of Coal Mined

Cause	1960		1959	
	Number of Fatal Accidents	Coal Mined per Fatal Accident	Number of Fatal Accidents	Coal Mined per Fatal Accident
Fall of roof coal	....	....	1	646,788
Crushed between tram and motor	....	....	1	646,788
Totals	....	....	2	323,394

Note.—There were no fatal accidents in strip-mining operations during 1960.

Ratio of Fatal Accidents, Underground Mines

District	Accident Death Rate			
	Per 1,000 Persons Employed		Per 1,000,000 Tons of Coal Mined	
	1960	1959	1960	1959
Vancouver Island	....	3.31	....	6.68
Nicola-Princeton	....	..	....	....
East Kootenay	....	1.44	....	2.06
Northern	....	....	....	....
Province, 1960	....		....	....
Province, 1959	....	1.95	....	3.09

There were 162 accidents involving loss of seven days or more reported to the Department by the management of the various mines. All these accidents were investigated and reported on by the District Inspectors of Mines.

The following three tables classify the accidents in coal mines in 1960 as to occupation of the men involved, as to cause, and as to injury:—

Accidents Classified as to Occupation

Occupation	Number of Accidents	Percentage of Accidents
Underground—		
Miners	88	54.32
Drillers and facemen	----	----------
Haulage and conveyor men	30	18.51
Trackmen and mechanics	4	2.47
Supervisors	4	2.47
Timbermen	8	4.94
Coal-cutters	----	----------
Miscellaneous	7	4.32
Surface—		
Shops	11	6.79
Surface	3	1.86
Preparation and coke-ovens	7	4.32
Miscellaneous	----	----------
Totals	162	100.00

Accidents Classified as to Cause

Cause	Number of Accidents	Percentage of Accidents
Fall of ground	28	17.29
Fall of material and flying material	16	9.87
Lifting and handling equipment and material	48	29.64
Machinery and tools	25	15.43
Slipped and tripped	29	17.90
Falling off staging and platforms	5	3.08
Miscellaneous	11	6.79
Totals	162	100.00

Accidents Classified as to Injury

Injury	Number of Accidents	Percentage of Accidents
Head and neck	15	9.26
Eyes	2	1.23
Trunk	26	16.05
Back	13	8.03
Arms	11	6.79
Hands and fingers	39	24.08
Legs	36	22.22
Feet	16	9.87
Toes	4	2.47
Totals	162	100.00

EXPLOSIVES

The following table shows the quantity of explosives used in underground coal mines in 1959, together with the number of shots fired, tons of coal produced per pound of explosives used, and the average number of pounds of explosives per shot fired (these quantities include all the explosives used for breaking coal and rock work in coal mines):—

Vancouver Island District

Colliery	Quantity of Explosives Used (Pounds)	Coal Mined (Tons)	Total Number of Shots	Average Tons per Pound of Explosives Used	Average Pounds of Explosives per Shot Fired
Tsable River Colliery (Canadian Collieries Resources Ltd.)	18,400	39,386	26,200	2.16	0.70
Tsable River Colliery (Comox Mining Company Ltd.)	26,700	49,378	48,000	1.85	0.56
Chambers No. 5 mine	......	47	......	......	......
Loudon No. 6 mine	560	612	560	1.09	1.00
Lewis mine (Timberlands)	450	831	750	1.85	0.60
Carruthers and Wakelem No. 3 mine	450	464	585	1.06	0.77
Stronach mine	200	326	275	1.66	0.73
Undun mines	200	360	250	1.80	0.80
Totals for district	46,960	91,404	76,620	1.95	0.61

Nicola-Princeton District

Princeton Blue Flame No. 3 mine	50	1,194	100	23.90	0.50
Coldwater mine	300	213	350	0.71	0.86
Totals for district	350	1,407	450	4.01	0.78

Northern District

Bulkley Valley Collieries	5,250	5,417	7,010	1.06	0.75
Reschke mine	100	149	125	1.49	0.80
Gething No. 3 mine	1,000	2,144	2,000	2.14	0.50
Totals for district	6,350	7,710	9,135	1.23	0.70

East Kootenay District

Michel Colliery (underground)	152,378	666,060	122,494	4.41	1.25

Province

Totals for Province	209,038	766,581	208,699	3.80	1.07

Quantity of Different Explosives Used

	Lb.
Monobel of different grades	206,540
Permissible rock powder	2,498
Total	209,038

MACHINE-MINED COAL

In 1960, mining-machines produced approximately 12,000 tons or 1.5 per cent of the total output from underground mining. A total of 77,919 tons of strip-mined coal was removed by mechanical means.

SAFETY LAMPS

There were 1,051 safety lamps in use in the mines of the Province. Of this number, 971 were approved electric lamps, mostly of the Edison type.

Approved Safety Lamps—Electric and Flame

The following is a list of approved safety lamps, electric and flame:—

The Wolf lamp, flame type.

The Koehler lamp, flame type.

The Edison electric lamp (cap) under Approval No. 18 of the United States Bureau of Mines, and all Edison lamps up to and including Model P, carrying the Approval Certificate No. 26 of the United States Bureau of Mines, Model R-4, Approval No. 29.

The Wheat electric lamp and having Approval No. 20, as issued by the United States Bureau of Mines.

The Wolf electric lamp, No. 830C.

The electric lamp manufactured by the Portable Lamp and Equipment Company, under Approval No. 27 of the United States Bureau of Mines.

M.S.A. single-cell trip lamp, carrying United States Bureau of Mines Approval No. 1009, approved for use on haulage trips in mines.

The Davis M.L. model pneumatic electric lamp.

ELECTRICITY

Electricity is used for various purposes on the surface and underground at three collieries. A total of 12,144 horsepower was used in and about these mines. Detailed information as to how and where this power was used is given in the report of the Senior Electrical Inspector of Mines.

INSPECTION COMMITTEES

The provisions of the *Coal Mines Regulation Act,* section 65, General Rule 19, require that an inspection committee of workmen shall inspect the mine regularly on behalf of the workmen and make a true report of the conditions found. In all the larger mines of the Province this rule is fully observed, and copies of the report are sent to the Inspectors for the district. The work of these committees is valuable and assists in furthering the interests of safety at the various mines.

COAL DUST

The danger of accumulations of coal dust on the roadways and in the working-places is fully realized, and as a rule the regulations regarding the control of coal dust are adequately carried out. Large quantities of limestone dust are used continually in the larger mines to combat this hazard. It is used in the roadways, working-places, and for the tamping of shots.

Dust samples are taken regularly from roof, sides, and floor of mine roadways and analysed. The report of the analyses are forwarded to the District Inspector each month.

DIESEL LOCOMOTIVES

Early in August, 1950, the first diesel underground locomotive to be used in any mine in British Columbia made its trial runs in No. 9 mine, Elk River Colliery, The Crow's Nest Pass Coal Company Limited.

MILLISECOND DELAY DETONATORS

In February, 1951, an amendment to the *Coal Mines Regulation Act* was passed to allow, with the permission of the Chief Inspector of Mines, more than one shot to be fired at a time in any coal mine or district of a mine. For further details *see* 1954 Annual Report.

DANGEROUS OCCURRENCES

On May 12th, 1960, it was reported that carbon monoxide tests indicated percentages ranging from 0.001 to 0.004 in the vicinity of the gob in the No. 9 Right beltroad section, "A" West mine, Michel Colliery, accompanied by a peculiar odour.

Tests on subsequent days failed to confirm the above findings until on June 5th, 1960, when substantially the same readings were obtained. A decision to seal off the area was made, and the actual sealing-off by the use of temporary stoppings was carried out in a matter of hours. All underground work at the colliery was suspended for twenty-four hours following the completion of these stoppings. Permanent stoppings were erected outby the temporary stoppings.

Some time after the sealing-off was completed, smoke was noticed issuing from a surface cave above the affected area. This cave and two others were subsequently filled with gravel in an attempt to complete the sealing-off of the area.

On August 24th, 1960, a trip of six loaded cars disconnected from the rope while being hoisted up No. 1 slope, "A" East mine, Michel Colliery. They were derailed by the safety drag but ran back down the slope for about 150 feet, knocking out three sets of timber and causing several small caves.

Subsequent investigation revealed that the coupling pin on the draw-bar of the first car, due to a broken cotter pin, had loosened and allowed the coupling link to pull free, thus disconnecting the rope from the trip.

On September 28th, 1960, a quantity of top coal fell in the gob of a pillar extraction off No. 6 raise in No. 2 Left beltroad section, "A" West mine, Michel Colliery, and slid into the working-place, completely burying one miner and cutting off the retreat of another. Rescue operations were started, and the two workmen were freed about one-half hour later, one being uninjured and the other suffering from severe bruises and shock.

On December 22nd, 1960, active fire was discovered under the foot of the fire stopping in No. 9 beltroad counter level, "A" West mine, Michel Colliery. About 1 ton of partially burnt coal was removed, and a plank stopping erected immediately outby the original seal. The space between the stopping and the seal was filled with limestone dust, also 30 tons of dust was blown through the sampling-pipes in an effort to extinguish any fire behind the original seal.

A permanent seal was erected outby the original seal.

BUMPS AND OUTBURSTS

On March 8th, 1960, a bump occurred in an abandoned area of workings near the inner end of the Main South level, " B " seam, Michel Colliery, which was felt on the surface and in some of the present workings in " B " seam. The concussion caused a small quantity of coal to slough off a rib in one of the working-places in " B " seam and one post was dislodged. A workman, in trying to dodge the falling post, twisted his ankle.

PROSECUTIONS

There were no prosecutions instituted at the various mines during the year.

SUPERVISION OF COAL MINES

During 1960 fifteen companies operated nineteen mines, employing 894 men underground. In the supervision of underground employees, there were two managers, ten overmen, three shiftbosses, and forty-seven firebosses, or approximately one official for every fourteen 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 10th, 1919, consists at present of R. B. Bonar, Deputy Chief Inspector of Mines, chairman and secretary; A. R. C. James, Inspector of Mines, member; and D. R. Morgan, Inspector of Mines, member.

The examinations are held at least once a year and more often if necessary.

All officials, before engaging in multiple blasting with millisecond delay detonators, are required to obtain a permit to do so from the Board of Examiners (Coal-mine Officials). This permit is issued only after the applicant has successfully passed oral and practical examinations in such work.

In addition to the examinations and certificates already specified as coming under the Board of Examiners, the Act provides that every coal-miner shall be the holder of a certificate of competency as such. Examinations are held as circumstances warrant in coal-mining districts, and no certificate is granted where the candidate has failed to satisfy the Board as to his fitness, experience in a coal mine, and a general working knowledge of the English language.

During 1960 there were forty candidates for coal-miners' certificates, one of whom was unsuccessful. In addition to the certificates granted above, substitute certificates were issued to those who had lost their original certificates. Permits to act as coal-miners, as provided by the Act, have been granted to younger men by Inspectors in their respective districts. This method allows promising men with less than one year's experience underground to work at the coal face as miners under the guidance of an experienced miner.

The Board of Examiners desires to thank the different coal-mining companies for the use of their premises for the holding of examinations where necessary.

NOTES ON COAL MINES

VANCOUVER ISLAND INSPECTION DISTRICT

By R. B. Bonar

The gross output of coal from the Vancouver Island Inspection District was 91,404 tons, a decrease of 58,264 tons or 38.3 per cent from the 1959 output. Only one large coal mine, the Tsable River mine, is now in production on the Island.

Operations in the once important Nanaimo coalfield are now restricted to six very small mines, providing employment for no more than fourteen men. These mines operate in outcrop, pillars, and barriers left during earlier working.

The Island coal-mining industry has suffered a rapid decline in the past few years. Production has declined over 60 per cent since 1951. The condition has resulted from loss of markets due to competition from other fuels, high costs of production, and from the depletion of reserves in the Nanaimo coalfield.

In 1960 there were twenty-two accidents reported and investigated. There were no fatal accidents.

The annual mine-rescue and first-aid meet organized by the Vancouver Island Mine Safety Association was held at Cumberland on Saturday, May 28th. Two teams from the Tsable River mine and a visiting team 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 team No. 2, captained by William High.

NANAIMO (49° 123° S.W.)

Chambers No. 5 Mine, Extension

R. H. Chambers and associates, operators; R. H. Chambers, manager. This mine is in Section 14, Range 7, in the Douglas district, near Extension. The present workings consist of a 600-foot slope driven in a section of the Wellington seam in the vicinity of the old Vancouver slope workings. The slope pillars and the pillars between the rooms driven to the right off the slope are being mined on the retreat.

The coal is mined by picking out the middle band of carbonaceous shale with hand-picks. It is then blasted and hand-loaded into cars which are hauled to the tipple by a gasoline-driven hoist. A small shaker screen sorts the coal into 2-inch, 1- to 2-inch, and under 1-inch sizes.

Due to the extremely mild winter, total production in 1960 was only 47 tons over a working period of eight 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 (Timberlands)

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 formed the western boundary of the old No. 8 mine. The seam is 6 feet thick, including two thin rock bands.

The coal is blasted off the solid and hand-loaded into cars which are hauled to the surface up the slope by a small hoist driven by a gasoline-operated engine. A shaker screen sorts the coal into lump, nut, and pea sizes. Total production in 1960 was 831 tons over a working period of 172 days, with a crew of two men. Working conditions were found to be satisfactory, and no accidents were reported.

Undun No. 2 Mine

J. Unsworth and A. Dunn, operators; A. Dunn, fireboss. This mine, which was brought into production in September, 1959, was established by cleaning up and retimbering the old No. 1 slope (Extension) for a distance of over 200 feet. By the end of March, 1960, all reserves of coal in this particular area were depleted and the mine was abandoned.

Total production in 1960 from this mine was 117 tons over a period of forty days by a crew of two men. Conditions as found during inspections were 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. An outcrop pillar of fairly thick coal was encountered, thus ensuring the mine of considerable life at present production.

Production was 243 tons over a period of seventy-four days with a crew of two men.

Conditions as found during inspections were satisfactory, and no accidents were reported.

NORTH WELLINGTON (49° 124° S.E.)

Loudon No. 6 Mine

William Loudon, operator; W. Loudon, fireboss. This mine is about 1 mile southeast of Wellington and has been opened up by flat-dipping slope driven in a small area of outcrop coal in the No. 2 Upper Wellington seam adjacent to the old No. 9 workings. The top portion of the seam, varying from 2 to 3 feet and consisting of carbonaceous shale, is blasted off the solid and stowed. The bottom 20 inches to 2 feet of coal is broken up with light shots and hand-loaded into cars which are hauled to the surface by a small gasoline-powered hoist. Production in 1960 amounted to 612 tons over a working period of 114 days with a crew of three men. Working conditions were found to be satisfactory during the course of inspections, and no accidents were reported.

Carruthers and Wakelem No. 3 Mine

R. B. Carruthers and W. Wakelem, operators; R. B. Carruthers, fireboss. This mine, near the Loudon mine, is also in the No. 2 or Upper Wellington seam adjacent to the abandoned workings of the old No. 9 mine. Production in 1960 amounted to 464 tons over a working period of 168 days with a crew of two men. Working conditions were found to be satisfactory in the course of inspections. No accidents were reported.

Stronach No. 2 Mine

Charles Stronach, operator; H. Gilmour, fireboss. This mine is in a section of the No. 2 or Upper Wellington seam adjacent to the old No. 9 mine. All the output comes from the mining of pillars and small areas of coal left in the early workings. Production in 1960 amounted to 326 tons over a period of 122 days with a crew of two men. Working conditions were found to be satisfactory in the course of inspections. No accidents were reported.

COMOX (49° 124° N.W.)

Canadian Collieries Resources Limited.—Head office, 566 Hornby Street, Vancouver 1. F. Ronald Graham, chairman of the Board; N. R. Whittal, president; E. O. T. Simpson, vice-president, mining; W. W. Johnstone, district superintendent.

Tsable River Mine.—S. J. Lawrence, manager; T. Ecclestone, overman; L. Cooper, A. Cullen, and A. Somerville, shiftbosses; W. Bennie, J. Cochrane,

M. Frobisher, W. High, L. Hutchinson, C. Lewis, G. Nicholas, J. Thomson, and A. Maxwell, firebosses; S. Gough, surface foreman.

The layout and method of operating this mine are fully described in the 1954 Annual Report. In the latter part of 1959 the company announced that its coal contracts would not be renewed after May 31st, 1960. Subsequently all development work was stopped underground and the extraction of pillars was intensified, especially in the northeast section.

All the coal is blasted off the solid by the use of electrical millisecond delay detonators and multiple blasting.

On April 14th, 1960, Canadian Collieries Resources Limited ceased operations at the Tsable River mine. Production of coal from January to April 19th amounted to 39,386 tons over a working period of fifty-eight days, with a crew averaging 180 men underground and sixty-eight on the surface. Conditions at the mine were usually found to be satisfactory.

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. Two mine-rescue teams of six men each were maintained, and these attended periodic practices at the Cumberland mine-rescue station.

Twenty-two accidents at or in the mine were reported and investigated.

Regular inspections of the mine were made each month by the committee appointed by the workmen, and copies of its report were forwarded to the office of the District Inspector through the courtesy of the committee.

Comox Mining Company Limited.—S. J. Lawrence, president; G. Dutfield, vice-president; P. F. Grundy, secretary; head office address, P. O. Box 4, Union Bay, B. C.

Tsable River Mine.—S. J. Lawrence, manager; James Cochrane, overman; A. Somerville, M. Frobisher, F. Thomson, A. Cullen, L. Cooper, and W. High, firebosses.

On May 9th, 1960, the Tsable River mine was again brought into production by the newly formed company, Comox Mining Company Limited. The company leases the property from Canadian Collieries Resources Limited and payment is made on a royalty of so much per ton of coal produced.

During the time the mine was inoperative, April 14th to May 9th, the existing tipple at the mine was altered to include a screening plant. A railway car-loading point was established at the Esquimalt and Nanaimo Railway at Buckley Bay. This included the clearing and black-topping of about 2 acres of land and the laying of a spur track from the Esquimalt and Nanaimo Railway. Railway cars are loaded at Buckley Bay and scows are loaded at Union Bay by the use of a temporary belt-conveyor system.

Mining has been concentrated in the northeast section, where previously developed pillars are being extracted by the use of shaker-conveyors and Joy loaders. Electrical multiple blasting with millisecond delay detonators is used throughout the mine.

Production in 1960 amounted to 49,378 gross tons over a working period of 160 days, with a crew averaging ninety-six men underground and ten on surface.

Conditions at the mine were usually found to be satisfactory in the course of inspections.

NICOLA-PRINCETON INSPECTION DISTRICT

By David Smith, except as noted.

Coal production in 1960 in the Nicola-Princeton district was 1,407 tons. Production was obtained from two small mines. Exploration work was carried out at the Mullin's strip mine near Blakeburn and in the Merritt coal basin.

No accidents were reported by either of the coal mines in 1960, nor were there any prosecutions under the *Coal Mines Regulation Act.*

Merritt (50° 120° S.W.)

Coldwater Mine

This property, 1 mile south of Merritt, is operated by the owners, S. Gerrard and partners. Mining of coal has been confined to the splitting of pillars and extraction of remnants of coal in the abandoned workings of the old Middlesboro No. 5 mine. Total production in 1960 was 213 tons, sold locally. A crew of two men was employed. Working conditions were satisfactory, and no methane was detected in the course of inspections.

Merritt Coal Basin (Imperial Metals and Power Ltd.)

Property held on option by Imperial Metals and Power Ltd. from S. Gerrard and partners consists of Lot 166, Lot 121, Lot 122, and Lot 123, and the north half of Lot 4, all in Township 91, Kamloops Land District. Exploration was directed to locate a coal seam that would be amenable to strip mining. The following work was done. The portals of Nos. 1, 4, and 4 East mines of the old Middlesboro Colliery were cleared of debris, but entry to the old workings was not possible. Some bulldozer work was done to expose outcrops at different points on the property. A total of fifteen vertical holes, with a total length of 2,684 feet, was drilled with a 6-inch rotary drill. A diamond drill (AX core) was used to deepen several of the holes; a total of 757 feet of diamond drilling was done. Two persons were employed under the supervision of M. K. Lorimer, engineer in charge.

Hat Creek (50° 121° S.W.)*

Inland Resources Company Limited

Company office, 602 West Hastings Street, Vancouver 2. This company holds Coal Licences Nos. 12 and 144 covering 960 acres in addition to a Crown-granted claim in the Hat Creek area. The property is at upper Hat Creek, 30 miles from Ashcroft and 15 miles from Pavilion. An unusually thick deposit of lignite coal occurs in a small basin of Tertiary sedimentary rocks. The Hat Creek coal deposit has been known of for many years, and small-scale mining for local requirements was carrried on from 1933 to 1945. Diamond drilling carried out in 1958 and 1959 is reported to have indicated very substantial reserves of coal on the property. In February, 1960, the property was sold to Western Development and Power Limited, a subsidiary of the British Columbia Electric Company Limited.

Princeton (49° 120° S.W.)

Blue Flame Colliery

This mine is about 10 miles by road south of Princeton and about half a mile west of the Hope–Princeton highway. T. Bryden, fireboss, and a partner work the mine on a lease basis. Total production for 1960 was 1,194 tons, most of which was sold to the Princeton brewery. Working conditions were satisfactory, and no methane was detected in the course of inspections.

* By A. R. C. James.

EAST KOOTENAY INSPECTION DISTRICT

By D. R. Morgan

The production of coal from the East Kootenay Inspection District during 1960 was 743,979 tons, an increase of 146,439 tons, or 24.5 per cent more than was produced in 1959. 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 731,381 tons, an increase of 162,160 tons or 28.4 per cent more than in 1959. The remainder of the production was obtained by Coleman Collieries Limited, which operates 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 from the British Columbia side during 1960 was 12,598 tons, a decrease of 15,721 tons or 55.5 per cent less than was produced in 1959. The strip mine was idle for most of the year, and activities on the British Columbia side were restricted to twenty-eight days.

The accident record showed an increase in both frequency and severity rates despite an effort to reduce the accidents, but it is pleasing to report there were no fatal accidents in the district during 1960. Five serious accidents were reported and investigated at Michel Colliery, all of which occurred underground. This was three more than the number reported in 1959. Minor accidents resulting in the loss of one or more working-days totalled 206, of which 172 occurred underground and thirty-four on the surface, an increase of seventy-five accidents. Four dangerous occurrences were investigated at Michel Colliery and are reported more fully in another part of this report under the heading " Dangerous Occurrences." There were no accidents or dangerous occurrences reported from the British Columbia side of the stripping operation on Tent Mountain.

The East Kootenay Mine Safety Association held its thirty-ninth annual mine-rescue and first-aid competitions at Chapman Camp on June 11th, and the various contests were well attended. Five teams, representing Fernie, Michel, Kimberley, and the Mineral King mine at Toby Creek, entered the mine-rescue competition, and the British Columbia Department of Mines and Petroleum Resources shield was won by the Fernie team, captained by Albert Littler. There were 135 contestants in the first-aid competitions, and the Rotary shield and the Department of Mines and Petroleum Resources cup were won by the Sullivan mine team, captained by W. D. McArthur. These two teams represented the East Kootenay District at the Provincial competitions held at Cranbrook on June 25th. The Fernie mine-rescue team was successful in winning the Provincial championship, and the Sullivan mine team was placed second in the first-aid competition. This was the second year in succession that the two teams have won this award.

The Crow's Nest Pass Coal Company Limited

T. G. Ewart, president, Fernie; Thomas F. Gleed, vice-president, 1010 White Building, Seattle, Wash.; James Littler, general superintendent, Fernie; W. R. Prentice, secretary, Fernie; J. F. Cleeve, treasurer, Fernie. This company owns extensive coal properties in the Crowsnest Pass area, and has conducted large-scale coal-mining operations in the district since 1897. Present operations are confined to the Michel Colliery, and include both underground and open-cast mining. The operations are directed from a head office in Fernie, and most of the production is sold on the industrial market. A large quantity of the fines is used for making coke.

MICHEL COLLIERY.—(49° 114° N.W.) James E. Morris, manager; Irving Morgan, senior overman; Walter McKay, safety supervisor; William Gregory, afternoon-shift overman.

The colliery is operated at Michel, 24 miles east of Fernie, and is on the Crowsnest Pass branch of the Canadian Pacific Railway. It is a large colliery and has been in operation since 1899. The present operations include five underground mines at Michel and a stripping operation on Baldy Mountain, near Michel. They also include a modern by-product plant and briquette plant, which are located on the colliery-site. The mines are operated on both sides of the valley, and are named according to the seam worked and the direction of development. Four of the mines are on the south side and the other on the north side. Those on the south side have been developed from a pair of long rock tunnels which have been driven across the synclinal structure of the coal measures, and are operated on both limbs of the syncline. The remaining mine, "A" North, is being developed from the outcrop of the seam on the north side of the valley. The mines in general are operated by the room-and-pillar system, and the pillars are extracted on the retreat. They are all fully mechanized, and both electricity and compressed air are largely used. The electrical equipment is of the flameproof type and has been approved for use in coal mines. The main haulage system in the rock tunnels and entry levels to the individual mines is by means of compressed-air locomotives. Battery locomotives are used at the "A" North mine. The production from all the mines is cleaned and treated at a modern preparation plant located near the entrances to the rock tunnels. A description of the plant has been given in past reports.

The underground operations are under the direct supervision of seven overmen and twenty-six firebosses.

"A" East Mine.—Harry Corrigan, overman; Frank McVeigh, Harry Sanders, Thomas Taylor, Roger Pasiaud, and Albert Littler, firebosses.

The mine is operated in "A" seam, on the eastern limb of the Michel syncline, and all the workings are on the left side of the rock tunnels. The mine has been in operation for many years, and present activities are confined mainly to dip workings, which are rapidly retreating toward the main rock tunnels.

The seam is of good quality, 10 to 12 feet thick, and dips at an angle of 20 degrees in a southwesterly direction. The coal is friable, gassy, and is overlain by a weak shale roof which is heavily fractured, and requires close timbering and careful attention for its support. The coal in the rooms is usually mined by pneumatic picks during advancement, and only occasional shots are required. It is loaded by duckbill conveyors or directly by hand onto conveyors. The pillars are extracted by the shortwall method, and, as the coal is friable, pneumatic picks are used to full advantage. The coal is loaded by hand onto shaker, chain, and belt conveyors and transferred to various loading points in the rooms. From the loading points it is hauled in trips of cars by compressed-air hoists up to the main east level, and from there to the surface by compressed-air locomotives via the rock tunnels.

The mine averaged a daily output of 650 tons during 1960 with a crew of 135 men. Most of the production was obtained from the No. 1 Slope district, and the remainder came from the extraction of pillars in two small sections of former workings, now known as the No. 3½ slope and No. 5½ incline. No. 1 Slope district is at the outer end of the main east levels and is developed from three slopes, driven to the base of the syncline. It was originally intended to continue the slopes to work an area of coal on the western side of the syncline but these workings were later abandoned owing to adverse mining conditions. Since that time the activities have been confined to the eastern limb of the syncline and were directed mainly to the extraction of pillars near the lower end of the slope. A section of old workings on the right side of the slopes was also dewatered early in 1960, and an entry was made to extract a large number of pillars left in the area. It is estimated that over 250,000 tons of coal is left in the unworked pillars. The workings were entered at a lower elevation from the No. 1 slope, and they were completely dewatered by means of drill-holes before they were entered. Electric pumps were installed to cope with the additional water, and they are now used in general throughout the mine. Conditions were found to be satisfactory during the course of inspections, with the exception of excessive roof pressures and breakages of timber supports in the No. 3½ slope following extensive pillar extraction. Some difficulty was also experienced on one occasion in the workings of the No. 2 left section in the No. 1 Slope district due to sluggish ventilation. This was later rectified.

The mine is ventilated by an electrically driven aerodyne fan which delivers 95,000 cubic feet of air to the workings at a 5.6-inch water-gauge. This quantity was found to be sufficient for the normal requirements of the workings.

"A" West Mine.—Daniel Chester, overman; Reginald Taylor, Robert Taylor, James Walsh, William Cytko, Stanley Menduk, Roger Girou, Henry Parsons, Arnold Webster, Andrew Davey, Thomas Krall, and Benjamin Volpatti, firebosses.

This mine has been developed in the "A" seam on both the eastern and western limbs of the Michel syncline. It is entered on the right side of the rock tunnels, and all the workings are toward the outcrop of the seam. The coal is of good quality, ranging from 12 to 28 feet in thickness and dipping at an angle of 20 to 35 degrees. The mine is worked by the room-and-pillar system, and the layout is so arranged that most of the extraction is carried out along the strike of the seam.

The mine is the largest producer at the colliery and averaged a daily output of 1,150 tons during 1960 with a crew of 215 men. Most of the production was obtained from the upper part of the mine, where the coal is 28 feet thick and the pillars are extracted by the caving system. These workings are partitioned into panels, and nearly all the roadways are driven on the footwall of the seam, the top coal being supported by timber sets. The rooms are driven at 45-foot centres, and the coal is mined by shortwall coal-cutters or is blasted from the solid by the use of millisecond delay action detonators. During the extraction of pillars the timber supports are withdrawn and the top coal is allowed to fall or is blasted into the roadways. The coal is loaded by duckbill conveyors which extend beyond the timber supports, thus preventing the workmen being exposed to the caved areas. All the coal is loaded onto conveyors and is transferred to a central loading point on the main west level, where it is loaded into large trips of cars and taken from the mine by compressed-air locomotives. Most of the equipment in the workings is operated by electricity, but compressed-air machines are used mainly at the faces.

The coal reserves in the upper section of the mine are rapidly nearing depletion. These workings have been the major producer for several years, but the operation had been reduced to a small number of working-places in the No. 4 left beltroad section by the end of 1960. During the year two other panels of workings were developed at a lower elevation in the mine to maintain the present output, and a third panel is in the course of development. The area of coal in which the panels are developed is "broken" by previous development, but the pillars are intact, and there is a large quantity of coal available for future mining.

The mine is ventilated by an electrically driven axivane fan which delivers 85,000 cubic feet of air to the workings at a 3.5-inch water-gauge. This quantity was found to be sufficient for the normal requirements of the mine. General conditions at the mine were found to be satisfactory during the course of inspections, with the exception of two instances of a gob fire in the No. 9 beltroad panel, which are reported more fully in this report under the heading of " Dangerous Occurrences." The panel was sealed from the remainder of the workings and is being carefully watched.

Upper "A" South Mine.—James Anderson, overman; Ronald Saad, Michael Tymchuk, William Verkerk, Henry Eberts, Joseph Serek, and Paul Kusnir, firebosses.

This mine was opened in October, 1956, and is being operated in order to develop a large area of "A" seam coal left between the old "A" South mine workings and the outcrop of the seam. The mine is on the western limb of the syncline and is entered by two inclines, which have been driven in the underlying seam and later connected to the "A" seam by two rock raises. The seam was entered in November, 1958, and since that time most of the activities have been directed to the advancement of three inclines on the full pitch of the seam, and the development of levels on each side of the inclines. The seam is 26 feet thick, is of good quality, and pitches at an angle of 35 degrees in a westerly direction. It is intended to extract the pillars by the caving system.

During 1960 the mine averaged a daily production of 515 tons with a crew of 100 men. Most of the production was obtained from the No. 1 North levels, which are being developed to the right of the main inclines, and the remainder came from the faces of the inclines. No. 1 North levels were advanced 1,300 feet during 1960, and six raises totalling 960 feet were driven from the levels for future extraction of pillars above the levels. Progress at the faces of the inclines was more restricted due to the presence of a large downthrow fault that was encountered at the end of 1959. The face of one of the inclines was stopped at the fault, and rock tunnels were driven from the other two to meet the continuation of the seam on the other side of the fault. Total advancement on each of the two inclines was 250 feet of rock work and a further advancement of 200 feet in the seam. The third incline was restarted inside the fault, and it is intended to make a connection between the two roadways at a later date. The coal at the faces is generally mined with pneumatic picks or is blasted from the solid by the use of millisecond delay detonators. It is loaded into chutes or conveyors and transferred to a central loading point on the main rock tunnels where all the coal from the mine is loaded. A " Borecut " continuous miner was used at the face of the lower level on the north side at the end of 1960, and it cut and loaded 60 tons per shift with a crew of three men. The coal was loaded into 10-ton-capacity bottom-dumping cars and transported to a bin on the main inclines by compressed-air locomotive.

The mine is ventilated by the old No. 3 fan, which also ventilates the "A" West mine workings, and was found to be satisfactory for the present requirements of the mine. Other conditions were also found to be satisfactory.

"A" North Mine.—John Whittaker, overman; Thomas Slee and Sidney Hughes, firebosses.

This mine is operated in the "A" seam on the north side of Michel Valley, approximately half a mile east of the preparation plant. The mine was opened in 1951, and is being developed from four main levels which follow the strike of the seam from the outcrop.

The seam is 12 feet thick where normal but is very irregular and faulty, and dips at an angle of 15 to 20 degrees in a southerly direction. The coal at most of the working-places is mined with pneumatic picks or is blasted from the solid by use of millisecond delay detonators. It is loaded by hand onto shaker and chain conveyors and transported by series of conveyors to various loading points on the main levels, where it is loaded into 10-ton-capacity bottom-dumping cars and taken from the mine by battery locomotives. The two bottom levels are more highly mechanized and are advanced by continuous miners, which mine and load the coal in one operation. Nearly all the equipment is operated by electricity, and compressed air, which is used mainly for operating the pneumatic picks, is supplied by three portable electric compressors, located on the main levels inside the mine. All production is taken to the preparation plant by trucks, which are loaded from bins at two of the portals of the mine.

The average daily production from the mine during 1960 was 110 tons with a crew of twenty-three men. Operations were considerably restricted owing to the present state of the coal market and activities were mainly directed to the extraction of pillars in a small area in the No. 4 incline panel of workings above the No. 2 level. The faces of both the No. 2 and No. 3 levels were idle throughout 1960, and operations at the No. 0 and No. 1 levels in the lower part of the mine were restricted to the first seven months. During this period the two levels were advanced 1,010 and 600 feet respectively, and the advancement of the two levels is now in line with the remainder of the development of the mine. The two " Borecut " continuous miners used for working the two bottom levels were taken from the mine in September, one being transferred to the Upper "A" South mine and the other to the surface machine-shops for overhaul. The latter machine has been operating under a restricted permit, and the management is endeavouring, through the Department of Mines and Technical Surveys, Ottawa, to have it properly certified for use in coal mines.

The mine is ventilated by an electrically driven axivane fan which delivers 85,000 cubic feet of air per minute to the workings at a 1.8-inch water-gauge. Small auxiliary fans capable of producing 5,000 cubic feet per minute are used for ventilating the faces of the main levels inby the last crosscuts and headings. These quantities were found to be sufficient to meet the requirements of the mine.

" B " South Mine.—William Davey, overman; John Krall, John McInnes, Robert Doratty, and Kenneth Kniert, firebosses.

This mine is operated in the " B " seam, on the western limb of the syncline, and on the left side of the main rock tunnels. The seam is 5½ feet thick, dips at an angle of 30 degrees in an easterly direction, and is overlain by a hard sandstone roof. The coal is of excellent coking quality, gassy, and is mined with pneumatic picks. No shot-firing is allowed. The mine is one of the oldest operations at the colliery and for many years was the major producer. Extensive pillar extraction over a period of years, however, has reduced the size of the operation considerably, and present activities are restricted to the extraction of roadside pillars left from former workings. These pillars are very limited, and the mine is rapidly nearing completion.

The mine averaged a daily output of 375 tons during 1960 with a crew of seventy-two men. Most of the production was obtained from the extraction of pillars alongside the old No. 3 incline, and the remainder was obtained from a small section of workings that is being driven to extract a limited number of pillars left in the " B " East mine above the outer end of the main south levels. The conditions in general were found to be satisfactory during the course of inspections, but some difficulty was experienced in maintaining sufficient clearance on a few of the roadways in the No. 3 incline section due to squeezing caused by pillar extraction.

The mine is ventilated by an electrically driven axivane fan which delivers 65,000 cubic feet of air to the workings at a 4.3-inch water-gauge. This quantity was found to be sufficient for the normal requirements of the mine.

No. 10 Seam Prospect Tunnel.—John Whittaker, overman. This prospect tunnel was started in September, 1960, and is being driven from the outcrop of the No. 10 seam to test the possibility of opening a mine in the seam. The tunnel is on the south side of the valley, near Natal, 1 mile west of the preparation plant, and is at a low elevation on the mountainside. The tunnel passed through 60 feet of unconsolidated gravel and continued a further 60 feet in the seam. A crosscut driven from the hangingwall to the footwall at this point indicated the seam to be 57 feet thick. The normal thickness of the seam, however, is thought to be 40 feet, and this is confirmed by three diamond-drill holes that were drilled from the surface ahead of the tunnel. Bulk samples of coal taken from the prospect for testing showed good coking qualities. The tunnel is being continued so that further tests can be made.

During 1960, 146,660 pounds of Monobel No. 4, 4,328 pounds of CXL-ite, and 114,566 electric detonators were used at the colliery for coal and rock blasting. Four misfired shots were reported.

Three hundred and thirty-two tons of limestone dust was used for application on the roadways to minimize the coal-dust hazard and for tamping shots, and an additional 130 tons of rock dust was used for combating the two fires in the "A" West mine. Regular monthly mine-dust samples were taken on the roadways at all the mines, and the samples were found to contain more than the required minimum contents of incombustible material.

Regular monthly examinations were made at all the mines by the miners' inspection committees, and a meeting was held at the colliery office each month by the pit safety committee. Copies of the findings and recommendations were sent to the office of the District Inspector through the courtesy of the committee members. All the report books kept at the mines in compliance with the *Coal Mines Regulation Act* were examined periodically and found to be in order.

Baldy Mountain Strip Mine.—James E. Morris, manager; T. Collopy, foreman.

This operation is on Baldy Mountain, 4 miles east of Michel. It is at a high elevation on the mountainside, and is reached by means of a private roadway leading from the colliery preparation plant. The operation has been active since 1948, and a description of the property has been given in past Annual Reports.

Operations were considerably restricted during 1960, and activities were mainly directed to the No. 2 pit, where a large area of overburden had been previously removed. The operation produced 65,321 tons of coal with a crew of two men in the pit and four truck-drivers for transporting the coal to the preparation plant. The coal reserves in the pit are rapidly nearing depletion, and stripping operations were commenced in another part of the area in November to open another pit. The new pit will be adjacent to the old No. 4A pit at a higher elevation on the mountainside, and will be known as the No. 4B pit. It is estimated that 300,000 cubic yards of overburden will have to be removed to expose 200,000 tons of coal. The stripping is carried out by Emil Anderson Construction Company on a contract basis, and that company has also taken over the loading of the coal in the No. 2 pit since December 1st. Conditions in general were found to be satisfactory during the course of inspections.

By-product Plant.—George Lancaster, superintendent. This plant is adjacent to the preparation plant at the colliery, and a description of its operation is included in the 1954 Annual Report. The only appreciable change at the plant since that time is a small drying plant that was constructed in 1959 and put into operation in 1960. The unit is used for drying and screening the fine coke product (breeze) in order to reduce its moisture content, and make it more suitable for market. The unit has a capacity of 4 tons per hour (dry basis), and has operated in a satisfactory manner.

Briquette Plant.—George Lancaster, superintendent. This plant was built and put into operation in 1954. It is adjacent to the preparation plant, and a full description of its operation is included in the 1954 Annual Report.

The plant was idle throughout most of 1960 due to lack of markets for briquettes. Only 833 tons of briquettes was produced.

Columbia Iron Mining Company

Head office, 120 Montgomery Street, San Francisco, Calif. This company, a wholly owned subsidiary company of the United States Steel Corporation, obtained an option in May, 1960, to explore and investigate all the coal properties of The Crow's Nest Pass Coal Company Limited with a view to purchasing all or part of the property if a sufficient quantity of suitable coal was found. The option covers a period of four years, and includes an intensive exploration programme. The field office was set up at the coal company's head office at Fernie.

Most of the field work during 1960 was done on the mountain known as the " Morrisey Ridge," located between Coal Creek and Morrisey Creek, south of Fernie. Four crews totalling thirty-two men were employed, engaged in geological mapping, trenching fifteen subsidiary ridges, and driving twelve adit tunnels with a total of 627 feet of drifting, 102 feet of raising, and 34 feet of crosscutting. A total of 1,934 feet of diamond drilling was done. Ten samples, each of 4 tons, were taken from the adits and shipped to the United States for washability and coking tests. Approximately 20 miles of tractor-roads was constructed for access to the property and to service the adits and drill-sites. Most of the operations ceased on October 1st due to winter conditions, but the diamond drilling was continued until November 24th. The area was reflown late in the summer for aerial photography, and a topographic map (scale, 1 inch=2,000 feet) is being prepared of the entire coal basin to assist in the field work in 1961. The field work was under the direction of James A. Noble, Pasadena, Calif., and W. R. Still, Prescott, Ariz.

Coleman Collieries Limited

(49° 114° N.W.) D. B. Young, general manager, Coleman, Alta.; John C. Shearer, strip-mine manager. The coal-mining activities of this company in the East Kootenay District are confined to a large stripping operation on the interprovincial boundary on Tent Mountain, near Corbin. Most of the operation is on the Alberta side, but large quantities of coal have been produced from the British Columbia side during the past nine years. Access to the property is by means of a private road leading from the No. 3 highway at Crowsnest Lake. The road is on the Alberta side, and all the production from the mine is taken to the company's preparation plant at Coleman, Alta.

The activities in British Columbia at present are confined to an open pit known as the No. 2. The pit is at an elevation of 7,200 feet and has been in operation since 1954. The coal is in a synclinal basin, and is over 100 feet thick in parts. The overburden has been removed in past working, and activities are now confined to the removal of coal by power-shovel. The operations on the British Columbia side during 1960 were considerably restricted due to shortage of markets for the coal and were further reduced because most of the activity was directed to a new pit which has been started on the Alberta side. Conditions in general were found to be satisfactory during the course of inspections.

NORTHERN INSPECTION DISTRICT

By D. Smith, except as noted.

The coal mines of the Northern District produced a total of 7,710 tons of coal in 1960. The output is sold entirely on the domestic market, which limits all operations to seasonal work only. Alberta coal is now being landed in Fort St. John by rail and is underselling that produced at Hudson Hope.

No accidents or dangerous occurrences were reported from the mines of this district during 1960.

TELKWA (54° 127° N.E.)

Bulkley Valley Collieries Limited

Company office, Telkwa. F. M. Dockrill, president; F. Bond and L. Gething, firebosses. This property is on Goat Creek, a tributary of Telkwa River, about 7 miles southeast of Telkwa. Total production in 1960 was 5,417 tons. The mine closed at the end of March and operations were resumed in September. An average crew of sixteen 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.

PEACE RIVER (56° 122° S.E.)

King Gething Mines

Q. F. (King) Gething, operator and fireboss. This property is on Lot 1039, 12 miles by road from Hudson Hope. Total production for 1960 was 2,144 tons. A crew of six men was employed. Conditions at the working-faces were found to be satisfactory in the course of inspections, and no methane was detected. No accidents were reported.

Reschke Coal Ltd.

Company office, Fort St. John. E. B. Summer, operator and fireboss (permit). This property is 23 miles by road from Hudson Hope and is about 1 mile north of the Peace River at an elevation of 2,600 feet. Operations have been less than seasonal, and only coal for local purposes has been obtained. Total production was 149 tons. Conditions were found to be satisfactory. No accidents were reported.

BOWRON RIVER (53° 121° N.W.)*

Tanar Gold Mines Limited

Company office, 285 Seventeenth Street, West Vancouver. A. D. Ross, president. Capital: 3,000,000 shares, 50 cents par value. This private company concluded an option agreement with A. J. Garraway and A. D. McIsaac to undertake exploration work in the area covered by Coal Licence No. 148 on Lot 9593 and part of Lot 9592 on the Bowron River, 30 miles due east of Prince George.

This property is in the Bowron River coalfield, which comprises Tertiary coal-bearing sediments underlying the Bowron River valley and forming a belt 1½ to 2 miles wide and about 7 miles long. The valley bottom is covered by heavy overburden, so that outcrops are restricted to the river banks. The coal measures in general strike about north 40 degrees west and dip northeast at 20 to 60 degrees. The surrounding rocks are largely volcanic. Intermittent previous exploration work has been done, mainly on seams outcropping on the west bank of the river on Lot 9593; the Bowron Coal Company did some work from 1946 to 1950, and this was continued by Central Industries from 1952 to 1954. A summary of this work is

* By A. R. C. James.

given in the 1954 Annual Report, and work done at the end of 1954 is described in the 1955 Annual Report. The property has been inactive since the end of 1954, but about two years ago A. J. Garraway, formerly manager of the property, was prospecting in the area and reports he found indications of radioactivity in the strata on the river bank 30 feet south of the main showings and also in the cuttings from the churn-drill holes drilled in 1954. According to Mr. Garraway, the presence of thucolite, a carbonaceous mineral containing uranium oxide, was identified in a sample of shale sent to Ottawa for examination.

The present company began work on July 11th and continued until November 15th. The old mine camp was rehabilitated. A 10- by 8-foot prospect shaft was sunk in the vicinity of Mine Creek, about half a mile northwest of the main showings on the river bank. It was intended to sink the shaft 80 feet—through approximately 50 feet of overburden and about 30 feet into the coal measures. However, when work was terminated, the shaft had only been sunk 30 feet. A crew of five men was employed under the supervision of A. J. Garraway.

[References: *Minister of Mines, B.C.,* Ann. Repts., 1948, pp. 233–240; 1954, p. 247; 1955, p. 162.]

Inspection of Electrical Equipment and Installations at Mines, Quarries, and Well Drilling Rigs

By L. Wardman, Senior Electrical Inspector

ELECTRIC POWER

In 1960 electric power was used by thirty mining companies in operations at thirty-five lode mines and three collieries. Twenty-five metallurgical mills and two coal-preparation plants were in operation during the year. No placer mine used electric power during 1960. Electric power was used at twenty-three structural-material and industrial-mineral mines and quarries. Fifty-two drilling rigs using electric power drilled on 179 well locations. Eighty-four wells were completed either as oil or gas wells, sixty-six were abandoned, and twenty-nine were drilling at the end of the year.

Lode-metal Mines

In 1960 three lode-metal mines did not operate, and one ceased using electricity. Three mines were reopened.

The kilovolt-ampere generating capacity of mining-company-owned plants which operated in 1960 and the type of prime mover is given below:—

Prime Mover	Generator Kva. Capacity
Diesel engines	11,632
Water-wheels	10,460
Steam turbines	1,800
Total	23,892

The electric power produced during 1960 was approximately 47,442,134 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 226,544,194 kilowatt-hours. The total amount of power consumed for mining and concentrating at lode mines was 273,986,328 kilowatt-hours. A general breakdown of the connected electrical load was as follows:—

Equipment	Horsepower
Hoists (incline and shaft)	6,152
Hoists (scrapers)	5,750
Fans (mine ventilating)	3,902
Pumps (mine unwatering)	6,657
Rectifiers and M.G. sets	7,142
Air compressors (supplying mining equipment)	16,546
Crushing	8,881
Sink-float	1,750
Grinding	16,234
Concentrating	12,109
Pumps	300
Workshops	2,106
Miscellaneous	6,359
Total	93,888

In addition to electrically powered equipment, there was approximately 6,250 horsepower of prime movers driving direct-connected or belt-connected equipment as tabulated below:—

Prime Mover	Horsepower
Diesel engines	4,765
Water-wheels	1,450
Gasoline engines	35
Total	6,250

On the surface and the underground haulage systems there were in use 103 battery locomotives, eighty-seven trolley locomotives, and seventeen diesel locomotives.

Structural-material and Industrial-mineral Mines and Quarries

Electric power was used at twenty-three structural-material and industrial-mineral mines and quarries. Electric power was produced at several of these properties, but for the others it was purchased. The capacity of the company-owned plants was approximately 2,700 kilovolt-amperes.

Approximately 11,204,200 kilowatt-hours of power was generated and 4,626,680 kilowatt-hours was purchased, making a total of 15,830,880 kilowatt-hours of power consumed.

The distribution of the connected load was approximately as follows:—

Equipment	Horsepower
Incline hoists	256
Scraper hoists	125
Fans and dust collecting	447
Pumps	883
Rectifiers and M.G. sets	37
Air compressors	700
Electric drills and electric shovels	210
Drying	190
Crushing	4,146
Conveyors	2,820
Screens	1,038
Milling	822
Workshops	456
Miscellaneous	2,183
Total	14,313

At these properties there was also direct-driven equipment totalling 6,597 horsepower.

One battery locomotive was used on underground haulage.

Coal Mines

The distribution of connected electrical load was as follows:—

Surface—	Horsepower
Compressed air	3,940
Ventilation	555
Hoisting	545
Haulage	15

	Horsepower	
Surface—*Continued*		
Coal washing and screening	2,607	
Pumping	225	
Briquetting	642	
Coke	1,240	
Miscellaneous	613	
Total		10,382
Underground—		
Ventilation	70	
Hoisting	60	
Haulage	60	
Coal-cutters	100	
Borecut	100	
Conveyors	822	
Pumping	350	
Compressed air	200	
Total		1,762
Total for surface and underground		12,144

Two battery locomotives and one diesel locomotive were in use underground.

A total of 20,536,000 kilowatt-hours of power was used for mining and coal-processing.

ELECTRICAL INSTALLATIONS

LODE MINES

CARIBOO

Wells-Barkerville (53° 121° S.W.)

Aurum (The Cariboo Gold Quartz Mining Company Limited).—A dual fan driven by two 3.9-horsepower motors was installed on the 3000 level to ventilate the development face. On the main haulage level a fan driven by a 20-horsepower motor was installed to boost the mine ventilation.

LILLOOET

Bridge River (50° 122° N.W.)

Bralorne Pioneer Mines Limited At the Bralorne mine a fan driven by a 150-horsepower 2,300-volt motor was installed at the top of the new vent raise. This fan circulates about 80,000 feet of air per minute. Provision was made for the installation of a second fan when needed. Sand-fill equipment requiring 150 horsepower was installed in the mine for back-filling the stopes. A new return call system was installed in the Crown shaft.

MERRITT

Craigmont (Birkett Creek Mine Operators Ltd.) (50° 120° S.W.) A 2,300-volt single-phase power-line was built between the transformer station at the 3500 level and Jackson Lake, a distance of 8,000 feet, to supply a 7.5-horsepower pump motor. A 10-kva. single-phase 2,300–230-volt transformer was installed to step down the voltage. A 40-kva.

diesel-driven generator was installed at the 2400 level for a temporary power-supply. Two ventilation fans, each driven by a 20-horsepower motor, were moved to this level.

Camp McKinney

Cariboo-Amelia (H. & W. Mining Co. Ltd.).—(49° 119° S.E.) Underground, two 20,000-watt heaters, each equipped with a 2.12-horsepower fan, have been installed and also a battery-charger.

Aspen Creek

H.B. (The Consolidated Mining and Smelting Company of Canada, Limited).—(49° 117° S.E.) In the mill, six No. 15 Denver flotation cells driven by three 3-horsepower motors were replaced with six No. 18 Denver cells driven by three 5-horsepower motors. Two No. 24 zinc cleaner cells driven by a 10-horsepower motor were also installed.

Iron Mountain

Jersey and Dodger (Canadian Exploration Limited).—(49° 117° S.E.) Major electrical work consisted of moving substation No. 408 to a new location, replacing substation No. 415 in service and dismantling substation No. 407. Several power-cables were moved to new locations.

Nelway

Reeves MacDonald Mines Limited

(49° 117° S.E.) The installation of the 200-horsepower No. 3 hoist was completed. A Hewettic rectifier was installed to supply power to the trolley locomotives at the O'Donnell end of the 1900 level haulage adit. A three-conductor No. 8 A.W.G. 3,000-volt armoured cable conducts 2,300-volt power from the O'Donnell power-line on the surface to a 2,300–266-volt transformer on the 1900 level to supply the rectifier. Three zinc cells driven by 7.5-horsepower motors, a 12-foot zinc-conditioner, and a zinc-concentrate pump were installed in the mill.

North Kootenay Lake

Riondel (49° 116° N.W.)

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

A 30-kilowatt 550-volt 3-phase heater was installed in the carpenters' shop, and a similar one was installed in the mill. Two pumps driven by 20-horsepower motors were installed on the surface for pumping back-fill into the mine. In the mine the two existing feeders, feeding 2A level from the surface, were paralleled and the 2A level load centre was revamped. On No. 5 level a Jeffery Aerodyne fan driven by a 40-horsepower motor was installed. On No. 8 level two 4GT 700-imperial-gallons-per-minute pumps driven by two 300-horsepower 550-volt motors were installed.

Kimberley

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

(49° 115° N.W.) A programme of improvement of the electrical installations at the concentrator has been put into effect. In the mill substation a 3,750-5,000-kva. 3-phase 66,000–550-volt transformer was installed. The old pole, bus-supporting structure was removed, and a new structure was built carrying new 66,000- and 550-volt buses. Other equipment installed consisted of 66,000-volt lightning-arresters, protective relays, metering panel, and a four-unit 1,200-ampere A.C.B. panel.

A 4-0 A.W.G. pyrotenax cable was installed from the mill substation to the tin plant twenty-six-unit control centre. In the plant the following motors were installed: Sixteen 15-horsepower flotation-machine motors, four 40-horsepower pump motors, two 25-horsepower pump motors, one 20-horsepower pump motor, one 20-horsepower conditioner motor, and one 1-horsepower fan motor.

For lime distribution the following motors were installed: One 10-horsepower pump motor, one 5-horsepower pump motor, one 0.5-horsepower conditioner motor, one motor control centre for two 0.5-horsepower and one 0.33 horsepower lime-slaking machine motors.

The 200-horsepower compressor motor switch was replaced with a line start switch.

In the mine two pumps driven by 100-horsepower motors were installed on the 2500 level at No. 1 shaft. A.c. and d.c. power-cables and hoist signal-cables have been installed in the new section of No. 1 shaft between the 2850 level and the 2500 level.

WINDERMERE

Toby Creek (50° 116° S.E.)

Mineral King and Paradise (Sheep Creek Mines Limited).—No additions were made to the electrical installations at the Mineral King. The Paradise mine was reopened and a 5-kva. lighting plant was installed for lighting the dry, cook-house, and bunk-house. A 5-kva. generator was installed to charge the battery of the one-battery locomotive. A compressor driven by a 120-horsepower diesel supplies air for mining.

REVELSTOKE

Mastodon (Mastodon Zinc Mines Limited).—(51° 118° S.E.) This property was reopened and operated until October 15th. On June 10th the 750-kva. hydro-electric power plant was damaged beyond economic repair. It was replaced by June 15th with a 500-kva. diesel-electric plant.

SKAGIT RIVER

A.M. (Canam Copper Company Ltd.).—(49° 121° S.E.) A locomotive-battery charging unit was installed for use during development work.

HOPE

Pride of Emory (Giant Nickel Mines Limited)

(49° 121° S.W.) At the 3550 level portal two 25-kva. 2,300–440-volt transformers were installed. Three 37.5-kva. 2,300–440-volt transformers were installed on the 3815 level to supply two scraper hoists and a pump motor. Five 20-kw. 440-volt heaters were installed in the mill, crusher, and concentrator. In the concentrator a 10-kva. 440–230/115-volt transformer was replaced with a 58-kva. dry type of the same voltage.

HOWE SOUND

Britannia (Howe Sound Company (Britannia Division))

(49° 123° N.W.) At the Victoria shaft three 33.33-kva. transformers and a 25-kw. 250-volt d.c. generator were installed. In the 4100 development drift, 3,700 feet of trolley wire was installed. A piece of 6,900-volt cable was installed in the Victoria shaft to extend the 6,900-volt cable from the

2200 level to the 4100 level. Six 200-kva. and two 150-kva. transformers were taken out of service. Three of them were replaced with three 75-kva. transformers for the Victoria hoist.

STRUCTURAL-MATERIAL AND INDUSTRIAL-MINERAL MINES AND QUARRIES

McDame

Cassiar Asbestos Corporation Limited (59° 129° S.W.) In 1960, 280.75 horsepower was added to the connected load in the mill, as follows: A fan driven by a 75-horsepower motor was added to the Wheelabrator system. Four fans requiring 125 horsepower were added to the aspirating system. Conveyors and feeders requiring 33 horsepower and also baggers, agitators, pumps, screen-cleaners, and miscellaneous equipment requiring 47.75 horsepower were installed.

A new dental clinic, recreation hall, and several houses were built. This added 224 horsepower to the load on the camp distribution system.

Kilgard

Clayburn-Harbison Ltd.—(49° 122° S.E.) A new adit to the fireclay mine was opened and a ventilation fan and scraper hoist were installed. The fan is driven by a 5-horsepower motor and the scraper by a 10-horsepower motor.

Port Mellon

Hillside Sand and Gravel Limited.—(49° 123° N.E.) A crusher driven by a 60-horsepower motor and three secondary conveyors were installed. The conveyors are driven by a 7.5-horsepower motor, a 5-horsepower motor, and a 3-horsepower motor respectively.

Cassidy

Cassidy Gravel Pit (49° 123° S.W.) Equipment installed during November and December consisted of three 37.5-kva. transformers, a washer requiring 10 horsepower, conveyors requiring 15 horsepower, screens requiring 5 horsepower, crushers requiring 40 horsepower, and pumps requiring 8 horsepower.

COAL MINES

Comox

Tsable River Mine (49° 124° N.W.) This mine was operated by Canadian Collieries Resources Limited until the end of April, then it was leased to Comox Mining Company Limited. The new company did not lease the washery plant at Union Bay, but instead it installed a screening plant at the mine consisting of the following: A primary crusher driven by a 30-horsepower motor; a secondary crusher driven by a 5-horsepower motor; a picking-belt, crushed-coal belt, and elevator, each driven by a 5-horsepower motor; and a screen driven by a 6-horsepower motor.

EAST KOOTENAY

Michel Colliery (The Crow's Nest Pass Coal Company Limited)

(49° 114° S.W.) A second set of gang-operated switches and fuses was installed in the main substation on the 66,000-volt primary, which permits the four 3-phase transformers, originally controlled collectively, to be isolated in pairs. Two of these transformers supply the compressor load and the other two supply the plant and underground load. A 2,300-volt power-line 750 feet long was run to the No. 10 mine to supply power for a compressor, conveyor, and a fan. Three 25-kva. transformers step the power down from 2,300 volts to 550 volts for the motors.

A new breeze-drying plant was built, and in conjunction with this a new switchroom was built to take care of the motors in the drying plant and coke-bins. The switchroom houses a 200-ampere entrance switch, gutter, and twelve magnetic starters. Eight 2-horsepower, two 5-horsepower, one 7.5-horsepower, and one 10-horsepower motors are controlled from this switchroom.

A new switchroom was built in the slack-bin to house a 400-ampere entrance switch, gutter, and five magnetic starters. One 25-horsepower, one 20-horsepower, one 15-horsepower, and two 5-horsepower motors are controlled from this switchroom.

Lode-metal Deposits Referred to in the 1960 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 1960:—

Northern British Columbia.—Atlin, Liard.

Central British Columbia.—Cariboo, Clinton, Omineca.

Coast and Islands.—Alberni, Nanaimo, New Westminster, Skeena, Vancouver, Victoria.

South Central British Columbia.—Greenwood, Kamloops, Lillooet, Nicola, Osoyoos, Similkameen, Vernon.

Southeastern British Columbia.—Fort Steele, Golden, Nelson, Revelstoke, Slocan, Trail Creek.

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Uranium	Chromium	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Cobalt	Page
Northern British Columbia																					
Copco	Liard	59° 129° S.W.	2	1																	6, A51
Windy and Craggy	Atlin	59° 137° N.W.			3															3	6
Central British Columbia																					
Aurum, Cariboo Gold Quartz	Cariboo	53° 121° S.W.	1	2																	15, A51
CAFB	Omineca	53° 127° S.E.														3					14
Cronin Babine	Omineca	54° 126° N.W.	2	1		1	1		2												13, A51
Jim	Cariboo	52° 121° N.E.	3																		19
Lustdust	Omineca	55° 125° N.E.	3	3			3														14
Porcupine Mountain	Clinton	51° 122° S.E.	3																		20
Scarn	Cariboo	53° 121° S.W.		3																	17
Silver Standard	Omineca	55° 127° S.W.	2	1	2	1	1														13, A51
Snell Group	Omineca	55° 125° N.E.																	3		14
Coast and Islands																					
A.M.	N. West'r.	49° 121° S.E.			3																87
Alice	Skeena	55° 129° S.E.														3					10
Apex, Morning	Alberni	49° 125° S.E.	3																		110
Berton	Alberni	49° 125° S.W.	3																		106
Big Interior	Alberni	49° 125° S.W.			3																110
Blue Grouse	Victoria	48° 124° N.E.		2	1																115, A52
Britannia	Vancouver	49° 123° N.E.	2	2	1	2	1		2												89, A52
Bugaboo Creek Iron	Victoria	48° 124° N.E.								3											116
Colossus	Vancouver	50° 125° N.E.			3																90
Domineer	Nanaimo	49° 125° N.W.			3																111
Double Ed	Skeena	55° 129° S.W.			3																10
East	Skeena	56° 130° S.E.	3	3																	7
Empire Development (Merry Widow, Kingfisher)	Nanaimo	50° 127° S.E.								1											89, A51
F.L.	Nanaimo	50° 126° S.W.								3											103
Gold Coin	N. West'r.	49° 121° S.E.			3	3	3														87
Harriet Harbour	Skeena	52° 131° S.E.								3											11
Hualpai	Nanaimo	49° 126° N.W.								3											106
Iron Mike	Nanaimo	50° 125° S.W.								3											104
Iron Mountain	Skeena	54° 128° S.W.								3											13
Kennedy Lake Iron	Alberni	49° 125° S.E.								3											108
King Solomon	Victoria	48° 123° N.W.			3																116

Shipping Mines.—(1) Metal contributed at least 10 per cent of gross value of the shipment. (2) Metal contributed less than 10 per cent of gross value of the shipment. Production for 1960 is listed in Table XV.

Non-shipping Mines.—(3) Metal present, indicated by assay or mineralogical determination.

LODE-METAL DEPOSITS REFERRED TO IN THE 1960 ANNUAL REPORT—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Uranium	Chromium	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Cobalt	Page
Coast and Islands— Continued																					
Nadira	Victoria	48° 124° N.W.			1																112, A52
Nimpkish, Klaanch	Nanaimo	50° 126° S.W.								1											101, A51
Old Sport	Nanaimo	50° 127° S.E.			3																100
Packsack	Skeena	53° 129° N.E.			3	3	3														12
Pride of Emory	N. West'r	49° 121° S.W.			1										2						87, A52
Roundy Creek	Skeena	55° 129° S.E.														3					10
Scotia	Skeena	54° 129° S.W.					3														12
Shag Rock	Skeena	54° 132° S.W.									3										11
Silbak Premier	Skeena	56° 130° S.E.	1	1	2	2	2														8, A52
Sunloch, Gabbro	Victoria	48° 124° S.E.			3																116
Surprise Group	Skeena	56° 129° S.W.				3	3														7
Telkwa	Skeena	54° 128° N.E.														3					13
Texada (Prescott, Paxton, Yellow Kid, Yellow Jacket)	Vancouver	49° 124° N.W.	2	2	1					1											89, A52
Todd Group	Skeena	56° 129° S.W.			3																7
Tofino	Alberni	49° 125° S.W.	1	2																	107, A51
Wolfe	Skeena	55° 129° N.W.		3																	8
You	Alberni	49° 125° S.W.	3																		106
South Central British Columbia																					
Aberdeen	Nicola	50° 120° S.W.		2	1																41, A53
Ace	Lillooet	50° 122° N.W.	3																		20
Askom	Kamloops	50° 121° N.W.			3																24
Beaver	Kamloops	50° 120° N.W.			3																25
Bethlehem	Kamloops	50° 120° S.W.			3																26
Betty Lou, Lou	Kamloops	50° 120° S.W.			3					3											41
Bounty Fraction	Greenw'd	49° 119° S.E.	2	1		2	1														63, A52
Bralorne	Lillooet	50° 122° N.W.	1	2																	21, A53
Bridge River	Lillooet	50° 122° N.W.	3																		23
Cariboo-Amelia	Greenw'd	49° 119° S.E.	1	2		2	2														62, A52
Copper Mountain	Similk'n	49° 120° S.W.	1	2	1																57, A53
Copper Nos. 1 to 4	Lillooet	51° 122° S.W.			3																19
Craigmont	Nicola	50° 120° S.W.			3					3											40
D.R.G.	Kamloops	50° 120° N.W.			3																41
Deep Gulch	Similk'n	49° 120° S.W.			3																55
F.H.	Similk'n	49° 120° N.W.			3																57
Fairview	Osoyoos	49° 119° S.W.															1				61, A53
French	Similk'n	49° 120° S.E.	1	2																	57, A53
Friday Creek	Similk'n	49° 120° S.W.			3																56
Gift	Kamloops	50° 120° N.E.								1											A53
Golconda	Osoyoos	49° 119° S.W.	2	2	1	2															61, A53
Golden Contact	Lillooet	50° 122° N.E.	3																		24
Highland-Bell	Greenw'd	49° 119° S.E.	2	1		2	1		2												62, A53
Horn Silver	Osoyoos	49° 119° S.W.	3	3																	58
Hurley River	Lillooet	50° 122° N.W.	3																		24
Jericho	Kamloops	50° 120° S.W.			3																26
Kim	Kamloops	50° 120° N.W.			3																41
Krain Copper	Kamloops	50° 121° N.E.			3																25
Law's Camp	Similk'n	49° 120° N.W.	3		3		3														53
Lodge	Kamloops	50° 120° N.W.			3																26
Morning Star	Osoyoos	49° 119° S.W.	3																		62
Mother Lode	Greenw'd	49° 118° S.W.	1	2	1																64, A53
Old England	Greenw'd	49° 119° S.E.	3	3																	62
P.C.M., Cap, Domino, Freda, Hank	Nicola	50° 120° S.W.			3					3											41
Phoenix	Greenw'd	49° 118° S.W.	1	2	1																65, A53
Pioneer	Lillooet	50° 122° N.W.	1	2																	21, A53
Providence	Greenw'd	49° 118° S.W.	1	1		2	2														A53
Rex 86	Vernon	49° 119° N.E.	1	2		2	2														A53
Rick	Similk'n	49° 120° S.E.			3																55
Silver Scandie	Greenw'd	49° 119° S.E.		1		2	1														63, A53
Stemwinder	Greenw'd	49° 118° S.W.	1	2	1																66, A52

LODE-METAL DEPOSITS REFERRED TO IN THE 1960 ANNUAL REPORT—*Continued*

Property	Mining Division	Latitude and Longitude	Gold	Silver	Copper	Lead	Zinc	Tungsten	Cadmium	Iron	Manganese	Uranium	Chromium	Tin	Nickel	Molybdenum	Silica	Sulphur	Mercury	Cobalt	Page
South Central British Columbia—Continued																					
Susie	Nicola	49° 119° S.W.	1	1		2	2														A53
Trojan	Kamloops	50° 120° N.W.			3																25
West Coast Resources	Greenw'd	49° 118° S.W.			3																63
Southeastern British Columbia																					
Anna	Slocan	49° 117° N.E.		1		2	2														76, A54
Argo	Revelstoke	50° 118° S.E.	3																		85
Banker	Slocan	49° 116° N.W.		1		2	2														A54
Bannockburn	Revelstoke	50° 117° N.E.		3		3	3														78
Big Mac	Nelson	49° 117° S.E.		3		3	3														66
Black Fox	Slocan	49° 117° N.E.		3		3	3														75
Black Warrior, Elsmere	Revelstoke	50° 117° N.E.		3		3	3														77
Bluebell	Slocan	49° 116° N.W.		2	2	1	1		2												72, A55
Bosun	Slocan	49° 117° N.E.		1		1	1														A55
Boy	Nelson	49° 117° S.E.				3	3														69
Crow Fledgling	Slocan	49° 116° N.W.		2		1	1		2												74, A55
Double "B"	Nelson	49° 117° S.E.		3		3	3									3					69
Duncan	Slocan	50° 116° S.W.				3	3														79
Empire	Slocan	49° 117° N.E.	2	1		1	1														75, A55
Euphrates	Nelson	49° 117° S.E.	1	1		1	2														A54
Gold Belt	Nelson	49° 117° S.E.	1	2		2	2														A54
Goodenough	Nelson	49° 117° S.E.	1	2		1	1														67, A54
H.B.	Nelson	49° 117° S.E.		2		1	1		2												68, A54
Highlander	Slocan	49° 116° N.W.	2	2		1	1		2												73, A55
Hummingbird	Nelson	49° 117° S.E.		1		1	1														67, A54
I.X.L.	Trail Cr'k	49° 117° S.W.	1	2																	A55
Jersey	Nelson	49° 117° S.E.		2		1	1		2												69, A54
Kootenay Belle	Nelson	49° 117° N.E.	1	2		1	1														A54
Kootenay Florence, Lakeshore	Slocan	49° 116° N.W.		2		1	1														74, A55
Krao	Slocan	49° 116° N.W.		1		1	1		2												74, A55
Laura M.	Slocan	49° 116° N.W.		2		1	1		2												A55
Lone Bachelor	Slocan	49° 117° N.E.	2	1		1	1		2												76, A55
Mag	Slocan	50° 116° S.W.		3		3	3														82
Mastodon	Revelstoke	51° 118° S.E.	2	2		2	1		2												86, A54
Millie Mack	Slocan	49° 117° N.W.	1	1		1	2														77, A55
Mineral King	Golden	50° 116° S.E.		2	2	1	1		2												83, A54
New Arlington	Nelson	49° 117° S.E.	1	2		1	1														A54
Nugget	Nelson	49° 117° S.E.	3																		68
Ottawa	Slocan	49° 117° N.E.		1		2	2														77, A55
Paradise	Golden	50° 116° S.E.		3		3	3														84
Ptarmigan	Golden	50° 116° N.E.		3	3																85
Reeves MacDonald	Nelson	49° 117° S.W.		2		1	1		2												71, A54
Ruby	Nelson	49° 117° S.E.		3		3	3														68
Ruth Hope	Slocan	49° 117° N.E.		1		1	2														A55
St. Andrew	Golden	50° 116° S.W.			3																85
Scranton	Slocan	49° 117° N.E.	3	3		3	3														74
Shirley	Slocan	49° 116° N.W.		1		1	2														A55
Silver Mountain	Slocan	49° 117° N.E.		1		1	1		2												A55
Silversmith, etc.	Slocan	49° 117° N.E.		3		3	3														76
Sullivan	Fort Steele	49° 115° N.W.	2	2	2	1	1														82, A54
Texas, Fourth of July	Slocan	50° 117° S.E.		3		3	3														75
Tungsten King	Nelson	49° 117° S.E.				3	3														70
Utica	Slocan	49° 117° N.E.	2	1		1	1		2												75, A55
Velvet	Trail Cr'k	49° 117° S.W.	1	2	1																66, A55
Victor	Slocan	49° 117° N.E.	2	1		1	1		2												76, A55
W.D.	Trail Cr'k	49° 117° S.W.	1	2		2	2														66, A55
Western Mines	Slocan	49° 116° N.W.		2		1	1		2												74, A55
White	Nelson	49° 117° S.E.	1	2		2	2														67, A54
Wigwam	Revelstoke	51° 118° S.E.		3		3	3														86
Wonderful	Slocan	49° 117° N.E.		1		1	2														A55
Yale	Slocan	49° 116° N.W.		1		1	1		2												74, A55
Yankee Dundee	Nelson	49° 117° S.E.	3																		67

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