BRITISH COLUMBIA DEPARTMENT OF MINES

HON. R. C. MACDONALD, *Minister* JOHN F. WALKER, *Deputy Minister*

A REPRINT OF THE
BRIEF ON MINING

A REVIEW OF MINING AND MINERAL RESOURCES IN BRITISH COLUMBIA

prepared for the

SECOND RESOURCES CONFERENCE
VICTORIA, B.C., FEBRUARY, 1949

by

HARTLEY SARGENT
Chief Mining Engineer
British Columbia Department of Mines

VICTORIA, B.C.:
Printed by DON MCDIARMID, Printer to the King's Most Excellent Majesty.
1949.

CONTENTS

TABLES

GENERALIZED GEOLOGY

LEGEND

Tertiary	Volcanic and sedimentary rocks, coal.
Cretaceous	Mainly sedimentary rocks, coal.
Mesozoic and Tertiary	Batholithic intrusions.
Cambrian to Jurassic	Sedimentary rocks.
Carboniferous to Jurassic	Sedimentary and volcanic rocks.
Carboniferous or pre-Carboniferous	Schist, gneiss, and quartzite.
Precambrian	Mainly sedimentary rocks.

(Geology after compilation by H. C. Gunning)

MINERAL PRODUCTION

PRINCIPAL LODE METALS 1895 TO 1947

COPPER GOLD SILVER LEAD ZINC

LARGE CIRCLE—PRODUCTION MORE THAN 1,000,000 TONS OF ORE.

SMALL CIRCLE—PRODUCTION BETWEEN 90,000 AND 1,000,000 TONS OF ORE.

METALS CONTRIBUTING 10 PER CENT OR MORE OF THE GROSS VALUE SHOWN BY SECTORS OF CIRCLE.

I.E. SILVER

OTHER LODE METALS

T TUNGSTEN M MERCURY — TONNAGE NOT INDICATED

COAL

● LARGE CIRCLE—PRODUCTION MORE THAN 15,000,000 TONS

● SMALL CIRCLE—PRODUCTION 2,000,000 TO 5,000,000 TONS

▲ GYPSUM; ▲ FIREBRICK; ▲ CEMENT; L S, LIMESTONE
TONNAGE NOT INDICATED

TRAIL SMELTER

DEPARTMENT OF MINES

Hon. R. C. MacDonald, *Minister.*

John F. Walker, *Deputy Minister.*

GENERALIZED GEOLOGY AND MINERAL PRODUCTION OF BRITISH COLUMBIA

SCALE 10 0 25 50 100 150 200 MILES

Prepared for the Jubilee of The Canadian Institute of Mining and Metallurgy, Annual General Meeting, held in Vancouver, British Columbia, April, 1948.

With the compliments of The Hon. R.C. MacDonald.

MINING

British Columbia
Production and Employment Records
with discussion of mineral
resources and future possibilities

Prepared for the Second Resources
Conference, Victoria, B.C., February 1949

by
Hartley Sargent.

Abstract

Use of the mineral resources of British Columbia began about 1836 with the recovery of coal from the beach at Suquash on the northern part of the east coast of Vancouver Island. Coal production began at Nanaimo in 1852. Placer gold production began a few years later. By 1895 lode mining was established. Production of brick, stone, and other building materials began early in the history of the province. The products of the mineral industry have continually become more diversified. The first year of recorded production and the total production to the end of 1947, for the principal items or groups of items are:

Item	First Production	Quantity to end of 1947	Value to end of 1947
Placer gold	1858	5,122,848 oz.	$92,973,897
Lode gold	1893	12,595,457 oz.	345,745,249
Silver	1887	319,313,786 oz.	169,782,205
Copper	1894	2,466,635,752 lb.	349,005,172
Lead	1887	9,325,515,538 lb.	423,411,969
Zinc	1909	6,254,896,754 lb.	292,553,500
Coal	1836	110,000,000 T.	444,566,745
Miscellaneous Metals & Minerals	before 1896		56,595,868
Structural Materials	before 1896		107,859,244
Total Value			$2,282,493,849

Metals have been produced principally for export, structural materials principally for use in British Columbia, coal partly for use in deep sea ships, partly for use by railways and in other provinces, but largely for use in British Columbia. In recent years, for industrial and domestic use in British Columbia, sales of Alberta coal have exceeded sales of British Columbia coal.

Mineral resources are concealed below the earth's crust. Discovery and delimitation of mineral resources is so expensive and requires so long that total resources cannot be estimated. Prices received for the products, mining, and metallurgical techniques, and the prices which the mining industry must pay for labour and materials determine the lower limit of grade of mineral material that can be mined. For this reason mineralization that might be considered valuable at one time may be regarded as waste at another. This fact further complicates estimation of mineral resources. Sound estimates can only be of a minimum quantity of specified grade or range of grade.

Accumulated data indicates large reserves of coal, iron ore deposits and iron sulphide tailings dumps sufficient for a modest iron and steel industry, and large reserves of limestone. Reserves of precious and base metals, although large, would not sustain the industry at its present scale of operation for more than a few years. However, the expectation is that additional ore will continue to be found. Materials used in the manufacturing of clay products and cement are expected to be adequate for an expanding industry. Diatomite, clays of superior quality and certain other resources are as yet unexploited or exploited on an extremely modest scale.

Since 1930 those employed directly in the mining industry have averaged about 14,000 in number. With increasing population it is expected that employment in the production of coal and structural materials would increase, and that production of limestone and industrial minerals would increase. Should an iron and steel industry be established to supply British Columbia requirements from British Columbia iron resources, production of ore, coal, and limestone, and the operation of the iron and steel making plants would require substantial numbers of employees. Use of British Columbia metals in secondary industries within the province would also provide additional employment.

Introduction

Mineral production in British Columbia and interest in mineral resources go back over a great many years. A report entitled "The Mineral Wealth of British Columbia," consisting of 163 printed pages, written by George M. Dawson and published by the Geological Survey of Canada in 1889, recorded much of the mining history to that time, summarized much of what was then known about the mineral resources of the Province and predicted the rise of a very important mineral industry.

In order to provide even brief coverage of the more important facts now available we have summarized production statistics in a series of four tables, two of which are keyed to a map of the Province so that the kind and quantity of the mineral production of the principal productive areas may be estimated. The other two tables make it possible to trace the growth of mineral production and give a great deal of detail on the production of 1947 and of the preceding 10 years and somewhat less detail for earlier production. Tables record additional data regarding production and data on employment, principal expenditures by the industry and expenditure per employee. Some of these tables are not discussed in the text.

BRITISH COLUMBIA MINERAL PRODUCTION AT FIVE-YEAR INTERVALS AND TOTAL INCLUDING 1947.

TABLE I

YEAR	GOLD - PLACER		GOLD - LODE (A)		SILVER (B)		COPPER (C)		LEAD (D)		ZINC (E)		COAL (F)		MISCELLANEOUS METALS & MINERALS (G)	STRUCTURAL MATERIALS (G)		TOTAL VALUE FOR YEAR
	Crude Ounces	Value	Fine Ounces	Value	Ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	Long Tons	Value	Value	Clay & Clay Products Value	Lime, rock, etc. Value	
1860	131,090	$ 2,228,543	--	$ --	--	$ --	--	$ --	--	$ --	--	$ --	14,246	$ 56,988	$ --	$ --	$ --	$ 2,285,531
1865	205,365	3,491,205	--	--	--	--	--	--	--	--	--	--	32,819	131,276	--	--	--	3,622,481
1870	78,640	1,336,956	--	--	--	--	--	--	--	--	--	--	29,843	119,372	--	--	--	1,456,328
1875	145,580	2,474,904	--	--	--	--	--	--	--	--	--	--	110,145	330,435	--	--	--	2,804,439
1880	59,640	1,013,827	--	--	--	--	--	--	--	--	--	--	267,595	802,785	--	--	--	1,816,612
1885	41,980	713,738	--	--	--	--	--	--	--	--	--	--	265,596	796,788	--	--	--	1,510,526
1890	29,080	494,435	--	--	70,427	73,948	--	--	Nil	Nil	--	--	678,140	2,034,420	4,500[5]	--	--	2,608,803
1895	28,330	481,683	39,264	785,491	1,496,522	977,229	952,840	47,642	16,475,464	532,235	--	--	939,654	2,818,962	3,800[2]	--	--	5,643,042
1900	75,220	1,278,724	167,153	3,453,381	3,958,175	2,309,200	9,997,080	1,615,289	68,358,621	2,691,887	--	--	F 1,590,177	4,744,530	1,740[3]	--	(250,000	16,344,751
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[4]	F 1,825,832	5,511,861	500[5]	--	1 (800,000	22,461,325
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	F 3,139,235	11,108,335	--	--	(1,450,000	26,377,066
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	F 1,972,580	7,114,178	2,000[6]	211,640	1,359,541	29,447,508
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	3,077,978	F 2,696,774	13,450,169	250.490	622,270	1,554,190	35,543,084
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	F 2,444,298	12,168,905	163,038	548,784	2,131,288	61,492,242
1930	8,955	152,235	160,778	3,323,576	11,289,171	4,307,270	90,421,545	11,738,525	319,199,752	12,535,931	250,287,306	9,010,093	1,887,130	9,435,650	796,145	687,573	3,404,995	55,391,993
1935	30,929	895,058	365,244	12,852,936	9,251,544	5,994,075	38,791,127	3,023,768	344,268,444	10,785,930	256,239,446	7,940,860	1,187,968	5,048,864	1,041,031	212,636	1,026,081	48,821,239
1940	39,067	1,236,928	583,416	22,461,516	12,327,944	4,715,315	77,980,223	7,865,085	485,364,420	16,317,952	310,767,251	10,600,271	1,667,827	7,088,265	2,880,983	519,583	2,015,257	75,701,155
1945	12,589	398,591	175,373	6,751,860	6,157,307	2,893,934	25,852,366	3,244,472	353,497,689	17,674,884	301,737,902	19,431,921	1,518,673	6,454,360	3,092,698	637,680	2,763,549	63,343,949
Total Production including 1947	5,122,848	$92,973,897	12,595,457	$345,745,249	319,313,786	$169,782,205	2,466,635,752	$349,005,172	9,325,515,538	$423,411,969	6,254,896,754	$292,553,500	103,859,798	$444,566,745	$56,595,868	* see footnote 1	$ [1] 107,859,244	$2,282,493,849

Footnotes:
A - Lode gold statistical record begins 1893
B - Silver statistical record begins 1887
C - Copper statistical record begins 1894
D - Lead statistical record begins 1887
E - Zinc - First shipments in 1901. Statistics before 1910 incomplete.
F - Quantity includes coal used in making coke; value includes value of coke; 1900,1905,1910-1925. Re totals - Quantity excludes coal used in making coke 1900 to 1925. Value includes value of coke produced in that period. Since 1925 coal used in making coke is included in quantity and value of coal output.
G - For details re miscellaneous metals, minerals, etc., and re structural materials, in recent years, see Table II.

1 - Total up to 1899 $1,700,000 Includes clay products with all structural materials to 1910.
2 - Total up to 1899 $ 32,900
3 - Iron
4 - Zinc ore - special shipment 9,413 tons
5 - Platinum
6 - Platinum, antimony ore and molybdenite ore also produced.

Coal totals include production from Suquash 1836-1852, 10,000 tons, and from Nanaimo 1852 to 1859, 27,385 tons.

TABLE II

BRITISH COLUMBIA MINE PRODUCTION

		Average per year 1937 - 1946		1947 Production		Production to end of 1947	
		Quantity	Value $	Quantity	Value $	Quantity	Value $
Principal Metals							
Gold, placer	oz.	33,176	1,007,061	6,969	200,585	5,122,848	92,973,897
Gold, lode	oz.	390,846	14,541,653	243,282	8,514,870	12,595,457	345,745,249
Silver	oz.	9,387,809	4,214,426	5,707,691	4,109,538	319,313,786	169,782,205
Copper	lb.	50,155,669	5,440,523	41,783,921	8,519,741	2,466,635,752	349,005,172
Lead	lb.	208,347,892	16,524,698	306,400,709	41,884,977	9,325,515,538	423,411,969
Zinc	lb.	173,902,359	13,455,657	268,450,926	30,147,039	6,254,896,754	292,553,500
Total			55,184,018		93,376,750		1,673,471,992
Fuel							
Coal	long tons	1,637,793	6,960,621	1,717,476	8,587,380	103,859,798(8)	444,566,745(9)
Miscellaneous Metals, Minerals and Non Metallics							
Metals, etc.							
⁂Antimony	lb.	1,541,500	242,369	1,150,463	384,255		
⁂Arsenic(1)	lb.	892,777	27,395				
⁂Bismuth	lb.	175,072	230,416	284,357	560,183		
⁂Cadmium	lb.	668,536	737,892	547,248	941,266		
⁂Mercury(2)	lb.	415,238	1,040,310				
⁂Platinum (1937-43)	oz.	27	785	1	59		
⁂Sulphur	tons	108,281	1,032,501	157,161	1,503,714		
⁂Tin	lb.	432,034	245,481	714,198	517,794		
⁂Tungsten Conc.(3)	lb. WO_3	156,972	119,743	496,023	680,792		
⁂Sundry(4)			131,824				
Total			3,808,716		4,588,063		
Non Metallics							
⁂Barites, Diatomite, Fluorspar and Mica			25,211		52,362		
⁂Fluxes - Limestone, Quartz	tons	53,649	56,333	102,918	174,655		
⁂Gypsum (Products), Gypsite		25,768 (5)	151,958 (6)	67,112	523,298		
⁂Iron Oxides		378	3,907	58	464		
⁂Slate and Rock Granules, Talc	tons	706	11,127	1,156	19,686		
⁂Sodium Carbonate, Magnesium Sulphate	tons	561	10,380	163	1,793		
Total			258,916		772,258		56,595,868(7)
Structural Materials							
Clay Products							
Brick							
Common	No.	4,984,105	87,278	4,318,000	122,660		
Face, Paving Sewer Brick	No.	926,145	34,633	1,232,812	64,849		
Fire Brick, blocks			182,483		389,899		
Fireclay	tons	952	9,991	11,428	9,675		
Structural Tile - Hollow Blocks			42,061		158,276		
Drain-tile, Sewer-pipe	No.	1,254,473	147,542	1,962,583	361,975		
Pottery - Glazed or Unglazed			6,527		3,476		
Bentonite; other Clay Products			4,335		9,332		
Total			514,850		1,120,142		
Other Structural Materials							
Cement		474,405	981,483	863,740	1,896,772		
Lime and Limestone	tons	111,025	321,918	151,671	714,126		
Sand and Gravel			857,671		1,828,919		
Stone - Building, Pulp-stones	tons	4,213	82,081	19,835	119,971		
Rubble, Riprap, Crushed Rock	tons	184,455	151,589	222,044	216,873		
Total			2,394,742		4,776,661		107,859,244
Grand Total			69,121,863		113,221,254		2,282,493,849

Footnotes:
(1) Produced only in 1942 and 1943.
(2) 1940 - 1943.
(3) Principally 1940 - 1943 and 1946.
(4) Indium - 471 oz., $5,887 in 1942: Magnesium - 204,632 lb., $88,184 in 1941 and 1942: Nickel - 114,072 lb., $37,753 in 1937.
(5) Gypsite 1939 - 1941, total 573 tons.
(6) Value of Gypsum products and gypsite.
(7) Includes all items marked ⁂, of these the production up to and including 1936 was valued at $11,433,756.
(8) Excludes in period 1895 - 1925 coal used in making 4,393,265 tons of coke valued at $25,673,600.
(9) Includes total value of coke, 1895-1925, subsequent to 1925 coal production figures include coal used in making coke.

QUANTITIES AND VALUES OF PLACER GOLD, LODE GOLD, SILVER, COPPER, LEAD, AND ZINC, 1895-1947 INCLUSIVE, AND EARLIER PLACER GOLD PRODUCTION AS NOTED

TABLE III

MINING DIVISIONS	ǂ LODE MINING CENTRES	GOLD - PLACER		GOLD - LODE		SILVER		COPPER		LEAD		ZINC		Division Total
		Ounces	Value $	Ounces	Value $	Ounces	Value $	Pounds	Value $	Pounds	Value $	Pounds	Value $	
Atlin	(1) Tulsequah -- Au	643,506	15,272,039	133,353	4,651,273	58,662	35,321	83,161	11,949	109,945	7,036	--	--	19,977,618
Stikine		39,595	905,275	114	4,120	20	8	--	--	--	--	--	--	909,403
Peace River		4,116	94,977	--	--	--	--	--	--	--	--	--	--	94,977
Portland Canal	(2) Salmon River -- Au, Ag (3) Anyox -- Cu	201	4,260	1,931,090	48,542,164	49,178,327	27,356,773	649,677,707	96,796,399	35,868,126	1,764,195	1,893,790	113,188	174,576,979
Omineca		49,469	1,300,126	8,638	197,545	2,350,522	1,454,237	6,126,209	1,345,688	6,240,382	345,914	3,960,186	248,673	4,892,183
Skeena	(4) Surf Inlet -- Au	3,919	86,924	414,794	9,979,046	265,198	182,759	7,671,642	1,215,720	39,539	1,287	15,277	490	11,466,226
Cariboo ǂǂ	(5) Wells -- Au	1,916,990	39,162,116	598,606	21,981,019	65,546	30,753	---	--	656	30	492	16	61,173,934
Quesnel ǂǂ		623,314	12,976,528	206	7,436	311	139	82	17	--	--	--	--	12,984,120
Clinton		9,994	238,032	23,388	827,260	31,564	14,214	57,548	5,905	193	7	--	--	1,085,418
Lillooet ǂǂ	(6) Bridge River -- Au	90,685	1,859,186	1,921,483	67,031,808	507,440	236,190	400	41	62,463	2,542	--	--	69,129,767
Kamloops	(7) Iron Mask -- Au, Cu	3,340	83,628	39,376	1,318,141	281,229	167,209	5,767,133	1,021,694	368,662	20,737	409,170	26,063	2,637,472
Revelstoke		5,986	126,861	47	1,035	62,014	39,294	683	124	969,641	56,779	8,093	469	224,562
Lardeau	(8) Cambourne -- Au	1,769	38,136	25,362	661,908	3,092,057	1,284,531	6,714	981	12,358,717	482,562	449,032	20,606	2,488,724
Golden	(9) Field -- Ag, Pb, Zn	467	11,213	74	1,587	1,414,796	841,585	57,378	10,590	98,848,378	3,707,360	119,529,943	4,631,669	9,204,004
Ashcroft		11,070	255,546	8,476	289,680	16,804	9,513	633,775	155,721	99	4	--	--	710,464
Nicola		230	4,652	8,525	234,914	267,098	126,317	549,975	106,230	2,235,137	90,469	320,456	10,566	573,148
Vernon		2,150	56,690	5,212	175,639	7,701	3,815	614	89	6,611	309	2,974	161	236,703
Alberni	(10) Zeballos -- Au	1,831	37,157	287,636	10,796,724	154,333	72,345	2,225,968	333,377	108,632	3,721	--	--	11,243,324
Nanaimo	(11) Vananda -- Au, Cu	596	13,711	74,501	1,562,556	546,574	314,350	21,014,708	3,329,066	--	--	--	--	5,219,683
Victoria	(12) Mount Sicker -- Au, Ag, Cu	612	15,223	37,081	795,590	780,932	424,088	21,208,627	3,148,167	139,900	6,932	2,961,848	163,158	4,553,158
Vancouver	(13) Britannia -- Cu	182	5,306	320,043	9,789,192	3,749,758	2,031,260	758,000,562	103,684,430	8,556,854	344,643	21,608,810	971,304	116,826,135
New Westminster		26,741	544,172	4,311	110,307	13,529	6,072	26,489	6,379	28,425	1,119	12,755	481	668,530
Similkameen	(14) Copper Mountain -- Cu (15) Hedley -- Au	11,496	242,811	107,119	3,612,425	2,624,846	1,263,429	367,700,854	45,472,736	238,577	9,006	64,377	2,616	50,603,023
Osoyoos	(16) Fairview & Dividend -- Au	1,812	36,574	1,274,353	36,319,225	525,290	333,679	2,203,756	251,580	252,418	7,475	5,209	163	36,948,696
Greenwood	(17) Beaverdell -- Ag (18) Camp McKinney -- Au (19) Phoenix-Greenwood -- Au, Cu (20) Jewel Lake -- Au (21) Franklin Camp -- Au, Ag	4,038	94,634	1,086,044	23,412,188	23,775,219	12,146,709	441,171,575	70,493,191	9,866,284	427,741	9,964,044	375,163	106,949,626
Trail Creek	(22) Rossland -- Au, Cu	848	24,176	2,979,075	63,144,484	3,990,914	2,258,671	135,545,097	19,932,619	17,508,816	761,279	157,920,611	5,292,655	91,413,884
Nelson	(23) Sheep Creek -- Au (24) Ymir -- Au, Ag, Pb, Zn (25) Erie Creek -- Au (26) Nelson -- Au, Ag, Cu	3,727	91,017	1,280,028	39,788,466	6,999,040	3,941,612	14,814,842	1,654,243	54,326,235	2,387,601	24,942,004	1,489,527	49,352,466
Slocan & Ainsworth	(27) Slocan Camp -- Ag, Pb, Zn (28) Ainsworth Camp -- Ag, Pb, Zn	362	9,286	10,855	283,056	60,579,495	36,543,073	219,318	42,287	546,234,295	24,840,819	313,529,837	17,947,910	79,666,431
Fort Steele	(29) Kimberley -- Ag, Pb, Zn (30) Moyie Lake -- Ag, Pb, Zn	21,023	472,584	2,532	56,964	157,206,605	77,656,746	28,592	6,193	8,521,786,036	387,820,727	5,597,297,816	260,258,612	726,271,826
Totals to 1947 - -		3,480,069	$74,062,840	12,582,322	$345,575,752	318,545,824	$168,774,692	2,434,793,409	$349,025,416	9,316,155,021	$423,090,294	6,254,896,754	$291,553,490	$1,652,082,484

ǂ Numbers appear also on Geogolical map with appropriate symbols indicating metals contributing 10 per cent or more, of the gross value. Mining centres from which less than 90,000 tons of ore has been mined are not listed, and are not shown on the map.

ǂǂ Placer gold production includes estimated production prior to 1895 as follows: Cariboo & Quesnel - from and including 1858 Lillooet - from and including 1874

TABLE IV

BRITISH COLUMBIA COAL PRODUCTION

Gross Output of Principal Coal Mining Centres

Vancouver Island District			
A Nanaimo - Wellington	1836-1947	52,300,000	long tons
B Comox	1888-1947	15,500,000	
Total		67,800,000	
Nicola - Princeton District			
C Princeton - Tulameen	1910-1947	3,800,000	
D Merritt	1907-1947	2,700,000	
Total		6,500,000	
East Kootenay District			
E Fernie	1898-1947	16,600,000	
F Michel	1899-1947	16,200,000	
G Corbin	1908-1936, 1943, 1944, 1947	3,500,000	
Total		36,300,000	
Sundry			
Suquash (N.E. Vancouver Island)	1909-1913	15,000	
Peace River (inc. Packwood Mine)	1940-1947	14,000	
Telkwa - Bulkley Valley	1931-1947	137,000	
Total		166,000	
Grand Total		110,766,000	

The appropriate letter, e.g. A = Nanaimo-Wellington, appears in the geological map with the symbol indicating a coal producing area.

In discussing the mineral production of British Columbia, we are concerned with a wide diversity of materials, including coal, limestone, broken rock, gravel, placer gold and platinum, and gold, silver copper, lead, zinc, cadmium, mercury and tin and sulphur obtained from ores mined in lode mines. The prices of these materials varied greatly over the period in which they have been mined, and between themselves vary greatly at any time. We have to consider materials ranging from values of two or three dollars to tens of dollars per ton, precious metals ranging in value from 40 cents to 100 dollars per Troy ounce, and base metals ranging from 3 cents to 2 dollars per pound. An ore usually contains more than one metal of economic value. Combinations such as gold and silver, gold, silver and copper, and silver, lead and zinc are common. Depending on the kinds and quantities of metals contained, an ore may be worth two or three dollars or a hundred dollars per ton. From these facts it is apparent that there is no practical common

denominator expressed either in terms of quantity of coal, ore etc., or of the metals or other valuable constituents. Quantities of coal, metal, etc. are set forth in the tables but for comparative purposes it is necessary to use value rather than quantity.

The sources of the statistical data are the Annual Reports of the Minister of Mines from 1874 onward, and the records of the Mining Division of the Bureau of Economics and Statistics of the Province of British Columbia.

Historical and Statistical Summary

1. Coal

Mineral production began soon after Europeans established themselves in the area that is now known as British Columbia. The first well authenticated production is of coal, obtained from beach diggings at Suquash as early as 1836. Some coal was mined there from time to time until about 1852. Thereafter, for some years coal mining activities were concentrated at Nanaimo and for many years the Nanaimo-Wellington field was the principal source of coal. By 1888 mining coal at Comox had reached an important level. Production in the Crow's Nest Pass field dates from 1898. These are still the most important fields. Nanaimo has declined greatly and will decline further. Comox should continue as an important producing area for years. A new field has come into production at Tsable River a few miles southerly from Comox. Production in the Crow's Nest Pass district centres at Coal Creek near Fernie, at Michel and at Corbin. The output of the Crow's Nest Pass field has exceeded that of Vancouver Island since 1940. A substantial part of the coal mined has been shipped to the United States and used by deep sea ships and a considerable part of the production of the Crow's Nest Pass field is shipped to Alberta, Saskatchewan, and Manitoba. Coke from the Crow's Nest Pass field is exported to the United States in considerable quantity. Formerly large quantities of coal from this field were exported to the United States for use by the Great Northern Railway Company. Competition by oil began to affect coal production adversely in the twenties and in the late twenties the Great Northern market was lost as the railway turned to burning oil. Oil competition reduced coal sales on all the principal markets, namely railways in Canada and the United States, steamships both coastal and deep sea, and domestic and industrial use both in British Columbia and elsewhere. Coal has been imported from Alberta for many years largely for domestic use. In recent years more Alberta coal than British Columbia coal has been used in British Columbia for industrial and domestic purposes. Since 1942 imports of Alberta coal have averaged about 750,000 long tons per year.

Up to the end of 1947 British Columbia's gross coal production has amounted to about 110,000 long tons. This total includes the losses in washing, coal burned under company boilers, and coal used in making coke, as well as coal sold.

2. Metals

The discovery of lode gold on the west coast of Moresby Island in the Queen Charlotte Islands was reported in 1851 and in the next year despite difficulties with the natives, a small quantity of rich gold ore was mined

from a narrow vein. It has been reported that gold was mined by the Spanish near Nootka on Vancouver Island in the seventeen seventies or eighties, this report is credible but is not established beyond question.

(1) Placer Mining

From 1857 to 1865 placer gold was discovered in several localities including Nicoamen River, the Fraser River near Yale, Quesnel River, Keithley, Antler, Williams, and Lightning Creeks in the Cariboo, Parsnip and Wild Horse Rivers, French Creek in the Big Bend of the Columbia River, and Leech River, Vancouver Island. Important discoveries have been recorded at intervals in succeeding years until 1932.

The influx of placer miners and other seekers after gold led to the union of the Vancouver Island and mainland colonies, to the opening up of much of the interior and to the establishment of government in country rapidly being opened up.

Large production of placer gold from the bars of the Fraser River lasted only a few years. The Cariboo reached its greatest output in 1863 but large production continued for quite a few years and placer mining is still important there. Placer mining booms occurred in other areas including Wild Horse River in the East Kootenay, the Big Bend of the Columbia River, Dease and Thibert Creeks in the north-western part of the Province, Granite Creek not far from Princeton, Atlin, Cedar Creek in the Cariboo, Squaw Creek in the north-western corner of the Province, and Wheaton or Boulder Creek discovered in 1932.

The first period of flush production was over in 1882 when the value of the placer gold output fell below $1,000,000. From 1899 to 1907 following the discoveries at Atlin production averaged more than $1,000,000 a year. Placer production was small for the following 25 years but began to increase again in the early thirties and continued well above $1,000,000 in value until 1942. In 1948 production increased materially from the low reached in 1947, and under more favourable economic conditions we might expect several good years for placer gold mining as dragline dredging, a technique previously little used in British Columbia, is now gaining headway.

(2) Lode Mining

The lode mine statistics contain no record of the gold mined on the west coast of Moresby Island in 1851 and 1852, nor of silver mined from the Eureka property 7 miles from Hope, between 1868 and 1874. The lode mine statistics begin with silver and lead produced near Ainsworth on Kootenay Lake in 1887, production from that area and the adjoining Slocan area grew rapidly. Silver-copper ore began to be mined at the Silver King mine, Nelson in 1889. Lode gold ore was mined and milled in the Fairview camp in 1893. The Rossland camp began yielding gold-copper ore in 1893 and the Boundary copper-gold ores were being mined by 1900. Some facts apparent from the statistical records for selected lode mining centres follow on Table V.

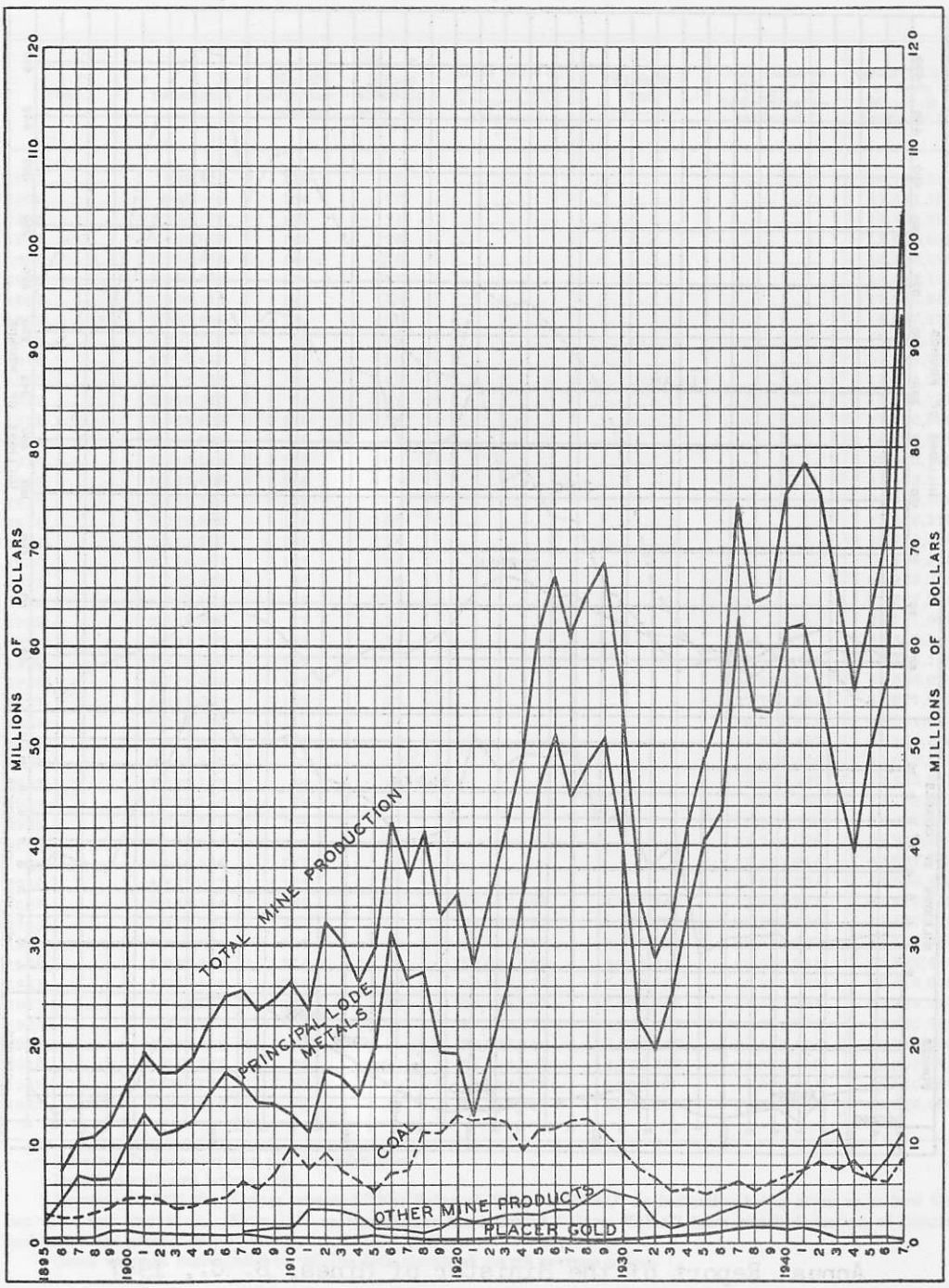
SELECTED LODE MINING CENTRES

TABLE V

Map Index No.	Centre	Principal Metals	1st Production	Periods of Major Production	Remarks
1	Tulsequah	Gold	1938	1938-1942, 1946 to date	Full scale operation
2	Portland Canal	Gold, Silver	1909 (?)	1920-1948	Shut down 1948
3	Anyox	Copper	1914	1914-1936	Shut down 1936
4	Princess Royal Island	Gold	1902	1917-1926, 1934-1942	Shut down
5	Wells	Gold	1933	1933 to date	Continuing
6	Bridge River	Gold	1899	1929 to date	Continuing
10	Zeballos	Gold	1929	1934-1942, 1945-1948	Shut down 1948
11	Van Anda	Gold, Copper	1896	1899-1919	Production being resumed 1948
12	Mt. Sicker	Copper, Gold, Silver	1898	1901-1909	Production in 1943, 1944 and 1947
13	Britannia	Copper	1905	1910-1920, 1923 to date	Full scale operation
14	Copper Mountain	Copper	1917	1917-1920, 1925-1930, 1937 to date	Full scale operation
15	Hedley	Gold	1904	1904 to date	Full scale operation
17	Beaverdell	Silver	1901	1922 to date	Continuing
19	Boundary	Copper, Gold	1900	1900-1919	Intermittent small production since 1919
22	Rossland	Gold, Copper	1893	1895-1924	Intermittent production by lessees since 1933
24	Sheep Creek	Gold	1899	1902-1915, 1930 to date	Production reduced and intermittent since 1942
27 & 28	Slocan and Ainsworth	Silver, Lead, Zinc	1887	Variable Production from numerous properties	Continuing
29	Kimberley	Silver, Lead, Zinc	1895	1900-1923 Large 1924 to date	Full scale operation
30	St. Eugene	Silver, Lead, Zinc	1899	1899-1910 and 1925-1929	Closed
M	Pinchi Lake	Mercury	1940	1940-1944	Production suspended

TABLE VI

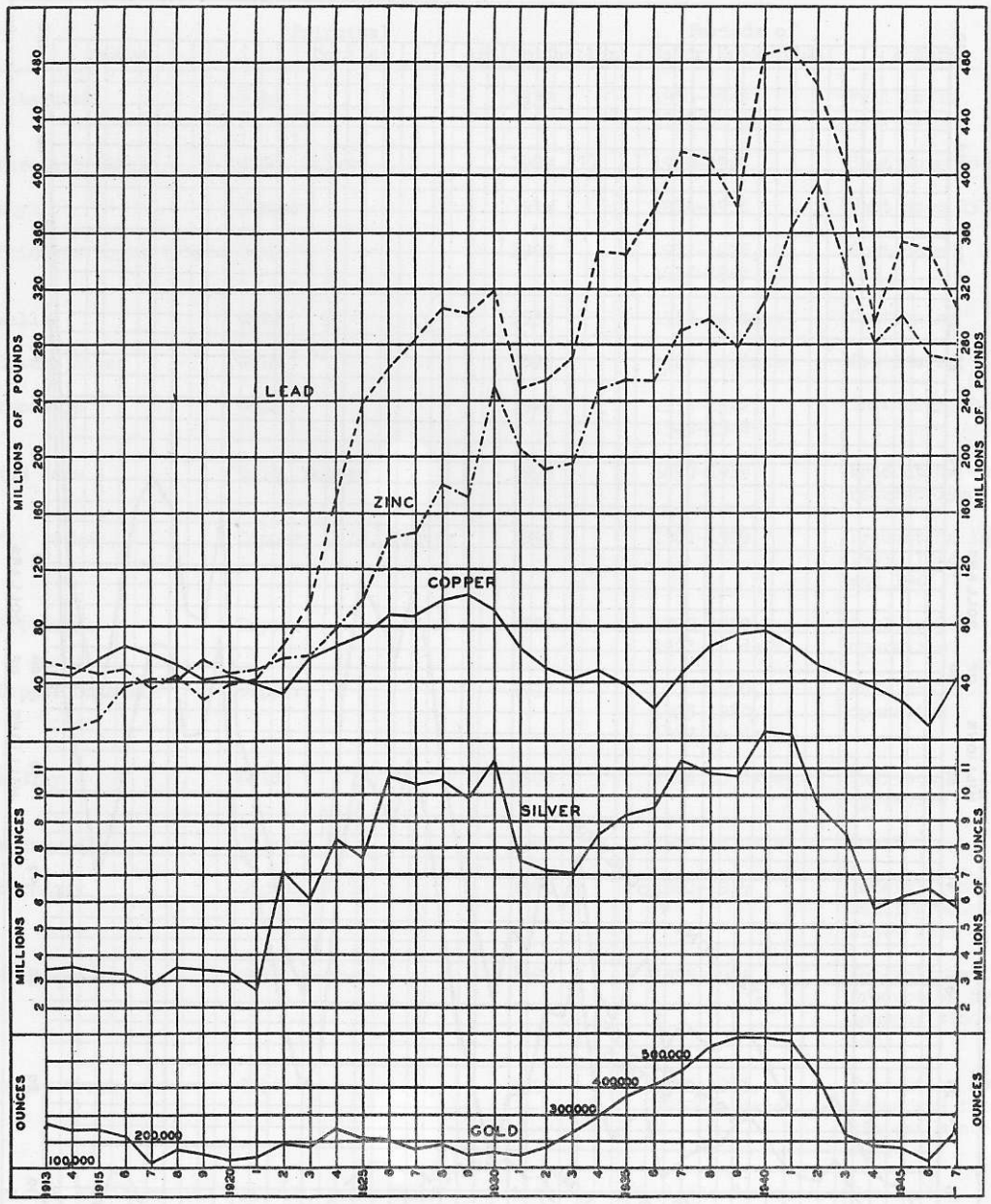
BRITISH COLUMBIA MINE PRODUCTION, 1895-1947.



Annual Report of the Minister of Mines, B. C., 1947

TABLE VII

BTITISH COLUMBIA LODE MINES PRODUCTION, 1913-1947



Annual Report of the Minister of Mines, B. C., 1947

TABLE VIII

LODE METAL MINES--TONNAGE, NUMBER OF MINES, NET AND GROSS VALUE OF MINERALS, 1901-1947

Year.	Tonnage.*	No. of Shipping-mines.	No. of Mines shipping over 100 Tons.	Gross value of Lode Minerals as reported by Shipper.†	Freight and Treatment.	Net Value to Shipper of Lode Minerals produced.‡	Gross Value of Lode Minerals produced.§
1901	920,416	119	78	.....	.....	.....	$14,100,282
1902	998,999	124	75	.....	.....	.....	11,581,153
1903	1,286,176	125	74	.....	.....	.....	12,103,237
1904	1,461,609	142	76	.....	.....	.....	12,909,035
1905	1,706,679	146	79	.....	.....	.....	15,980,164
1906	1,963,872	154	77	.....	.....	.....	18,484,102
1907	1,804,114	147	72	.....	.....	.....	17,316,847
1908	2,083,606	108	59	.....	.....	.....	15,847,411
1909	2,057,713	89	52	.....	.....	.....	15,451,141
1910	2,216,428	83	50	.....	.....	.....	14,728,731
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	2,690,110	132	59	.....	.....	.....	19,992,149
1916	3,188,865	169	81	.....	.....	.....	31,483,014
1917	2,761,579	193	87	.....	.....	.....	26,788,474
1918	2,892,849	175	80	.....	.....	.....	27,590,278
1919	2,112,975	144	74	.....	.....	.....	19,750,498
1920	2,178,187	121	60	.....	.....	.....	19,444,365
1921	1,562,645	80	35	.....	.....	.....	12,920,398
1922	1,573,186	98	33	.....	.....	.....	19,227,857
1923	2,421,839	77	28	.....	.....	.....	25,347,092
1924	3,397,105	86	37	.....	.....	.....	35,538,247
1925	3,849,269	102	40	.....	.....	.....	46,200,135
1926	4,775,073	138	55	.....	.....	$38,558,613	51,508,031
1927	5,416,021	132	52	.....	.....	27,750,364	44,977,082
1928	6,241,310	110	49	.....	.....	29,070,075	48,281,825
1929	6,977,681	106	48	.....	.....	34,713,887	51,174,859
1930	6,803,846	68	32	.....	.....	21,977,688	40,915,395
1931	5,549,103	44	22	.....	.....	10,513,931	22,535,573
1932	4,340,158	75	29	.....	.....	7,075,393	19,700,235
1933	4,030,978	109	47	.....	.....	13,976,358	25,007,137
1934	5,116,897	145	69	.....	.....	20,243,278	33,895,930
1935	4,916,148	177	72	.....	.....	25,407,914	40,597,569
1936	4,381,027	168	70	.....	.....	30,051,207	43,666,452
1937	6,145,144	185	113	$48,617,920	4,663,843	43,954,077	62,912,783
1938	7,377,021	211	92	40,222,237	4,943,754	35,278,483	53,877,333
1939	7,211,223	217	99	45,133,788	4,416,919	40,716,869	53,522,098
1940	7,937,358	216	92	50,004,909	6,334,611	43,670,298	62,848,642
1941	7,938,803	200	96	52,354,870	5,673,048	46,681,822	62,216,019
1942	6,708,277	126	76	50,494,041	5,294,637	45,199,404	55,359,479
1943	5,429,557	48	32	37,234,070	3,940,367	33,293,703	46,089,042
1944	4,763,332	51	31	29,327,114	2,877,706	26,449,408	39,315,910
1945	4,377,722	36	27	34,154,917	2,771,292	31,383,625	49,997,071
1946	3,705,375	50	32	48,920,971	2,904,130	46,016,841	56,519,691
1947	**4,953,030**	**75**	**33**	**81,033,093**	**4,722,010**	**76,311,087**	**93,176,165**

* Does not include mercury nor tungsten ores.

† Data not collected before 1937.

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

§ Gross value as represented by valuing lode metals at yearly average prices.

TABLE IX

COKE PRODUCTION FROM BEE-HIVE OVENS IN BRITISH COLUMBIA FROM 1895 to 1925

	Tons. (2,240 lb.)	Value.		Tons. (2,240 lb.)	Value.
1895–97	19,396	$96,980	1913	286,045	$1,716,270
1898 (estimated)	35,000	175,000	1914	234,577	1,407,462
1899	34,251	171,255	1915	245,871	1,475,226
1900	85,149	425,745	1916	267,725	1,606,350
1901	127,081	635,405	1917	159,905	959,430
1902	128,015	640,075	1918	188,967	1,322,769
1903	165,543	827,715	1919	91,138	637,966
1904	238,428	1,192,140	1920	67,792	474,544
1905	271,785	1,358,925	1921	59,434	416,038
1906	199,227	996,135	1922	45,835	320,845
1907	222,913	1,337,478	1923	58,919	412,433
1908	247,399	1,484,394	1924	30,615	214,305
1909	258,703	1,552,218	1925	75,185	526,295
1910	218,029	1,308,174			
1911	66,005	396,030	Totals	4,393,265	$25,673,600
1912	264,333	1,585,998			

TABLE X

COAL PRODUCTION PER YEAR TO DATE *

	Tons. (2,240 lb.)	Value.		Tons. (2,240 lb.)	Value.
1836–1885	3,029,011	$9,468,557	1918	2,302,245	$11,511,225
1886	326,636	979,908	1919	2,267,541	11,337,705
1887	413,360	1,240,080	1920	2,595,125	12,975,625
1888	489,301	1,467,903	1921	2,483,995	12,419,975
1889	579,830	1,739,490	1922	2,511,843	12,559,215
1890	678,140	2,034,420	1923	2,453,223	12,266,115
1891	1,029,097	3,087,291	1924	1,939,526	9,697,630
1892	826,335	2,479,005	1925	2,328,522	11,642,610
1893	978,294	2,934,882	1926	2,330,036	11,650,180
1894	1,012,953	3,038,859	1927	2,453,827	12,269,135
1895	939,654	2,818,962	1928	2,526,702	12,633,510
1896	896,222	2,688,666	1929	2,251,252	11,256,260
1897	882,854	2,648,562	1930	1,887,130	9,435,650
1898	1,135,865	3,407,595	1931	1,707,590	7,684,155
1899	1,306,324	3,918,972	1932	1,534,975	6,523,644
1900	1,439,595	4,318,785	1933	1,264,746	5,375,171
1901	1,460,331	4,380,993	1934	1,347,090	5,725,133
1902	1,397,394	4,192,182	1935	1,187,968	5,048,864
1903	1,168,194	3,504,582	1936	1,346,471	5,722,502
1904	1,253,628	3,760,884	1937	1,444,687	6,139,920
1905	1,384,312	4,152,936	1938	1,309,428	5,565,069
1906	1,517,303	4,551,909	1939	1,477,872	6,280,956
1907	1,800,067	6,300,235	1940	1,667,827	7,088,265
1908	1,677,849	5,872,472	1941	1,802,353	7,660,000
1909	2,006,476	7,022,666	1942	1,938,158	8,237,172
1910	2,800,046	9,800,161	1943	1,821,654	7,742,030
1911	2,193,062	7,675,717	1944	1,933,639	8,217,966
1912	2,628,804	9,200,814	1945	1,518,673	6,454,360
1913	2,137,483	7,481,190	1946	1,463,640	6,220,470
1914	1,810,967	6,338,385	1947	1,717,476	8,587,380
1915	1,611,129	5,638,952			
1916	2,084,093	7,294,325	Totals	103,859,798	$418,893,145
1917	2,149,975	7,524,913			

* For all years to 1925 (inclusive) figures are net coal production and do not include coal made into coke; subsequent figures are entire coal production, including coal made into coke.

Miscellaneous metals and related elements are now produced in important volume, largely as by-products in mining and treating the ores of the principal metals. However, mercury, which was produced in important quantity during 1940 to 1944 and tungsten, produced in the form of high grade concentrates, from 1939 to 1944 and again being produced, are not by-products. Information concerning production of these miscellaneous metals and also of sulphur and arsenic is given in Table II. All these materials except arsenic, platinum, tin, and part of the sulphur are recovered as by-products at the Trail Smelter. Some gold-bearing concentrates shipped to the Tacoma Smelter contain arsenic and the arsenic for which credit was received is recorded in the table. The platinum shown is from placer operations. Tin is recovered as a by-product at the Sullivan Mill and is smelted and refined there. Much of the sulphur shown was recovered as elemental sulphur at Trail or is the sulphur content of fertilizer or of sulphuric acid used in making fertilizer at Trail. The remainder of the sulphur was contained in pyrite concentrates produced at the Britannia mill and sold principally for use in chemical plants. It includes exports to Japan, Holland, France, Mexico, and the United States as well as some thousands of tons used in British Columbia each year.

Varying proportions ranging from all to a large part of the metals and related materials are produced for export. They are exported mainly as refined metals but since 1936 all copper produced has been exported in concentrates which are smelted at Tacoma; except for copper bearing dross from the Trail lead smelter which also is exported to Tacoma.

3. Non Metallics and Structural Materials

A great variety of materials used in chemical industries or as building or construction materials, including gypsum for hardwall plaster and wall board, and granules used in making roofing, are produced in British Columbia. Products such as these are usually used close to the point of origin. Their production is dependent on the local market and consequently has increased greatly in recent years.

Mineral Resources

1. Introductory Discussion

We have learned in recent years that nuclear fission may create some elements by breaking down others; however, nothing yet suggests that nuclear fission will supply any considerable quantity of metals or other elements. Coal, oil, and certain other items obtained from the ground were formed from living organisms; however, the formation of any considerable quantity required so long that the quantity already formed must be regarded as the supply for all time. Salts obtainable from saline lakes might be regarded as replenishable, but for practical purposes we must consider that all other mineral deposits available in British Columbia for all time, exist now in the form in which they will finally be found.

This fact might be thought to simplify estimation of mineral resources but experience has shown that discovery and exploration of mineral

deposits is difficult and very costly and estimation of the volume of a deposit is difficult and apt to be uncertain. Further it is impossible to say now just what may be regarded as a valuable mineral deposit some time in the future. With today's techniques zinc associated with lead adds to the value of an ore; fifty years ago the zinc was apt to be regarded as an undesirable impurity. With today's prices rock containing 3 or 4 per cent lead or zinc might be profitable ore, where ten years ago, even 5 years ago, it would not have been worth mining.

Most deposits of valuable minerals are poorly exposed in nature. The veins or lodes of metallic minerals were formed well below the surface of the earth, and sedimentary deposits such as seams of coal or beds of limestone, formed in bodies of fresh or salt water, are apt to be rather deeply buried by other sediments deposited subsequently. In the course of time many mineral deposits became partly exposed by the erosion of the overlying rocks, but even the parts nearest to the surface are apt to remain largely concealed by soil, sand, gravel, or other unconsolidated material. The part or parts of a mineral deposit exposed by nature are apt to be so small and to be so altered by weathering that they rarely constitute a good sample of the deposit or give much indication of its size. Some deposits do not outcrop at all, and are discovered only by chance or by testing a geological theory by diamond drilling or other exploratory work. Some mineral deposits are more uniform in character than others and may be expected to continue moderate distances beyond known exposures but continuity is limited. Mineral deposits are often likened to plums in a pudding. Considered by themselves some mineral deposits are large and exceedingly sweet plums, but when we consider their size in relation to the volume of rock in which they occur they are small and very widely spaced. They are apt to occur in certain favourable areas widely separated from other favourable areas.

Experience has shown that it is unsafe to count on the existence of ore, coal or most other mineral much beyond the volume of rock that has been explored by surface or underground workings including drill holes. Principles for estimation are well established. These principles lead to statements that a certain quantity of material of a certain grade exist, that a quantity probably exists, or that within a certain volume of rock, a certain quantity of material of a certain range in grade may with some reason be expected to exist. These estimates serve to guide those who must decide whether or not to spend the large amount of money that will be required if the deposit is to be more completely explored, or to be prepared for production, and whether or not further funds should be spent to provide transportation, power, concentrators, smelters, or other refining or processing plants. In general such estimates show the minimum quantity that exists or may be expected to exist. Estimates based on less definite data have repeatedly led to grief. The cost of obtaining the necessary data is so high that deposits are rarely completely delimited. Preparation for production is begun if it has been shown that the part of a deposit or of a favourable area already explored contains enough material of profitable grade, to warrant the further expenditure required. Mines may be operated for several decades and never have proven reserves sufficient to carry them for more than two to five years.

A further aspect that must be considered is the grade, or the value per unit of quantity. We usually express grade of base metal ore in percentage and of precious metal ore in troy ounces or fractions of a troy ounce per ton. Whether or not material of a certain grade can be classed as ore depends on many factors including the price of the metal or metals contained, the size of the deposit, the location of the deposit, i.e., distance from market, established transportation, power, treatment plants, and the like; another factor is the physical nature of the deposit which will determine the cost of mining; mining and metallurgical techniques are also important. At the prices of 50 years ago and with the milling and smelting techniques then available, the Sullivan silver, lead, zinc deposit was of rather doubtful value. Although this deposit was discovered in 1892 and although work done on it indicated the probability of very large tonnage of ore containing a great deal of metal per ton, it was not until 1923 that the Sullivan mine was brought into production on a large scale. After years of experimenting and research, development of milling and metallurgical techniques eventually made it highly profitable to treat this rather complex ore. At today's prices similar mineralized matter containing a half or possibly only a fourth of the metal contained in a ton of Sullivan ore might be profitable.

Compilations have been made of the data on mineral deposits of several types, and estimates have been published of quantities of iron ore, coal, and certain other valuable minerals. Insofar as they are well founded, such estimates will be seen in due course to be conservative estimates of the amount of the particular mineral in specific deposits, not the total quantity of that mineral or element that exists in the part of the earth's crust lying within the boundaries of this Province.

2. Coal

The latest estimate of our Coal Reserves[1] indicates that although some coal areas have been seriously depleted remaining recoverable coal probably exceeds 5 billion tons. Important reserves exist on Vancouver Island with perhaps less certain reserves near Princeton and with important quantities possible but so far inaccessible in the Peace River district and lesser quantities in some other parts. By far the greatest known reserves are in the southern East Kootenay area not far from existing rail transportation. We have not since 1928 mined as much as 2,000,000 tons in any year, in the year of greatest production, 1910 the quantity mined was less than 3,200,000 tons.

3. Iron

Our iron ore reserves were estimated in 1926[2] as (a) almost certain--1,307,300 tons; (b) probable (including (a))--2,172,000± tons; (c) possible (including (b))--6,450,000+ tons. Today for ores of the same classes we might add about 1,000,000 tons to (a) and 3,000,000 tons to (c). These estimates included deposits in the coastal area and in widely separated parts

(1)MacKay, B. R., "Coal Reserves of Canada," Reprint of Chapter 1 and Appendix A of Report of Royal Commission on Coal, 1946. King's Printer and Comptroller of Stationery, Ottawa, pages 46-55 and 97-105.

(2)Young, G. A. and Uglow, W. L., The Iron Ores of Canada, Vol. I, British Columbia and Yukon, based on table, page 3.

of the Interior. It should be stated that knowledge of iron ore deposits has been accumulated in spite of the fact that there has been almost no iron ore mined in British Columbia and there has been little incentive for spending money in delimiting the deposits that have been discovered.

We might also regard as potential iron ore, iron sulphide either known and partly delimited but still unmined, or mined and accumulated as stock piles or tailings dumps. Unmined deposits include the Ecstall River deposit which may contain several million tons of pyrite, with which is associated some copper, also the pyrite in the ore of the Britannia mine, and the pyrrhotite and pyrite in the ore of the Sullivan mine in parts of the Sullivan hitherto regarded as too low in lead and zinc to be classed as ore. The tailings dumps of the Sullivan mine have received since 1923 some 35,000,000 tons of material containing iron sulphide, equivalent to about 14,000,000 tons of iron and about an equal quantity of sulphur. Under the right conditions iron sulphides will probably be used as a source of both iron and sulphur.

Undoubtedly other deposits both of iron oxide and of iron sulphide remain to be explored and to be found. We may also consider the magnetite content of certain replacement copper deposits, such as are found in the northern part of Vancouver Island, as potential sources of by-product iron. Under some circumstances also black sands found in beaches and in river gravels might be regarded as potential sources of iron and of gold, platinum, or nickel or perhaps other metals.

4. Gold, Silver, Copper, Lead, Zinc

These metals singly or in various combinations have been mined in many deposits, are now being mined in many deposits, and are known to exist in quite a few others in concentration which would currently be considered as of profitable grade or not far from profitable grade. Few deposits now being worked have proven reserves sufficient to maintain operation at the present rate for more than half a decade, however, it is reasonable to expect that the present rate of production can be maintained for a longer period from deposits now known. Experience indicates that if the demand--as measured by prices sufficient to permit profitable operation--exists, gold ores, in deposits of small to moderate size, will continue to be found for many years. Silver has been produced largely as a by-product and is apt to continue principally as a by-product. Our copper production has come very largely from a few large deposits. Similar unexploited deposits of comparable grade have not been proven; however, a moderate increase in the purchasing power of copper would probably make it profitable to mine several deposits now sub-marginal because of lowness of grade or smallness of size. It is to be expected that discovery of additional ore at mines now being worked, and elsewhere will permit continued mining for decades of copper ores in British Columbia, provided that prices and economic conditions do not change adversely.

Silver-lead-zinc ore is now the basis for the most important part of the mining industry. Numerous deposits of silver-lead-zinc ore are known, some as yet unworked. The prospects of finding additional ore are

good. The Sullivan mine is the source of most of the silver, lead, and zinc now being mined and that have been mined to date. The expectation of life for this mine is good. Several additional silver-lead-zinc deposits are now being prepared for production. Discoveries of some interest have been made in northern British Columbia in recent years.

5. Mercury and Tungsten

Moderate reserves exist in mines that have been or are in production. With favourable prices production of either or both metals much in excess of probable requirements in British Columbia may be expected.

6. Other Metals

Deposits of magnesite are known but unworked, with dolomite and magnesian limestone, known in several parts of the Province. They may in due course supply refractories and magnesium metal.

Nickel deposits are known but are sub-marginal under present conditions.

7. Industrial Minerals

Limestone of high purity, gypsum, barite, bentonite, magnesium sulphate, sodium carbonate, and some other industrial minerals exist or are probable in quantities sufficient to meet the requirements of a much larger population.

8. Structural Materials

Deposits of limestone, building stone, clay suitable for the manufacture of refractories and tiles, and clays suitable for high grade earthen ware, white sanitary ware, and china could undoubtedly for many years supply existing industries or industries that might be established. Deposits of materials suitable for making cement and of clays suitable for making common brick exist in many parts of the Province.

We might go through a long list of metals and minerals recording similar observations with considerable detail for many but such a listing would serve little purpose. Sources of data on various minerals and metals are listed in the bibliography.

Factors Relating to the State of Development of the Mining Industry, and Future Possibilities

To repeat certain facts: we have produced metals and sulphur principally for export, coal partly for our own use and partly for export and structural materials very largely for our own use. High enough prices will probably lead to increased production for export, though the increase might be effected by prolonging the present rate of production through the use of lower grade ores rather than materially increasing the rate of production. We can for the forseeable future produce much more than our own

small requirements of metals. We could produce all the coal needed in British Columbia and have some for export; however, some of our coal seams are expensive to work and the price required to make them workable invites competition by more cheaply mined, if generally inferior coal brought in from Alberta. Much larger participation of East Kootenay coal in the British Columbia domestic market is possible. Further factors that may bear on the production of coal are the availability of hydro-electric energy and the competition of petroleum. Should coal gain in competition with petroleum very important changes in our coal production might result.

The output of the mineral industry has fluctuated rather widely in the past. The general courses of the production curves have been upward (see graphs, Tables VI and VII). Fluctuations have in part reflected world conditions since most of our production has been sold on the world market. However, our resources are so diversified and the industry has been so enterprising that a high level of output has been maintained for most of the time since 1895. We can expect further fluctuations but we have good reason to expect that a high average level of production will be maintained provided the industry is not strangled by restrictions and loaded with undue burdens. The industry must compete in the world market and factors that seriously increase costs will tend to reduce the contribution that the mining industry can make to the wealth of the Province of British Columbia. Costs cannot be passed on to a consumer who can buy cheaper elsewhere. Taxes, restriction of ready access to timber required in mining, and restriction of prospecting may imperil the future of the mining industry, and result in great loss of the potential wealth of the province.

The volume of our mineral production for export depends on demand originating outside of British Columbia not on the population of British Columbia. For this reason there is little likelihood that increased population would increase the production of the metals that have been the principal part of our mineral production; indeed, decline in some items is inevitable at some time. If increased population results in withdrawal from prospecting of additional large areas, because they have been designated as parks, increasing population might reduce our production of metals.

Availability of cheap electrical energy might favour some mineral resources not now being used or not being used fully, e.g., magnesite and dolomite as a source of magnesium, iron sulphide as a source of sulphur for chemical industry. Increased population would probably require use of structural materials about in direct ratio to the increase, but other factors such as changing costs of some competing materials, e.g., lumber, might also be very important, and it could well be that fashion or superior performance might result in mineral products replacing wood in some fields, as for example in roof covering. Again there is the probability that sufficiently increased local market because of increased population and increased industrialization might permit the existence of some industries based on mineral resources that so far have not been exploited because the industries are not economic unless the demand is greater than the British Columbia market has been. In this connection one thinks of making pig iron from iron ore and of steel, in part from pig iron. Should anyone wish to determine in a few minutes the requirements of a population of 1,000,000, 3,000,000 and 5,000,000,

in iron, steel, coke, and the like, figures are presented in Table XI, taken from Minerals Yearbooks, published for each year by the United States Bureau of Mines, showing the quantities used in the United States in each of the years 1935 to 1939 inclusive. These figures indicate a range from less than a quarter of a ton to more than half a ton per head of population.

DATA RE UNITED STATES IRON AND STEEL PRODUCTION TABLE XI

	1935 Tons	1936	1937	1938	1939
Iron Ore Produced	30,540,252	48,778.745	72,093,548	28,447,282	51,721,369
Pig Iron Produced	20,827,196	30,254,022	36,145,095	18,582,322	31,075,914
Steel Produced	34,092,594	47,767,856	50,568,701	28,349,991	47,141,709
Ferro Alloys Produced	545,316	818,488	1,008,170	584,724	735,171
Total Ferrous Scrap Consumed	26,415,330	36,358,133	38,006,272	21,344,934	32,434,407
Pig Iron Consumed for Steel	17,520,144	25,619,270	28,851,266	15,691,312	27,196,352
Coke Consumed by Iron Furnaces and Making Ferro Alloys	20,821,286	31,255,648	33,571,349	19,035,270	31,422,272
Ferro-manganese Produced in Terms of Contained Manganese	170,168	249,933	299,425	191,104	214,040
Population U.S.A.	127,250,232				130,879,718

Source: Minerals Year Book for 1935, 1936, 1937, 1938, and 1939.

Steel production ranges from a quarter to about four-tenths of a ton per head, the other figures range similarly. A 1942 estimate suggested that the consumption in British Columbia of products that might be rolled in a steel mill of justifiable capital cost would run to about a tenth of a ton per head of population per annum, and would require about a tenth of a ton each of iron ore and coal and a hundredth of a ton of limestone. To supply the iron ore, coal, and limestone might require the services of about 150 men per 100,000 tons of steel. Blast furnace, steel furnace, and rolling mill operation might require the employment of a further 800 or 900 men. These figures suggest that establishment of an iron and steel industry to supply a population of 3,000,000 would give employment to 3,000 and possibly to 6,000 men, and that a larger population which may be expected to require more of the larger and special rolled steel shapes and might justify the large capital required for mills to roll such shapes might result in an increased ratio of employees to total population. However, in considering such possibilities we must not overlook the possible competition of light metals with iron, neither should we overlook the possibility that extrusion or some other technique may partly replace the present practice of producing steel shapes by rolling.

Employment in the Mining Industry

The number employed in the mining industry each year beginning with 1901 is set out in Table XIII. Comparison of this table with output suggests inconsistencies. These are explained in part by the fact that large numbers must be employed in exploration and development, sometimes for years, before production is undertaken. A further explanation lies in the fact that from time to time as in depressions and during war emergencies the industry has lived on its capital. That is, much less exploration and development have been done than are required on the average to maintain reserves of exploitable mineral.

Probably we should not expect much change in employment for what is now the major part of the mining industry, namely, production of gold, silver, copper, lead, zinc, and related by-products. Employment in coal mining and production of structural and miscellaneous materials, might be expected to increase in about the same ratio as the population. Iron and steel making might occasion important additions. We have no present figures for iron and steel making as they have not been based on British Columbia ore. Our figures for miscellaneous mineral products include employees, in coke plants at the coal mines, and in city plants making gas for domestic use. Our figures do not include employees in the chemical works at Trail. Figures for miscellaneous employees are not available. The number of technical employees at present might reasonably be estimated as at least 350.

Estimates of future employment are highly conjectural. The situation will undoubtedly be affected by many factors other than population changes, and population changes may not fit predictions too well. However, as an estimate is requested, the following table is presented. It records the average for the 15-year period for 1931 to 1945 inclusive, which may serve for an estimate of the requirements of a population of 1,000,000, and estimates are listed for 3,000,000 and 5,000,000 population. These estimates are subject to more reservations than can be listed conveniently.

Taking a long range view, it is unlikely that the products we have for export will be less in demand in the future than they have been in the past. It is likely that for years to come the supply of most metals will be adequate for British Columbia secondary industries, that may use them in manufacturing, and for export. Increased use of metals now exported in secondary industries is apt to be more effective than increased metal mining in creating employment. It seems probable that the part of the industry supplying the British Columbia market will be the part most affected by change in the population of British Columbia. Increased production of clay products, other structural materials, and coal, would probably accompany increased population. Production of iron and steel and chemical industry based on mineral resources would probably be established if the population increased sufficiently. These increases in output would require considerable increases in the numbers employed. Establishment of another base metal smelter and production of metallic magnesium are possibilities that would call for many additional employees.

NUMBER OF EMPLOYEES IN THE MINING INDUSTRY TABLE XII

	Average 1931-1945	Estimated for 3,000,000 pop.	Estimated for 5,000,000 pop.
Placer Mining	880	500	500
Lode Mining			
Underground	2,760	3,000	3,000
Above	1,670	1,800	1,800
Total at Mines	4,430	4,800	4,800
In Concentrators	840	900	900
In Smelters	2,940	3,200	3,200
Coal Mining			
Underground	2,200	6,500	8,000
Above	760	2,000	2,300
Total	2,960	8,500	10,300
Structural Materials			
Quarries & Pits	750	2,500	3,500
Plants	330	1,100	1,700
Miscellaneous[2]	540	1,500	2,100
Total	[1]13,670	23,000	27,000
Add Total for Iron and Steel Industry[3]		3,000	7,000
Related Chemical Industries		2,000	4,000
Grand Total	13,670	28,000	38,000

N.B. [1]Direct employees only, does not include employees at Trail chemical works.

[2]Includes employees at mine, coke plants, and city gas plants

[3]Includes those mining iron ore, coal, and limestone

Current Problems

Present and continuing problems of the industry are (1) finding mineral deposits capable of supplying the materials that the industry markets and (2) finding markets for the products. The second implies markets at a price that permits profitable operation. Both aspects are not equally acute at the same time for the same branch of the industry. At present gold mining is faced with the second aspect of the second problem, and paradoxically that problem helps to create the first. Most of the other branches of the industry are having little or no difficulty with marketing. Inadequate supply of labour and material has reduced exploratory work in recent years

TABLE XIII

AVERAGE NUMBER EMPLOYED IN THE MINING INDUSTRY OF BRITISH COLUMBIA, 1901-1947

Year.	Placer-mining.	Lode-mining.			In Concentrators.	In Smelters.	Coal-mining.			Structural Materials.		Miscellaneous.	Total.*
		Under.	Above.	Total.			Under.	Above.	Total.	Quarries and Pits.	Plants.		
1901	.....	2,736	1,212	3,948	.....	.....	3,041	931	3,974	.....	.....	.....	7,922
1902	.....	2,219	1,126	3,345	.....	.....	3,101	910	4,011	.....	.....	.....	7,356
1903	.....	1,662	1,088	2,750	.....	.....	3,137	1,127	4,264	.....	.....	.....	7,014
1904	.....	2,143	1,163	3,306	.....	.....	3,278	1,175	4,453	.....	.....	.....	7,759
1905	.....	2,470	1,240	3,710	.....	.....	3,127	1,280	4,407	.....	.....	.....	8,117
1906	.....	2,680	1,303	3,983	.....	.....	3,415	1,390	4,805	.....	.....	.....	8,788
1907	.....	2,704	1,239	3,943	.....	.....	2,862	907	3,769	.....	.....	.....	7,712
1908	.....	2,567	1,127	3,694	.....	.....	4,432	1,641	6,073	.....	.....	.....	9,767
1909	.....	2,184	1,070	3,254	.....	.....	4,713	1,705	6,418	.....	.....	.....	9,672
1910	.....	2,472	1,237	3,709	.....	.....	5,903	1,855	7,758	.....	.....	.....	11,467
1911	.....	2,435	1,159	3,594	.....	.....	5,212	1,661	6,873	.....	.....	.....	10,467
1912	.....	2,472	1,364	3,837	.....	.....	5,275	1,855	7,130	.....	.....	.....	10,967
1913	.....	2,773	1,505	4,278	.....	.....	4,950	1,721	6,671	.....	.....	.....	10,949
1914	.....	2,741	1,433	4,174	.....	.....	4,267	1,465	5,732	.....	.....	.....	9,906
1915	.....	2,709	1,435	4,144	.....	.....	3,708	1,283	4,991	.....	.....	.....	9,135
1916	.....	3,357	2,036	5,393	.....	.....	3,694	1,366	5,060	.....	.....	.....	10,453
1917	.....	3,290	2,198	5,488	.....	.....	3,760	1,410	5,170	.....	.....	.....	10,658
1918	.....	2,626	1,764	4,390	.....	.....	3,658	1,769	5,247	.....	.....	.....	9,637
1919	.....	2,513	1,746	4,259	.....	.....	4,145	1,821	5,966	.....	.....	.....	10,225
1920	.....	2,074	1,605	3,679	.....	.....	4,191	2,158	6,349	.....	.....	.....	10,028
1921	.....	1,355	975	2,330	.....	.....	4,722	2,163	6,885	.....	.....	.....	9,215
1922	.....	1,510	1,239	2,749	.....	.....	4,712	1,932	6,644	.....	.....	.....	9,393
1923	.....	2,102	1,516	3,618	.....	.....	4,342	1,807	6,149	.....	.....	.....	9,767
1924	.....	2,353	1,680	4,033	.....	.....	3,894	1,524	5,418	.....	.....	.....	9,451
1925	.....	2,298	2,840	5,138	.....	.....	3,828	1,615	5,443	.....	.....	.....	10,581
1926	299	2,606	1,735	4,341	808	2,461	3,757	1,565	5,322	493	324	124	14,172
1927	415	2,671	1,916	4,587	854	2,842	3,646	1,579	5,225	647	138	122	14,830
1928	355	2,707	2,469	5,176	911	2,748	3,814	1,520	5,334	412	368	120	15,424
1929	341	2,926	2,052	4,978	966	2,948	3,675	1,353	5,028	492	544	268	15,565
1930	425	2,316	1,260	3,576	832	3,197	3,389	1,256	4,645	843	344	170	14,032
1931	688	1,463	834	2,297	581	3,157	2,957	1,125	4,082	460	526	380	12,171
1932	874	1,355	900	2,255	542	2,036	2,628	980	3,608	536	329	344	10,524
1933	1,134	1,786	1,335	3,121	531	2,436	2,241	853	3,094	376	269	408	11,369
1934	1,122	2,796	1,729	4,525	631	2,890	2,050	843	2,893	377	187	360	12,985
1935	1,291	2,740	1,497	4,237	907	2,771	2,145	826	2,971	536	270	754	13,737
1936	1,124	2,959	1,840	4,799	720	2,678	2,015	799	2,814	931	288	825	14,179
1937	1,371	3,603	1,818	5,421	1,168	3,027	2,286	867	3,153	724	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

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

TABLE XIV

SALARIES AND WAGES, FUEL AND ELECTRICITY, AND PROCESS SUPPLIES, 1947

Class.	Salaries and Wages.	Fuel and Electricity.	Process Supplies.
Lode-mining	$23,280,623	$3,622,346	$9,419,772
Placer-mining	100,114	5,701	36,122
Coal-mining	5,273,600	485,129	506,942
Miscellaneous metals, minerals, and materials	1,445,515	198,650	2,712,057
Structural materials industry	2,060,486	1,007,644	394,055
Totals, 1947	**$32,160,338**	**$5,319,470**	**$13,068,948**
Grand totals, 1946	$26,190,200	$5,427,458	$8,367,705
Grand totals, 1945	22,620,975	7,239,726	5,756,628
Grand totals, 1944	23,131,874	5,788,671	6,138,084
Grand totals, 1943	26,051,467	7,432,585	6,572,317
Grand totals, 1942	26,913,160	7,066,109	6,863,398
Grand totals, 1941	26,050,491	3,776,747	7,260,441
Grand totals, 1940	23,391,330	3,474,721	6,962,162
Grand totals, 1939	22,357,035	*3,266,000	6,714,347
Grand totals, 1938	22,765,711	3,396,106	6,544,500
Grand totals, 1937	21,349,690	3,066,311	6,845,330
Grand totals, 1936	17,887,619	2,724,144	4,434,501
Grand totals, 1935	16,753,367	2,619,639	4,552,730
Grand totals, 1935-47	307,623,257	*60,597,687	90,081,091

* Estimated.

NOTE.—The above figures, compiled from returns on the subject made by companies and individuals, illustrate the amount of money distributed in salaries and wages, fuel and electricity, and process supplies (explosives, chemicals, drill-steel, lubricants, etc.).

Annual Report of the Minister of Mines, B. C., 1947

TABLE XV

DISTRIBUTION OF GROSS VALUE OF PRODUCTS PER PERSON EMPLOYED

	Average per year 1937-1946	Year 1947
Number Employed	14,060	14,899
Salaries and Wages	$ 1,710	$ 2,155
Freight and Treatment (lode mining)	310	130
Fuel and Electricity	355	355
Process Supplies	470	875
Dividends	1,080	1,870
Process Supplies		1,080
Taxes, Dominion *		240
Provincial		38
Municipal etc.		31
Levied W. Compensation Unemp. Insur. etc.		
Unaccounted	975	824
Total	4,900	7,600

*Income Tax is collected by the Dominion Government and a compensating payment is made to the Province. The compensating payment is not based on the taxes paid by mining companies.

but that situation is beginning to be righted.

Coal is one of our great resources, perhaps it has been neglected. It presents a profitable field for research on many lines:

(a) to achieve better extraction
(b) to gain more of the British Columbia market
(c) to provide for possible new uses, e.g., in gas turbines, as a source of low ash, coke, and as a source of liquid fuel.

Relationship with Other Primary Industries

The mining industry affords a very considerable market for fish, products of the forest, and of agriculture. Chemical fertilizer, a by-product of the industry, finds some of its market in British Columbia, and the market for much of the coal and the structural materials produced is in British Columbia, dependent on other primary industries.

Problems and Conflicts

Increased use of British Columbia coal in British Columbia, use of diatomite, of superior clays and of by-product iron sulphide are not improbable and would aid materially in expanding and stabilizing the mining industry. The problem of gold mining with a fixed price and inflated costs, even though lessened by the Emergency Gold Mining Assistance Act, is a very real problem, almost certainly the solution must come from national or international rather than provincial action. Restriction of prospecting by creating parks and other reserved areas are apt to hamper or prevent the discovery and working of mineral deposits and therefore to prevent mining from reaching and maintaining its optimum level. Imposition of burdensome direct taxes, and denial of ready access to timber for mining purposes by creation of forest reserves, will result in increased costs and therefore will hamper the mineral industry of the province in the foreign market, and also in the home market, where there is competition with mineral products originating outside the province.

Bibliography of Publications Relating to the Mineral Resources of British Columbia

The appended bibliography lists works dealing with specific mineral resources and with discussions of the mineral resources of British Columbia. It is considered unnecessary to list individually all the Annual Reports of the Minister of Mines of British Columbia and all the Bulletins published by the British Columbia Department of Mines. The Annual Reports record production and progress of the mineral industry and give information about particular mineral deposits. Some of the Bulletins deal with a particular mineral or type of deposit. Most of the Bulletins deal with selected areas recording the geological observations and giving detailed data concerning mineral deposits. Similarly the numerous memoirs and other publications of the Geological Survey of Canada, dealing with geology and mineral resources of selected areas in British Columbia have not been listed individually.

Alcock, F. J.
(1930): Zinc and Lead Deposits of Canada; Geol. Surv., Canada, Econ. Geol. Ser. No. 8, pp. 265-358.

Armstrong, J. E.
(1946): Geology and Mineral Deposits of Northern British Columbia West of the Rocky Mountains; Geol. Surv., Canada, Geol. Surv. Bull. No. 5.

Banks, H. R.
(1941): Tin at the Sullivan Concentrator. Trans. C.I.M.M. Vol. XLIV, pp. 611-622.

Brewer, W. M.
(1925): Mineral Resources Tributary to the Coast section of the Pacific Great Eastern Railway; Trans. C.I.M.M., Vol. XXVIII, pp. 387-397.

British Columbia Minister of Mines Annual Reports 1874-1947

Department of Mines Bulletins 1-26, 1940-1947.

Campbell, E. E.
(1921): Mineral Occurrences in the Stewart District, British Columbia; Trans. C.I.M.M. Vol. XXIII, pp. 391-395.

Cole, L. H.
(1913): Gypsum in Canada; Mines Branch, Canada, Pub. No. 245, pp. 91-106.

(1928): Silica in Canada, Pt. II, Western Canada; Mines Branch, Canada, Pub. No. 686, pp. 37-41.

(1930): Gypsum industry in Canada; Mines Branch, Canada; Pub. No. 714, pp. 58-71.

Cole, L. H. and Rogers, R. A.
(1933): Anhydrite: Mines Branch, Canada, Pub. No. 732, p. 27.

Committee on Resources and Railways, Province of British Columbia Report 1945.

Cooke, H. C.
(1946): Canadian Lode Gold Areas: Geol. Surv., Canada, Ec. Geol. Ser. No. 15, pp. 9-29.

Cummings, J. M.
(1940): Saline and Hydromagnesite Deposits of British Columbia; Dept. of Mines, B. C., Bull. No. 4.

Dawson, G. M.
(1877): General notes on the Mines and Minerals of Economic Value of British Columbia...Geol. Surv., Canada, Rept. of Prog. 1876-77, pt. V, pp. 103-149.

(1889): The Mineral Wealth of British Columbia; Geol. Surv., Canada, Ann. Rept. 1887-88, Vol. III, pt. I, pt. R., pp. 6-163.

Department of Mines and Resources, Canada,
Bureau of Mines Reports.

Memorandum Series.

Lists of mines, and metallurgical plants.

Dominion Bureau of Statistics, Canada,
Coal Statistics for Canada.

Industrial or Non-metallic Minerals in Canada.

Miscellaneous Metals in Canada.

Nickel-Copper Mining, Smelting and Refining Industry in Canada.

Summary Review of the Gold Mining Industry in Canada.

Summary Review of the Silver Mining Industry in Canada.

Dowling, D. B.
(1915): Coal Fields and Coal Resources of Canada; Geol. Surv., Canada, Mem. 59, pp. 104-146.

(1915): Coal Fields of British Columbia; Geol. Surv., Canada, Mem. 69.

Eardley-Wilmot, V. L.
(1925): Molybdenum; Mines Branch, Canada, Pub. No. 592, pp. 30-53.

Eardley-Wilmot, V. L.
(1927): Siliceous Abrasives; Mines Branch, Canada, Pub. No. 673, pp. 87-90.

(1927): Garnet; Mines Branch, Pub. 677, pp. 7, 26, 27.

(1928): Diatomite; Mines Branch, Canada, Pub. 691, pp. 43-54.

Ellsworth, H. V.
(1932): Rare-element minerals of Canada; Geol. Surv., Canada, Ec. Geol. Ser. No. 11, pp. 136-139.

Geol. Surv. Canada.
Repts. of Progress - 1871-1884

Annual Reports - 1885-1904

Summary Reports - 1905-1933.

Memoirs - 1905 to date, some 60 of which pertain to British Columbia.

Preliminary Papers - 1936 to date, some 60 of which pertain to British Columbia.

(1947): Map of Dominion of Canada, Mining Areas: Geol. Surv., Canada, No. 900A.

(1947): Geology and Economic Minerals of Canada; Geol. Surv., Canada; Ec. Geol. Ser. No. 1, pp. 260-310.

Goudge, M. F.
(1946): Limestones of Canada, Pt. V, Western Canada; Mines and Geology Branch, Canada, Pub. No. 811, pp. 124-225.

Gunning, H. C.
(1943): Geology and Mineral Resources of British Columbia; The Miner, Vol. 16, No. 6, pp. 35-39; Vol. 16, No. 7, pp. 33-38.

Hanson, G.
(1932): Manganese Deposits of Canada; Geol Surv., Canada, Ec. Geol. Ser. No. 12, pp. 107-119.

Hume, G. S.
(1933): Oil and Gas in Western Canada; Geol. Surv., Canada, Ec. Geol. Ser. No. 5, pp. 306-308.

Hurst, M. E.
(1927): Arsenic-bearing deposits of Canada; Geol. Surv., Canada, Ec. Geol. Ser. No. 4, pp. 36-85.

Irwin, A. L.
(1939): Tailings disposal at the Sullivan Concentrator: Trans. C.I.M.M. Vol. XLII, pp. 268-273.

Kerr, F. A.
(1929): The Development and Mineral Resources of Northern British Columbia; Trans. C.I.M.M., Vol. XXXII, pp. 51-64.

Leverin, H. A.
(1947): Peat Moss Deposits in Canada; Mines and Geology Branch, Pub. No. 817, pp. 88-94.

MacDonald, M. A.
(1936): Report of the Commissioner - Coal and Petroleum Products Commission (British Columbia).

MacKay, B. R.
(1942): Coal Reserves of Canada, Reprint of Chapter and Appendix A of Report of Royal Commission on Coal, 1946. King's Printer and Comptroller of Stationery, Ottawa.

MacLellan, L.
(1910): The Geology and Mineral Resources of the Queen Charlotte Islands; Journ. Can. Min. Inst., Vol. XIII, pp. 288-296.

McClelland, W. R.
(1948): Notes on Lead Occurrences in Canada; Bureau of Mines, Canada, Mem. Ser. No. 99, pp. 12-26.

Mandy, J. T.
(1935): Gold-bearing Black Sand Deposits of Graham Island, Queen Charlotte Islands, B. C.; Trans. C.I.M.M., Vol. XXXVII, pp. 563-573.

Mathews, W. H.
(1947): Calcareous Deposits of the Straits of Georgia Area; Dept. of Mines, British Columbia, Bull. No. 23.

Mathews, W. H.
(1947): Geology and Coal Resources of the Carbon Creek-Mount Bickford Map-area; Dept. of Mines, British Columbia, Bull. No. 24.

Munitions Resources Commission (Canada) Final Report 1920. (1920).

O'Neill, J. J. and Gunning, H. C.
(1934): Platinum and Allied Metal Deposits of Canada; Geol. Surv., Canada, Ec. Geol. Ser. No. 13, pp. 76-107.

Parks, W. A.
(1917): Report on the Building and Ornamental Stones of Canada, Vol. V., British Columbia; Mines Branch, Canada; Pub. No. 452.

Report of the Royal Commission on Coal (1946).

Report of the Zinc Commission (1906).

Spence, H. S.
(1922): Barium and Strontium in Canada; Mines Branch, Canada, Pub. No. 570, pp. 22, 87.

(1922): Talc and Soapstone in Canada; Mines Branch, Canada, Pub. No. 583, pp. 18-23.

(1924): Bentonite; Mines Branch, Canada, Pub. No. 624, pp. 7-10.

(1929): Mica, Mines Branch, Canada, Pub. No. 701, pp. 76-80.

(1940): Talc, Steatite, Soapstone and pyrophyllite; Mines and Geology Branch, Canada, Pub. No. 803, pp. 131-135.

Stevenson, J. S.
(1940): Molybdenum deposits of British Columbia; Dept. of Mines, B. C. Bull. No. 9.

(1940): Mercury Deposits of British Columbia; Dept. of Mines, B. C., Bull. No. 5.

(1943): Tungsten Deposits of British Columbia; Dept. of Mines, B. C., Bull. No. 10.

Thomas, L. D.
(1944): Mineral Possibilities of areas adjacent to the Alaska Highway; Part II - British Columbia Section, C.I.M.M. Trans. Vol. 47, pp. 203-227.

Williams, M. Y.
(1934): Mineral Resources of the Peace River Area; Trans. C.I.M.M., Vol. 37, pp. 351-357.

Wilson, M. E.
(1926): Talc Deposits of Canada; Geol. Surv., Canada, Ec. Geol. Ser. No. 2, pp. 33-52.

(1929): Fluorspar deposits of Canada; Geol. Surv., Canada, Ec. Geol. Ser. No. 6, pp. 21-30.

Young, G. A.
(1915): Hydromagnesite Deposits of Atlin, B. C.; Geol. Surv., Canada, Sum. Rept. 1915, pp. 50-61.

Young, G. A. and Uglow, W. L.
(1928): Iron Ores of Canada, Vol. I, British Columbia and Yukon; Geol. Surv., Canada, Ec. Geol. Ser. No. 3.

- - - - - - - -