ANNUAL REPORT

OF THE

MINISTER OF MINES

FOR THE

YEAR ENDING 31ST DECEMBER

1915

BEING AN ACCOUNT OF

MINING OPERATIONS FOR GOLD, COAL, ETC.

IN THE

PROVINCE OF BRITISH COLUMBIA

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA.

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1916.

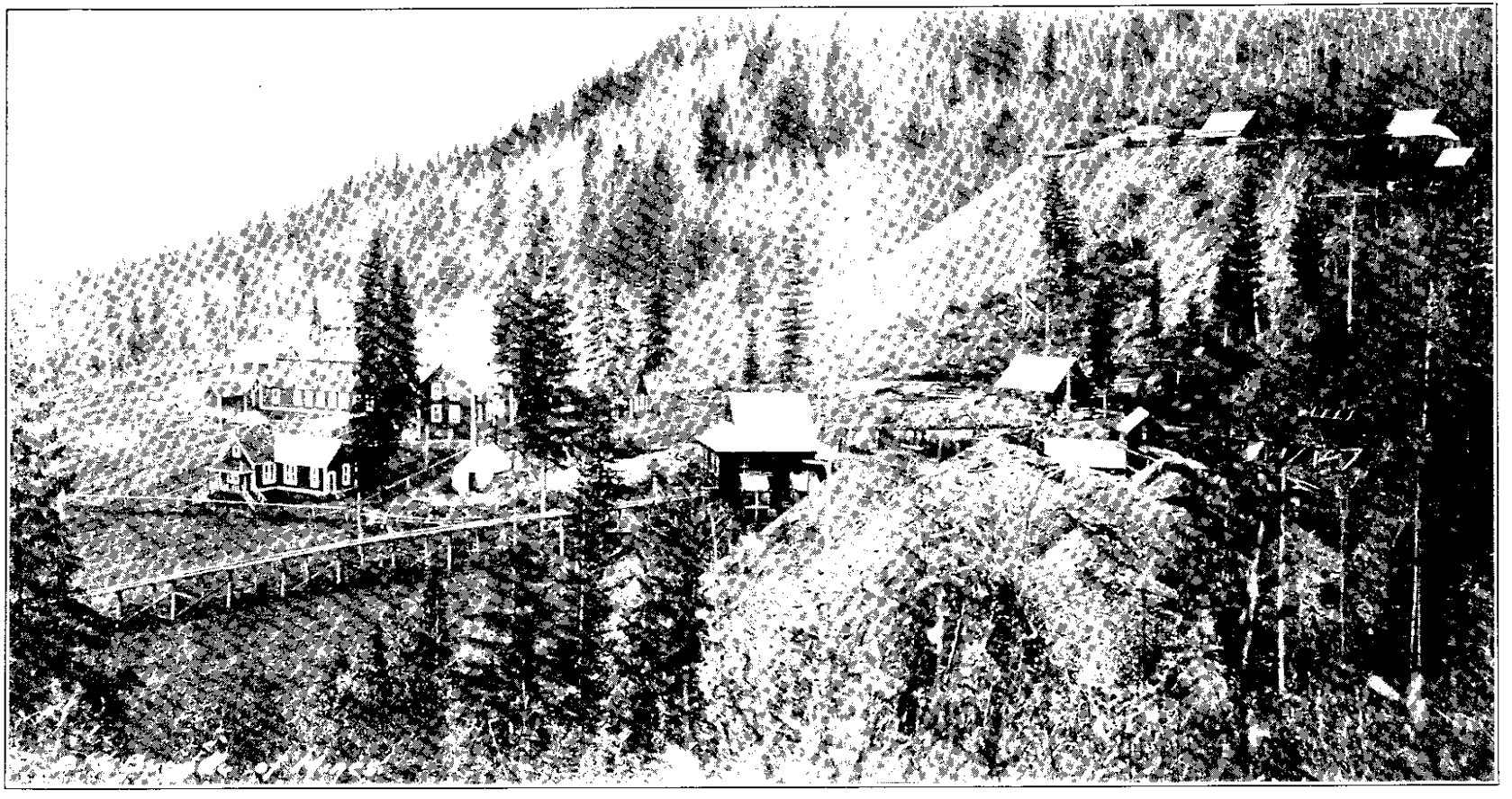
To His Honour FRANK STILLMAN BARNARD,
Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

The Annual Report of the Provincial Mineralogist upon the Mining Industry of the Province for the year 1915 is herewith respectfully submitted.

L. A. CAMPBELL,
Minister of Mines.

Minister of Mines' Office,
March 31st, 1916.



Standard Mine, near Silverton—Slocan M.D.

To the Honourable Lorne A. Campbell,
Minister of Mines.

SIR,—I have the honour to submit herewith my Annual Report on the Mining Industry of the Province for the year ending December 31st, 1915.

The statistical tables give the total mineral output of the Province to date, and show in considerable detail the actual mineral production of the past year, as based on smelter or mill returns; also, a summary of the production of each of the last four years, thus illustrating by comparison the progress made in productive mining during this period.

To facilitate comparison with information previously given, I have retained, as closely as was possible, the general form already established for such tables and for the Report.

I have the honour to be,
Sir,
Your obedient servant,

WILLIAM FLEET ROBERTSON,
Provincial Mineralogist.

Bureau of Mines, Victoria, B.C.,
March 31st, 1916.

MINERAL PRODUCTION OF BRITISH COLUMBIA.

METHOD OF COMPUTING PRODUCTION.

In assembling the output of the lode mines in the following tables, the established custom of this Bureau has been adhered to, viz.: The output of a mine for the year is considered that amount of ore for which the smelter or mill returns have been received during the year. This system does not give the exact amount mined during the year, but rather the amount credited to the mine on the company's books during such year.

For ore shipped in December the smelter returns are not likely to be received until February in the new year, or later, and have, consequently, to be carried over to the credit of such new year. This plan, however, will be found very approximate for each year, and ultimately correct, as ore not credited in one year is credited in the next.

In the lode mines tables, the amount of the shipments has been obtained from certified returns received from the various mines, as provided for in the "Inspection of Metalliferous Mines Act, 1897." In calculating the value of the products, the average prices for the year in the New York Metal Market have been used as a basis. For silver 95 per cent., for lead 90 per cent., and for zinc 85 per cent. of such market prices have been taken. Treatment and other charges have not been deducted, except that in copper the amount of metal actually recovered has been taken, thus covering loss in slags.

TABLE I.—TOTAL PRODUCTION FOR ALL YEARS UP TO AND INCLUDING 1915.

Gold, placer	$ 74,039,603
Gold, lode	86,763,450
Silver	39,298,273
Lead	33,407,662
Copper	96,774,870
Coal and coke	156,928,640
Building-stone, bricks, etc.	25,398,282
Other metals, zinc, etc.	3,659,473
Total	$516,270,253

TABLE II.—PRODUCTION FOR EACH YEAR FROM 1852 TO 1915 (INCLUSIVE).

1852 to 1892 (inclusive)	$ 81,090,069
1893	3,588,413
1894	4,225,717
1895	5,643,042
1896	7,507,956
1897	10,455,268
1898	10,906,861
1899	12,393,131
1900	16,344,751
1901	20,086,780
1902	17,486,550
1903	17,495,954
1904	18,977,359
1905	22,461,325
1906	24,980,546
1907	25,882,560
1908	23,851,277
1909	24,443,025
1910	26,377,066
1911	23,499,072
1912	32,440,800
1913	30,296,398
1914	26,388,825
1915	29,447,508
Total	$516,270,253

Table III. gives a statement in detail of the quantities and value of the different mineral products for the years 1913, 1914, and 1915. It has been impossible as yet to collect complete statistics regarding building-stone, lime, bricks, tiles, and other miscellaneous products, but such figures as has been possible to secure are given in some detail in Table V.

TABLE III.

QUANTITIES AND VALUE OF MINERAL PRODUCTS FOR 1913, 1914, AND 1915.

	Customary Measure.	1913.		1914.		1915.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer	Ounces.	.....	$ 510,000	.....	$ 565,000	38,500	$ 770,000
" lode	"	272,254	5,627,490	247,170	5,109,004	250,021	5,167,934
Silver	"	3,465,856	1,968,606	3,602,180	1,876,736	3,366,506	1,588,991
Lead	Pounds	55,364,677	2,175,832	50,625,048	1,771,877	46,503,590	1,939,200
Copper	"	46,460,305	7,094,489	45,009,699	6,121,319	56,918,405	9,835,500
Zinc	"	6,758,768	324,421	7,866,467	346,125	12,982,440	1,460,524
Coal	Tons, 2,240 lb.	2,137,483	7,481,190	1,810,967	6,338,385	1,611,129	5,638,952
Coke	" "	286,045	1,716,270	234,577	1,407,462	245,871	1,475,226
Miscellaneous products	.....	.....	3,398,100	.....	2,852,917	.....	1,571,181
			$30,296,398		$26,388,825		$29,447,508

TABLE IV.

OUTPUT OF MINERAL PRODUCTS BY DISTRICTS AND DIVISIONS.

NAMES.	DIVISIONS.			DISTRICTS.		
	1913.	1914.	1915.	1913.	1914.	1915.
CARIBOO DISTRICT	.....	.....	.....	$ 226,024	$ 308,807	$ 885,502
Cariboo Mining Division	$ 131,000	$ 166,500	$ 217,500	.....	.....	.....
Quesnel "	55,000	37,000	86,000	.....	.....	.....
Omineca "	40,024	105,307	582,002	.....	.....	.....
CASSIAR DISTRICT	.....	.....	.....	412,748	2,079,177	4,420,988
EAST KOOTENAY DISTRICT	.....	.....	.....	5,947,935	4,703,672	4,653,836
WEST KOOTENAY DISTRICT	.....	.....	.....	7,092,107	6,311,205	7,308,793
Ainsworth Division	627,150	471,534	360,846	.....	.....	.....
Slocan and Slocan City "	2,258,309	1,780,936	2,455,462	.....	.....	.....
Nelson "	863,966	579,563	608,277	.....	.....	.....
Trail Creek "	3,305,771	3,456,610	3,865,284	.....	.....	.....
Other parts	36,911	22,562	18,924	.....	.....	.....
BOUNDARY-YALE DISTRICT	.....	.....	.....	7,925,336	4,867,029	5,470,689
Osoyoos, Grand Forks & Greenwood Divisions	6,833,902	4,270,744	5,023,635	.....	.....	.....
Similkameen, Nicola, Vernon	1,019,340	533,991	371,733	.....	.....	.....
Yale, Ashcroft, Kamloops	72,094	62,294	75,321	.....	.....	.....
LILLOOET DISTRICT	.....	.....	.....	71,445	38,978	25,643
COAST DISTRICTS (Nanaimo, Alberni, Clayoquot, Quatsino, Victoria, Vancouver)	.....	.....	.....	8,620,803	8,079,957	6,682,057
				$30,296,398	$26,388,825	$ 29,447,508

TABLE V.

MISCELLANEOUS PRODUCTS AND TOTALS OF PRODUCTION, 1915.

DISTRICT AND DIVISION.	DETAILS OF MISCELLANEOUS PRODUCTS.										SUMMARY OF TOTALS OF PRODUCTION.				
	Cement.	Lime and Limestone.	Building-stone.	Riprap.	Crushed Rock.	Sand and Gravel.	Pottery and Tile.	Red Brick.	Fire, Face, & Silica Brick.	Clay, Gypsum, etc.	Total Miscellaneous Products.	Total Output of Collieries.	Total of Metalliferous Mines.	Totals for Divisions.	Totals for Districts.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
CARIBOO															885,502
Cariboo		1,000		1,000		500					2,500		215,000	217,500	
Quesnel					1,000						1,000		85,000	86,000	
Omineca				1,000		500					1,500		580,502	582,002	
CASSIAR															4,420,988
Atlin		8,400									8,400		395,086	403,486	
Liard-Stikine Skeena, Portland C Queen Charlotte		2,500	5,000	2,000	1,000	3,000					13,500		4,004,002	4,017,502	
EAST KOOTENAY															4,653,836
Fort Steele			1,000	1,000	2,000	3,000					7,000	3,224,310	1,370,876	4,602,186	
Windermere-Golden			1,000	1,000	3,000	2,000					7,000		44,650	51,650	
WEST KOOTENAY															7,308,793
Ainsworth			1,000			1,000					2,000		358,846	360,846	
Slocan & Slocan City													2,455,462	2,455,462	
Nelson		1,000	2,000	3,000	3,000	3,600		2,000			14,600		593,677	608,277	
Trail Creek		2,000		15,000	10,000	10,000				1,710	38,710		3,826,574	3,865,284	
Other Divisions		1,000			2,000	2,000					5,000		13,924	18,924	
BOUNDARY-YALE															5,470,689
Grand Forks Greenwood		54,654	3,000	3,000	3,000	3,000		2,000			68,654		4,954,981	5,023,635	
Osoyoos Similkameen Nicola Vernon		2,000		1,000	2,000	2,000					7,000	346,731	18,002	371,733	
Yale Ashcroft Kamloops		2,000		2,000	3,000	3,000		1,323			11,323		63,998	75,321	
LILLOOET			2,000	5,000	5,000	5,000					17,000		8,643	25,643	25,643
COAST DISTRICT	464,690	51,088	252,450	274,669	37,948	80,542	82,744	40,383	71,827	9,653	1,365,994	3,543,137	1,772,926	6,682,057	6,682,057
	464,690	125,642	267,450	309,669	72,948	119,142	82,744	45,706	71,827	11,363	1,571,181	7,114,178	20,762,149	29,447,508	29,447,508

TABLE VI.—PLACER GOLD.

Table VI. contains the yearly production of placer gold to date, as determined by the returns sent in by the banks and express companies, of gold transmitted by them to the mints, and from returns sent in by the Gold Commissioners and Mining Recorders. To these yearly amounts one-third was added up to the year 1878; from then to 1895 and from 1898 to 1909, one-fifth; and since then one-tenth, which proportions are considered to represent, approximately, the amount of gold sold of which there is no record. This placer gold contains from 10 to 25 per cent. silver, but the silver value has not been separated from the totals, as it would be insignificant.

YIELD OF PLACER GOLD PER YEAR TO DATE.

1858	$ 705,000	1873	$ 1,305,749	1888	$ 616,731	1903	$ 1,060,420
1859	1,615,070	1874	1,844,618	1889	588,923	1904	1,115,300
1860	2,228,543	1875	2,474,004	1890	490,435	1905	969,300
1861	2,666,118	1876	1,786,648	1891	429,811	1906	948,400
1862	2,656,903	1877	1,608,182	1892	399,526	1907	828,000
1863	3,913,563	1878	1,275,204	1893	356,131	1908	647,000
1864	3,735,850	1879	1,290,058	1894	405,516	1909	477,000
1865	3,491,205	1880	1,013,827	1895	481,683	1910	540,000
1866	2,662,106	1881	1,046,737	1896	544,026	1911	426,000
1867	2,480,868	1882	954,085	1897	513,520	1912	555,500
1868	3,372,972	1883	794,252	1898	643,346	1913	510,000
1869	1,774,978	1884	736,165	1899	1,344,900	1914	565,000
1870	1,336,956	1885	713,738	1900	1,278,724	1915	770,000
1871	1,799,440	1886	903,651	1901	970,100		
1872	1,610,972	1887	693,709	1902	1,073,140		
						Total	$74,039,603

TABLE VII.—PRODUCTION OF LODE MINES.

YEAR.	GOLD.		SILVER.		LEAD.		COPPER.		ZINC.		TOTAL VALUE.
	Oz.	Value.	Oz.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	
		$		$	$			$		$	$
1887	.....	.....	17,690	17,331	204,800	9,216	.....	.....	.....	.....	26,547
1888	.....	.....	79,780	75,000	674,500	29,813	.....	.....	.....	.....	104,813
1889	.....	.....	53,192	47,873	165,100	6,498	.....	.....	.....	.....	54,371
1890	.....	.....	70,427	73,948	*Nil.*	*Nil.*	.....	.....	.....	.....	73,948
1891	.....	.....	4,500	4,000	*Nil.*	*Nil.*	.....	.....	.....	.....	4,000
1892	.....	.....	77,160	66,935	808,420	33,064	.....	.....	.....	.....	99,999
1893	1,170	23,404	227,000	195,000	2,135,023	78,996	.....	.....	.....	.....	297,400
1894	6,252	125,014	746,379	470,219	5,662,523	169,875	324,680	16,234	.....	.....	781,342
1895	39,264	785,271	1,496,522	977,229	16,475,464	532,255	952,840	47,642	.....	.....	2,342,397
1896	62,259	1,244,180	3,135,343	2,100,689	24,199,977	721,384	3,818,556	190,926	.....	.....	4,257,179
1897	106,141	2,122,820	5,472,971	3,272,836	38,841,135	1,390,517	5,325,180	266,258	.....	.....	7,052,431
1898	110,061	2,201,217	4,292,401	2,375,841	31,693,559	1,077,581	7,271,678	374,781	.....	.....	6,529,420
1899	138,315	2,857,573	2,939,413	1,663,708	21,862,486	873,870	7,722,591	1,351,453	.....	.....	6,751,604
1900	167,153	3,453,381	3,958,175	2,309,200	63,358,621	2,691,887	9,997,080	1,615,289	.....	.....	10,069,757
1901	210,384	4,348,603	5,151,333	2,884,745	51,582,906	2,002,733	27,603,746	4,446,963	.....	.....	13,683,044
1902	236,491	4,888,269	3,917,917	1,941,328	22,536,381	824,832	29,636,057	3,446,673	.....	.....	11,101,102
1903	232,851	4,812,616	2,996,204	1,521,472	18,089,283	689,744	34,359,921	4,547,535	.....	.....	11,571,367
1904	222,042	4.589,608	3,222,481	1,719,516	36,646,244	1,421,874	35,710,128	4,576,087	.....	.....	12,309,035
1905	238,660	4,933,102	3.439,417	1,971,818	56,580,703	2,399,022	37,692,251	5,876,222	.....	.....	15,180,164
1906	224,027	4,630,639	2,990,262	1,897,320	52,408,217	2,667,578	42,990,488	8,288,565	.....	.....	17,484,102
1907	196,179	4,055,020	2,745,448	1,703,325	47,788,703	2,291 458	40,832,720	8,166,544	.....	.....	16,216,847
1908	255,582	5,282,880	2,631,389	1,321,483	43,196,733	1,632,799	47,274,014	6,240,249	.....	.....	14,477,411
1909	238,224	4,924,090	2,532,742	1,239,270	44,396,346	1,709,259	45,597,245	5,918,522	8,500,000	400,000	14,191,141
1910	267,701	5,533,380	2,450,241	1,245,016	34,658,746	1,386,350	38,243,934	4,871,512	4,184,192	192,473	13,228,731
1911	228,617	4,725,513	1,892,364	958,293	26,872,397	1,069,521	36,927,656	4,571,644	2,634,544	129,092	11,454,063
1912	257,496	5,322,442	3,132,108	1,810,045	44,871,454	1,805,627	51,456,537	8,408,513	5,358,280	316,139	17,662,766
1913	272,254	5,627,490	3,465,856	1,968,606	55,364,677	2,175,832	46,460,305	7,094,489	6,758,768	324,421	17,190,838
1914	247,170	5,109,004	3,602,180	1,876,736	50,625,048	1,771,877	45,009,699	6,121,319	7,866,467	346,125	15,225,061
1915	250,021	5,167,934	3,366,506	1,588,991	46,503,590	1,939,200	56,918,405	9,835,500	12,982,440	1,460,524	19,992,149
Tot'l	4,208,294	86,763,450	70,107,401	39,298,273	838,151,986	33,407,662	652,126,311	96,774,870	48,284,691	3,168,774	259,413,029

TABLE VIII.—COAL AND COKE PRODUCTION PER YEAR TO DATE.

COAL.

Year.	Tons (2,240 lb.).	Value.
1836-1881	1,873,907	$ 6,003,245
1882	282,139	846,417
1883	213,299	639,897
1884	394,070	1,182,210
1885	265,596	796,788
1886	326,636	979,908
1887	413,360	1,240,080
1888	489,301	1,467,903
1889	579,830	1,739,490
1890	678,140	2,034,420
1891	1,029,097	3,087,291
1892	826,335	2,479,005
1893	978,294	2,934,882
1894	1,012,953	3,038,859
1895	939,654	2,818,962
1896	896,222	2,688,666
1897	882,854	2,648,562
1898	1,135,865	3,407,595
1899	1,306,324	3,918,972
1900	1,439,595	4,318,785
1901	1,460,331	4,380,993
1902	1,397,394	4,192,182
1903	1,168,194	3,504,582
1904	1,253,628	3,760,884
1905	1,384,312	4,152,936
1906	1,517,303	4,551,909
1907	1,800,067	6,300,235
1908	1,677,849	5,872,472
1909	2,006,476	7,022,666
1910	2,800,046	9,800,161
1911	2,193,062	7,675,717
1912	2,628,804	9,200,814
1913	2,137,483	7,481,190
1914	1,810,967	6,338,385
1915	1,611,129	5,638,952
Total	42,810,516	$138,146,015

COKE.

Year.	Tons (2,240 lb.).	Value.
1895-97	19,396	$ 96,980
1898 (estimated)	35,000	175,000
1899	34,251	171,255
1900	85,149	425,745
1901	127,081	635,405
1902	128,015	640,075
1903	165,543	827,715
1904	238,428	1,192,140
1905	271,785	1,358,925
1906	199,227	996,135
1907	222,913	1,337,478
1908	247,399	1,484,394
1909	258,703	1,552,218
1910	218,029	1,308,174
1911	66,005	396,030
1912	264,333	1,585,998
1913	286,045	1,716,270
1914	234,577	1,407,462
1915	245,871	1,475,226
Total	3,347,740	$18,782,625

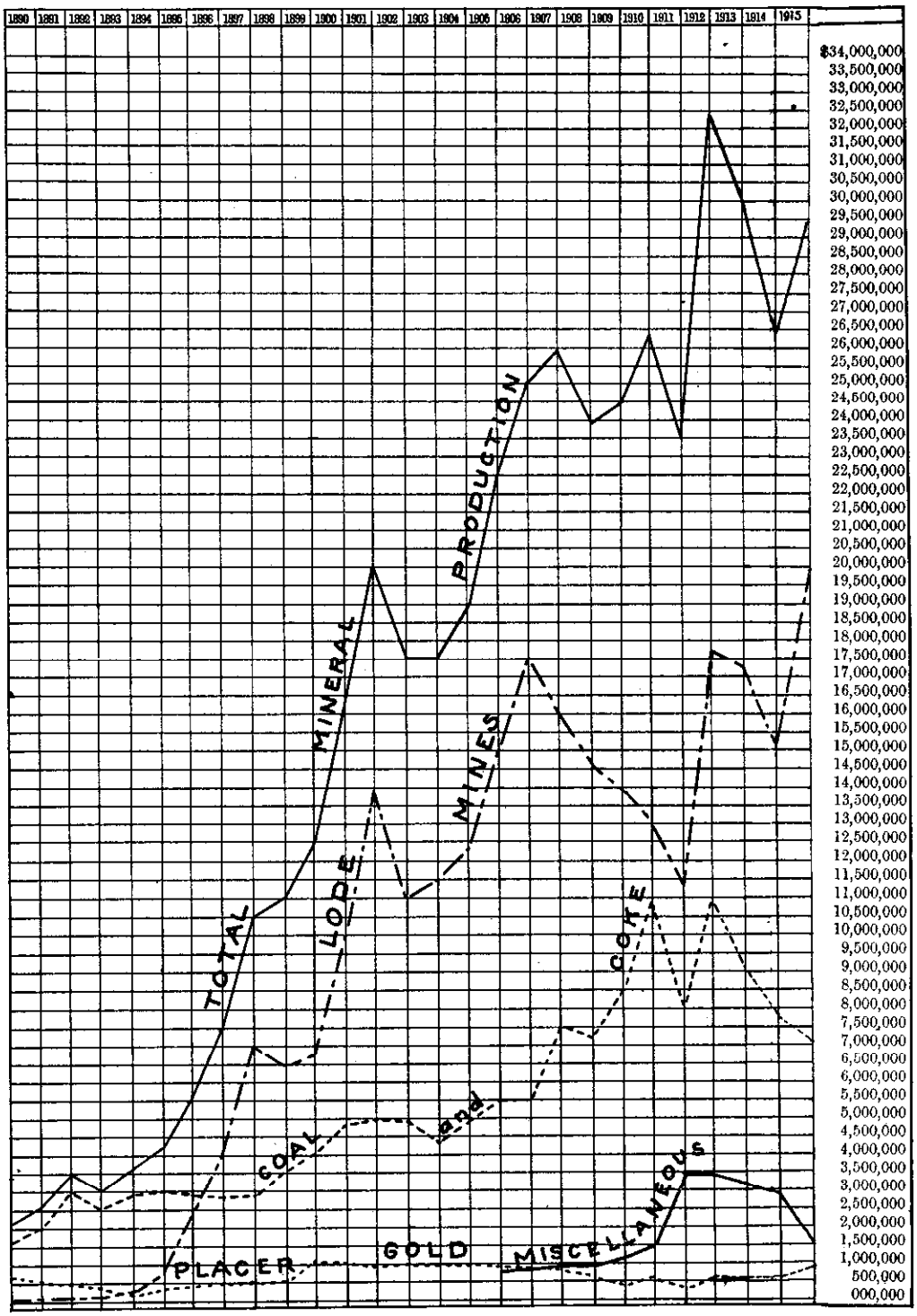
TABLE IX.—PRODUCTION IN DETAIL OF THE

DISTRICT.	YEAR	TONS.	GOLD—PLACER.		GOLD—LODE.		SILVER.	
			Ounces	Value.	Ounces.	Value.	Ounces.	Value.
				$		$		$
Cariboo								
Cariboo Division	1912		9,000	180,000				
	1913		6,550	131,000				
	1914		8,250	165,000				
	1915		10,750	215,000				
Quesnel "	1912		2,500	50,000				
	1913		1,500	30,000				
	1914		1,750	35,000				
	1915		4,250	85,000				
Omineca "	1912		400	8,000				
	1913	353	300	6,000	62	1,281	46,298	26,297
	1914	850	300	6,000	203	4,196	135,265	70,473
	1915	17,545	600	12,000	1,524	31,501	79,155	37,361
Cassiar								
Atlin Division	1912		14,500	290,000				
	1913	310	15,750	315,000	1,355	28,008		
	1914	270	16,100	322,000	1,000	20,670		
	1915	320	18,850	377,000	875	18,086		
Liard, Stikine, Skeena, Queen Charlotte, Portland Canal Divisions.	1912	3,249	450	9,000	197	4,072	5,868	3,391
	1913	51	650	13,000	29	599	4,714	2,678
	1914	261,987	1,150	23,000	2,884	59,612	131,509	68,516
	1915	646,391	1,450	29,000	5,034	104,053	176,179	82,684
East Kootenay								
Fort Steele Division	1912	29,910	100	2,000			376,918	217,821
	1913	32,626	100	2,000			362,311	205,798
	1914	36,384	50	1,000			492,080	256,374
	1915	44,372	750	15,000			481,258	227,154
Windermere-Golden	1912	20,400					7,405	4,279
	1913	10,000					4,756	2,701
	1914							
	1915	5,556					1,188	561
West Kootenay								
Ainsworth Division	1912	32,741			80	1,653	301,755	174,384
	1913	92,472			25	517	447,015	253,905
	1914	66,441			100	2,067	329,586	171,714
	1915	42,630			121	2,501	289,565	136,675
Slocan and Slocan City	1912	103,629			198	4,092	1,657,105	957,641
	1913	116,206			252	5,209	1,841,226	1,045,816
	1914	104,510			13	269	1,775,975	925,283
	1915	114,292			26	537	1,812,550	865,524
Nelson Division	1912	52,323	50	1,000	17,513	361,994	164,182	94,881
	1913	79,843	50	1,000	26,324	544,117	129,011	73,278
	1914	57,879			15,298	316,210	150,268	78,290
	1915	23,634	50	1,000	9,233	190,846	9,405	4,439
Trail Creek Division	1912	243,870			132,073	2,729,949	87,530	50,584
	1913	253,870			137,004	2,831,873	109,585	62,244
	1914	297,260			138,568	2,864,201	130,185	70,952
	1915	338,568			142,595	2,947,439	159,584	75,324
Revelstoke, Trout Lake and Lardeau	1912	451	225	4,500	89	1,840	43,536	25,159
	1913	546	100	2,000	54	1,116	23,397	13,289
	1914	149	100	2,000	8	165	11,295	5,885
	1915	155	100	2,000	15	310	16,740	7,901
Boundary-Yale								
(Grand Forks, Greenwood and Osoyoos Divisions.)	1912	1,989,084	50	1,000	104,849	2,167,229	389,341	225,000
	1913	1,844,795	50	1,000	101,195	2,091,701	394,048	223,819
	1914	1,093,229	50	1,000	84,908	1,775,048	347,981	181,298
	1915	1,228,724	100	2,000	87,870	1,816,273	273,795	129,231
Similkameen, Nicola, and Vernon Divisions	1912		100	2,000				
	1913	54	150	3,000	1	20	335	190
	1914	150	150	3,000	35	724	15	8
	1915	225	600	12,000	101	2,088	347	164
Yale, Ashcroft and Kamloops Divisions	1912		100	2,000				
	1913	557	100	2,000	25	517	126	72
	1914	279	150	3,000	14	289	57	30
	1915	2,134	500	10,000	106	2,191	1,702	803
Lillooet								
Lillooet and Clinton Divisions	1912		250	5,000				
	1913	840	150	3,000	1,368	28,277	295	168
	1914	120	150	3,000	231	4,775	390	203
	1915	50	400	8,000	31	641	5	2
Coast								
(Nanaimo, Alberni, Clayoquot, Quatsino, New Westminster, Vancouver, and Victoria Divisions.)	1912	212,875	50	1,000	2,497	51,613	98,468	56,905
	1913	231,286	50	1,000	4,560	94,255	102,739	58,356
	1914	256,463	50	1,000	3,908	80,778	91,574	47,710
	1915	225,454	100	2,000	2,490	51,468	66,033	31,168
TOTALS	1912	2,688,532	27,775	555,500	257,496	5,322,442	3,132,108	1,810,045
	1913	2,663,809	25,500	510,000	272,254	5,627,490	3,465,856	1,968,606
	1914	2,175,971	28,250	565,000	247,170	5,109,004	3,602,180	1,876,736
	1915	2,690,110	38,500	770,000	250,021	5,167,934	3,366,506	1,588,991

METALLIFEROUS MINES, ETC., FOR 1912, 1913, 1914, AND 1915.

LEAD.		COPPER.		ZINC.		TOTALS FOR DIVISIONS.				TOTALS FOR DISTRICTS.
Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	1912.	1913.	1914.	1915.	1915.
	$		$		$	$	$	$	$	$
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	880,502
.....	.....	.....	.....	.....	.....	180,000	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	131,000	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	165,000	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	215,000	.....
.....	.....	.....	.....	.....	.....	50,000	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	30,000	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	35,000	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	85,000	.....
.....	.....	.....	.....	.....	.....	8,000	.....	.....	.....	.....
156,862	6,165	1,838	281	.....	.....	.....	40,024	.....	.....	.....
323,432	11,322	6,000	816	.....	.....	.....	.....	92,807	.....	.....
249,279	10,395	2,831,279	489,245	.....	.....	.....	.....	.....	580,502	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,399,088
.....	.....	.....	.....	.....	.....	290,000	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	343,008	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	342,670	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	395,086	.....
41,512	1,670	88,403	14,446	.....	.....	32,579	.....	.....	.....	.....
6,579	259	1,336	204	.....	.....	.....	16,740	.....	.....	.....
.....	.....	11,123,376	1,512,779	.....	.....	.....	.....	1,603,907	.....	.....
30,462	1,270	21,915,481	3,786,995	.....	.....	.....	.....	.....	4,004,002	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,415,526
18,288,238	733,907	.....	.....	.....	.....	953,728	.....	.....	.....	.....
18,525,083	728,036	.....	.....	.....	.....	.....	935,329	.....	.....	.....
24,363,105	870,209	.....	.....	.....	.....	.....	.....	1,127,583	.....	.....
26,582,050	1,108,472	.....	.....	180,000	20,250	.....	.....	.....	1,370,876	.....
2,249,287	90,509	.....	.....	142,643	8,416	103,204	.....	.....	.....	.....
2,495,355	98,067	.....	.....	.....	.....	.....	100,768	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
216,327	9,021	.....	.....	311,719	35,038	.....	.....	.....	44,650	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,248,483
4,863,894	195,723	.....	.....	.....	.....	371,760	.....	.....	.....	.....
9,027,861	354,795	.....	.....	150,680	7,233	.....	616,450	.....	.....	.....
8,069,525	282,433	.....	.....	280,000	12,320	.....	.....	468,534	.....	.....
3,436,184	143,289	.....	.....	678,948	76,381	.....	.....	.....	358,846	.....
16,944,811	681,859	.....	.....	5,215,637	307,723	1,951,315	.....	.....	.....	.....
22,648,766	890,096	.....	.....	6,608,088	317,188	.....	2,258,309	.....	.....	.....
15,233,910	533,187	.....	.....	7,254,464	319,197	.....	.....	1,777,936	.....	.....
14,925,345	622,387	.....	.....	8,684,572	977,014	.....	.....	.....	2,455,462	.....
2,293,000	92,270	26,257	4,291	.....	.....	554,436	.....	.....	.....	.....
1,936,418	76,101	815,126	124,470	.....	.....	.....	818,966	.....	.....	.....
2,004,436	70,155	586,764	79,800	332,003	14,608	.....	.....	559,063	.....	.....
967,775	40,356	30,240	5,225	3,127,209	351,811	.....	.....	.....	593,677	.....
11,396	459	2,539,900	415,045	.....	.....	3,196,037	.....	.....	.....	.....
.....	.....	2,538,661	387,654	.....	.....	.....	3,281,771	.....	.....	.....
.....	.....	3,779,330	514,057	.....	.....	.....	.....	3,449,210	.....	.....
.....	.....	4,651,681	803,811	.....	.....	.....	.....	.....	3,825,574	.....
229,366	9,230	.....	.....	.....	.....	40,729	.....	.....	.....	.....
521,771	20,506	.....	.....	.....	.....	.....	36,911	.....	.....	.....
128,912	4,512	.....	.....	.....	.....	.....	.....	12,562	.....	.....
89,041	3,713	.....	.....	.....	.....	.....	.....	.....	13,924	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,036,981
.....	.....	33,372,199	5,453,351	.....	.....	7,846,580	.....	.....	.....	.....
45,982	1,807	28,621,973	4,370,575	.....	.....	.....	6,688,902	.....	.....	.....
1,678	59	16,428,959	2,234,339	.....	.....	.....	.....	4,171,744	.....	.....
7,127	297	17,402,662	3,007,180	.....	.....	.....	.....	.....	4,964,961	.....
.....	.....	.....	.....	.....	.....	2,000	.....	.....	.....	.....
.....	.....	8,073	1,233	.....	.....	.....	4,443	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	3,732	.....	.....
.....	.....	21,701	3,750	.....	.....	.....	.....	.....	18,002	.....
.....	.....	.....	.....	.....	.....	2,000	.....	.....	.....	.....
.....	.....	29,505	4,505	.....	.....	.....	7,094	.....	.....	.....
.....	.....	14,525	1,975	.....	.....	.....	.....	5,294	.....	.....
.....	.....	295,164	51,004	.....	.....	.....	.....	.....	63,998	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8,643
.....	.....	.....	.....	.....	.....	5,000	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	31,445	.....	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	7,978	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	8,643	.....
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,772,926
.....	.....	15,429,778	2,521,380	.....	.....	2,630,898	.....	.....	.....	.....
.....	.....	14,443,793	2,205,567	.....	.....	.....	2,359,178	.....	.....	.....
.....	.....	13,070,245	1,777,553	.....	.....	.....	.....	1,907,041	.....	.....
.....	.....	9,770,197	1,688,290	.....	.....	.....	.....	.....	1,772,926	.....
44,871,454	1,805,627	51,456,537	8,408,513	5,358,280	316,139	18,218,266	.....	.....	.....	.....
55,364,677	2,175,332	46,460,305	7,094,489	6,758,768	324,421	.....	17,700,838	.....	.....	.....
50,622,048	1,771,877	45,009,699	6,121,319	7,866,467	346,125	.....	.....	15,790,061	.....	.....
46,503,590	1,939,200	56,918,405	9,835,500	12,982,440	1,460,524	.....	.....	.....	20,762,149	20,762,149

TABLE X.—SHOWING MINERAL PRODUCTION OF BRITISH COLUMBIA.

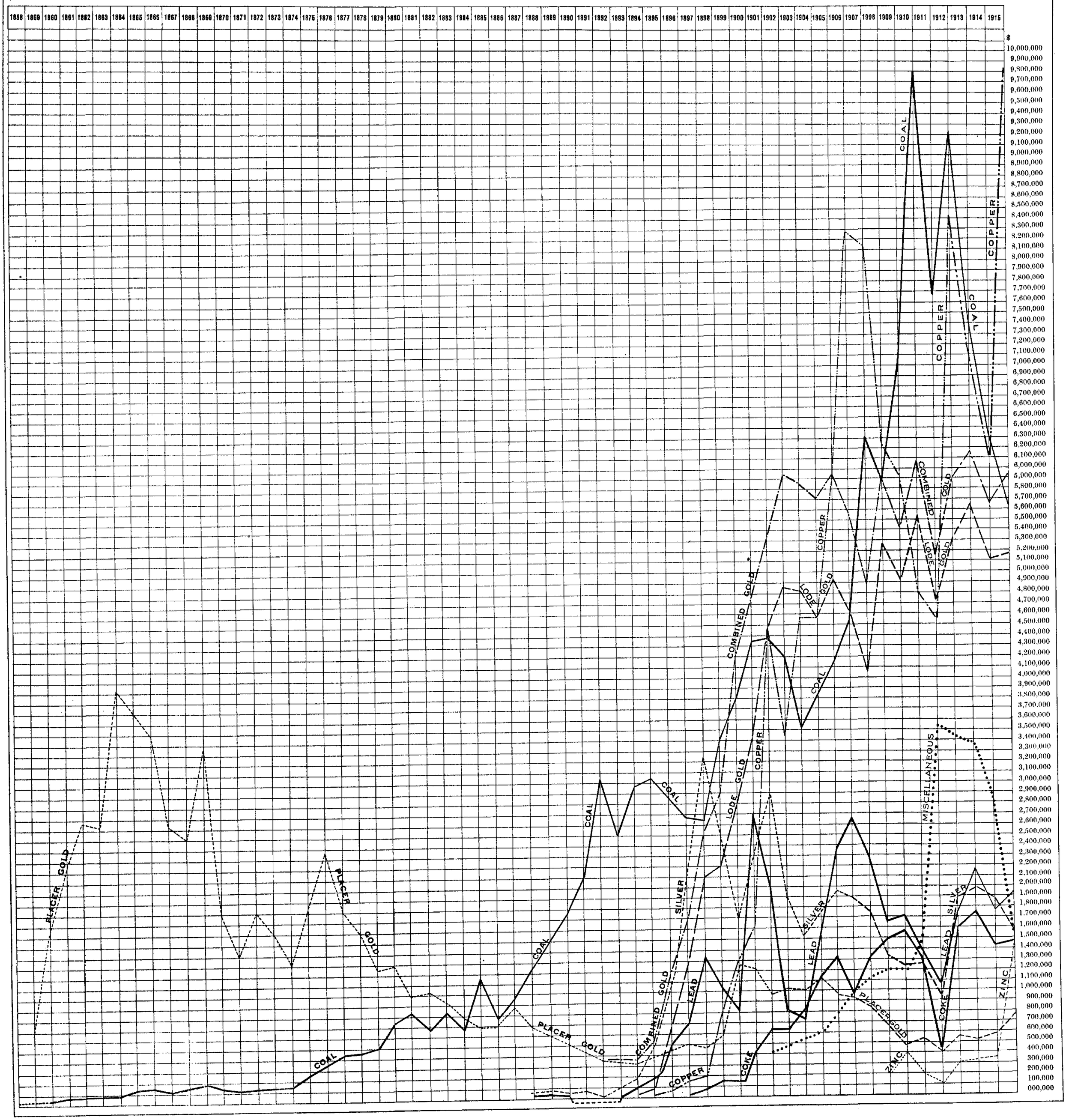


TABLE

SHOWING MINERAL PRODUCTION

OF

BRITISH COLUMBIA



PROGRESS OF MINING.

The gross value of the mineral production for 1915 was $29,447,508, an increase over that of the year 1914 of 3,058,683, or nearly 12 per cent. The gross value of the metallic minerals recovered in 1915 was $20,762,149, which represents an increase over last year of nearly $5,000,000, a percentage increase of about 31 per cent., which is certainly a matter of congratulation.

It might be further pointed out that the metalliferous output for 1915 was the greatest in the history of mining in the Province, being nearly 14 per cent. greater than the former record year of 1912. Yet the year 1915 opened under very inauspicious conditions as far as mining was concerned; the war had only fairly started, and at that time the final issue was in doubt, while the duration of the conflict was then quite unknown.

Under these circumstances it is not to be wondered at that the metal market was so uncertain that producers felt timid as to the future, particularly as the opening months of the year saw the prices of all the metals, except zinc, much below normal.

Apparently no one foresaw or appreciated the trend of modern warfare, with its unprecedented use of artillery, nor realized the tremendous amounts of metal that would be consumed thereby.

How great this consumption of the metals has been can scarcely be appreciated when expressed in figures, but some conception of the enormous expenditure of metals can be obtained from a calculation published by the *Mining and Scientific Press*, and based upon French official statements, that 4,500,000 shells were used by the section of the French Army in Champagne during a four days' bombardment along a twenty-mile front.

The editor, T. A. Rickard, calculates that these shells contained about 18,000,000 lb. of copper, 30,000,000 lb. of lead, and 8,000,000 lb. of zinc. To apply these quantities to the total output of British Columbia made during the year 1915, it will be seen that the year's output of copper would have lasted that small section of the French Army about twelve and one-half days, the lead-output for six days, and the zinc-output for six and one-half days.

The close of 1914 found many of the mines shut down and most of the large producers restricting their output under a common agreement to do so.

Then came the enormous demand for shells of all sorts, from all the Allies, necessitating the use of an amount of copper, lead, zinc, and other metals which soon depleted the stocks, so that by May and June the prices of the metals began to soar, and all the mines that were in a position promptly to supply the demand were pushed to make as great an output as possible.

These higher prices for metals continuing throughout the remainder of the year, stimulated the mineral production very greatly and rendered the margin of profit on production much higher.

It seems to have been generally considered that these higher prices were only war prices, and that, at the close of hostilities, the value of metals would drop at least to normal, if not below. Consequently, as the duration of the war was not expected to be very long, those mines not prepared to make a production in the near future could not expect to profit by higher prices, and, as capital was in demand for other purposes, the amount available for development was very slight.

The result has been that actual producers increased their outputs, but few new ones began a production, so that the amount of new development done throughout the year has been less than normal.

In British Columbia the recruiting sergeant has found such ready response from the prospectors and miners that prospecting is practically at a standstill and is left to those too old to be accepted for military service or otherwise disqualified.

Of all the metals produced in British Columbia, silver was the only one the price of which was not raised by the war, for the reason that it is not used in war materials, despite the old saying that "wars are won with silver bullets." On the contrary, the price of silver fell off very considerably; in 1913 the price of silver in New York varied between 63 and 57.8 cents, averaging for the year 59.8 cents; in 1914 the average price for the year was 54.8 cents, while for 1915 the average price for the year was only 49.7 cents.

This low price of silver acted as a deterrent to production in many of the silver-lead mines of the Slocan, Ainsworth, and Nelson Divisions, the ores of which contain, on the average, about twice the value in silver that they do in lead.

To show the effect of this drop in silver values in these Divisions, using the lead produced as an indicator, as the proportions of lead and silver are fairly constant in our galena ores, Ainsworth produced in 1915 only about one-third as much lead as in 1914, Slocan produced about 97 per cent. (but here the ores of the larger properties carry so much zinc that there was a profit in that metal), while in the Nelson Division the lead output in 1915 was less than half that of the previous year.

The output of silver in 1915 was $287,745 less than in the preceding year.

With the exception of silver, which has already been commented upon, all the other metals show a material increase. The colliery-output, however, shows a heavy falling-off—about $631,669; while the value of building materials, etc., produced has decreased by $1,281,736, or 45 per cent. of the previous year's output.

These two latter items are not an index of mining, properly speaking, but are influenced by the general industrial and financial state of the Province, as they are to all intents and purposes for home consumption and not for export.

The features of the year are the very great increases in the copper and zinc productions' and, as the prices of both these metals seem to show no indication of serious decrease, while the present developments of properties gives reason to expect further large increases in 1916, there is every cause to believe that the coming year will be a record one as far as the metalliferous mines are concerned.

It is to be noted that this past year the value of the copper-output was practically 50 per cent. of that of the gross metalliferous production of the Province.

It is a matter of congratulation also that zinc is now being refined in the Province—as described later—and there is every prospect that within a short time copper will also be refined here, thus enabling us to ship these products in a marketable form.

The gradual increase in production during the past twenty-six years, and its fluctuations, are graphically shown in Table X., on page 14 of this Report.

The tonnage of ore mined in the lode mines of the Province during the past year was greater than that of 1914. The ore mined amounted to 2,690,110 tons, showing an increase from that of the previous year of 514,139 tons.

The tonnage mined in 1915 was produced by the various districts in about the following proportions: Boundary, 45.77 per cent.; Rossland, 12.60 per cent.; Cassiar, 24.04 per cent.;

the Coast District, 8.38 per cent.; Slocan District, 4.25 per cent.; Ainsworth, 1.58 per cent.; Nelson, 0.87 per cent.; East Kootenay, 1.85 per cent.; and all other parts of the Province combined, 0.66 per cent.

The following table shows the number of mines which shipped ore during the year 1915, the districts in which they are situated, and the tonnage produced in each district, together with the number of men employed, both above ground and underground:—

TABLE SHOWING DISTRIBUTION OF SHIPPING MINES IN 1915.

	Tons of Ore shipped.	No. of Mines shipping.	No. of Mines shipping over 100 Tons in 1915.	Men employed in these Mines.		
				Below.	Above.	Total.
CASSIAR DISTRICT:						
Atlin, Stikine, Queen Charlotte, and Portland Canal	722	6	2	28	16	44
Skeena	645,989	1	1	256	55	311
CARIBOO DISTRICT:						
Omineca	17,545	12	2	73	58	131
EAST KOOTENAY DISTRICT:						
Fort Steele	44,372	2	2	82	47	129
Windermere-Golden	5,556	2	1	14	22	36
WEST KOOTENAY DISTRICT:						
Ainsworth	42,630	18	5	122	50	172
Slocan and Slocan City	114,292	27	12	384	132	516
Nelson	23,634	21	11	139	65	204
Trail Creek	338,568	6	4	715	151	866
Other Divisions	155	4	.....	18	12	30
BOUNDARY-YALE DISTRICT:						
Grand Forks, Greenwood, and Osoyoos	1,228,724	16	11	460	227	687
Yale, Ashcroft, and Kamloops	2,134	4	1	37	25	62
Similkameen, Vernon, and Nicola	285	5	1	7	9	16
LILLOOET DISTRICT	50	2	.....	2	4	6
SOUTHERN COAST DISTRICT	225,454	6	6	213	439	652
Total	2,690,110	132	59	2,550	1,312	3,862

In explanation of the table it should be said that, in its preparation, a mine employing twelve men for four months is credited in the table with four men for twelve months, so that the total given is less than the actual number of individuals who worked in the mines during the year.

TABLE SHOWING NON-SHIPPING MINES AND MEN EMPLOYED.

District.	Number of Mines.			Men employed.		
	Working.	Idle.	Total.	Below.	Above.	Total.
COAST AND CASSIAR	4	9	13	55	20	75
EAST KOOTENAY	.....	2	2	.....	.....	.....
AINSWORTH	1	7	8	4	2	6
SLOCAN	12	13	25	44	16	60
NELSON	7	4	11	31	17	48
TRAIL CREEK	.....	5	5	.....	.....	.....
LARDEAU	1	2	3	2	2	4
BOUNDARY	3	10	13	9	46	55
LILLOOET	3	1	4	14	20	34
Total	31	53	84	159	123	282

SUMMARY OF THE STATISTICAL TABLES.

Referring to the preceding tables of the mineral production of the Province, the following is a summary of their contents:—

TABLE I. shows the total gross value of each mineral product mined in the Province up to the end of 1915, aggregating $516,270,253. From this table it will be seen that coal-mining has produced more than any other separate class of mining, a total of $156,928,640; followed next in importance by copper at $96,774,870, and next in order is lode gold at $86,763,450, with placer gold in fourth place at $74,039,603.

The metal gold, obtained from both placer and lode mining amounts to a value of $160,803,053, the greatest amount derived from any one mineral, the next important being coal, the total gross value of which, combined with that of coke, is $156,928,640, followed by copper at $96,774,870, silver at $39,298,273, and lead at $33,407,662.

TABLE II. shows the value of the total production of the mines of the Province for each year from 1893 to 1915 (inclusive), during which period the output increased nearly tenfold, and reached a production, for the year 1913, valued at $30,296,398, which is nearly three times what it was in 1898. The gross production for the year 1915 is $29,447,508, which is $3,058,683 greater than that of the year 1914. This is certainly a matter for congratulation, more particularly as the year 1915 did not open auspiciously in regard to mining.

The value of the total mineral production of the Province up to the end of 1915 was $516,270,253.

TABLE III. gives the quantities in the customary units of measure, and the values, of the various metals or minerals which go to make up the total of the mineral production of the Province, and also, for the purposes of comparison, similar data for the two preceding years.

The table shows that there has been this year an increase in the production of placer gold of $205,000, and at the same time an increase in the output of lode gold of $58,930, making an increase of $263,930 in the total production of the metal.

The amount of silver produced this year was 3,366,506 oz., having a gross value of $1,588,991, a decrease in the number of ounces produced of 235,674, due to a decreased output in the Omineca, Fort Steele, Ainsworth, Nelson, and Boundary Districts, which was partially compensated by increases in Skeena and Slocan Districts. The value of the silver production in 1915 was $287,745 less than in 1914; this large decrease shows the effect of the prevailing low market price of silver in 1915.

The table shows an output of lead in 1915 amounting to 46,503,590 lb., valued at $1,939,200, which is a decrease from the production of the preceding year of 4,121,458 lb. of lead, but an increase in value of $167,323, due to the advance in value of the metal.

The production of copper this year was 56,918,405 lb., valued at $9,835,500, an increase in amount of 11,908,706 lb., or about 26.5 per cent. The value of the product was greater than that of the preceding year by $3,714,181—an increase of slightly over 60 per cent.

TABLE IV. shows the proportions of the total mineral productions made in each of the various districts into which the Province is divided.

It will be noted that this year the West Kootenay District has the honour of first place on the list, followed, in order of importance, by the Coast and Boundary Districts. The Coast and East Kootenay Districts owe a considerable proportion of their output to the coal-mines situated within their limits, whereas, in the other districts, the production is chiefly from metal-mining.

The Coast District also derives a fair proportion of its production from "Miscellaneous products," such as building materials, etc., due to the larger cities therein; this year this amounted to $1,365,994, as shown in Table V.

TABLE V. is a new table introduced four years ago, and is an endeavour to show in some detail the production of those products, such as building materials, previously summarized under "Miscellaneous products," and which amounts this year to $1,571,181. Much difficulty has been found in obtaining reliable figures regarding these products, and in many cases they have had to be estimated; but, while the figures are not as complete as desired, they are at least approximate, and show what an important branch of mineral production this has become, despite the falling-off due to the war and depressed financial conditions.

TABLE VI. gives the statistical record of the placer mines of the Province from 1858 to 1915, and shows a total production of $74,039,603. The output for 1915 was $770,000, an increase, as compared with the previous year, of about 36.3 per cent.

TABLE VII. relates entirely to the lode mines of the Province, and shows the quantities and values of the various metals produced each year since the beginning, in 1887, of such mining in the Province. The gross value of the product of these mines to date is $259,413,029; this figure includes the zinc production of 1909 and all subsequent years.

Lately a new column was made in this table in which to record the zinc production, and the output since 1909 has been recorded therein. In former years the zinc production was small and was listed as miscellaneous material.

TABLE VIII. contains the statistics of production of the coal-mines of the Province. The total amount of coal produced to the end of 1915 was 42,810,516 tons (of 2,240 lb.), worth $138,146,015. Of this, there was produced in 1915 1,611,129 tons valued at $5,638,952, a decrease of 199,838 tons in quantity and of $699,433 in value compared with the preceding year. In these figures of coal production the coal used in making coke is not included, as such coal is accounted for in the figures of output of coke. The amount of coal used in making coke in 1915 was 361,451 tons, from which was made 245,871 tons of coke, having a value of $1,475,226, an increase over the preceding year of 11,294 tons, or about 4.8 per cent., with an increase in value of $67,764. The total value of the output of the collieries of the Province in 1915 was $7,114,178.

The average selling prices taken this year in the calculation of value of product are the same as those used last year; that for coal being $3.50 and for coke being $6 a ton of 2,240 lb. The prices used in calculations prior to 1907 were $3 and $5 respectively.

More detailed statistics as to the coal production of the Province and of the separate districts are given elsewhere in this Report.

TABLE IX. gives the details of production of metalliferous mines of the Province for the years 1912, 1913, 1914, and 1915, and the districts in which such productions were made, showing the tonnage of ore mined in each district, with its metallic contents and its market value.

The total tonnage of ore mined in the Province during the year 1915 was 2,690,110 tons, having a gross value of $19,992,149 and with the placer gold a total value of $20,762,149.

The following table shows the percentages of such tonnage derived from the various districts of the Province:—

Boundary District	45.77	per cent. of tonnage.
Trail Creek Mining Division	12.60	" "
Cassiar District	24.04	" "
Southern Coast District	8.38	" "
Slocan District	4.25	" "
Ainsworth Mining Division	1.58	" "

Nelson Mining Division	0.87	per cent. of tonnage.
East Kootenay District	1.85	" "
Other Divisions	0.66	" "
	100.00	

In reports previous to 1910 there has been included in this table the "Miscellaneous products," and in 1910 these were shown distributed to the various districts; the great increase of these products in the past few years has rendered it advisable that this table be reserved exclusively for metalliferous products, and so a new table (No. V.) was introduced in 1911, giving in some detail, the output of these miscellaneous products.

In making comparisons of this table with similar tables in previous reports, the fact that "Miscellaneous" has been removed will have to be borne in mind.

TABLE X. presents in graphic form the facts shown in figures in the tables, and demonstrates to the eye the rapid growth of lode-mining in the Province, and also the fluctuations to which it has been subject.

It will be seen that, although coal-mining has been a constantly increasing industry during this whole period of twenty-six years, lode-mining did not begin practically, until 1894, since when it has risen with remarkable rapidity, though not without interruption, until it reached, in 1906, the $17,500,000 line. The total mineral production in 1910 reached the $26,000,000 line, and in 1912 it reached the $32,000,000 line, while this year it almost touches the $30,000,000 line.

GOLD.

Placer Gold.

The production of placer gold during the past year was worth about $770,000 as nearly as can be ascertained; great difficulty is found in obtaining reliable figures, since the work is, in many cases, carried out by individuals or unorganized groups of men who keep no books, frequently paying wages, or for supplies, in gold-dust, which, being readily transported, is scattered, and the tax imposed thereon by law is thus evaded

This year's output shows an increase, as compared with 1914, of $205,000, chiefly due to a better season than usual in the Atlin and Cariboo Districts.

Considerable work in connection with placer-mining was done in the Similkameen District, although the actual production was small.

The production of placer gold is nearly all from the Atlin and Cariboo districts; about 90 per cent. of the total coming from these two sections.

The output of placer gold is larger this year than it has been since 1907, and was about $205,000 greater than that of last year. This comes as an agreeable surprise, for the snowfall of the winter of 1914-15 was unusually light, and, as this is the principal source of the water-supply, it was anticipated that the quantity of water available for hydraulicking would fall short of the usual quota.

In hydraulic mining it has been pretty well demonstrated that the gold-output is in direct proportion to the number of days in which water was available for piping, hence there seemed little hope for even a normal production of placer gold during the season of 1915.

The Weather Bureau, however, as though in compunction for the niggardly amount of snow provided, so arranged the spring weather that the snow melted very gradually—not much faster than the water could be used—while the absence of spring freshets prevented the great waste of water usual at such times. Subsequent summer rains in the Cariboo District also very much assisted in keeping up the water-supply.

The shortage of work general throughout the Province during the early summer caused a greatly increased number of men, both whites and Chinese, to undertake small placer operations; this was particularly noticeable in the districts adjacent to Quesnel and Quesnel Forks.

During the summer months the unusually low water exposed bars on the Fraser and Thompson rivers which are seldom accessible, and these were worked in numerous places by Indians and Chinese, with good results.

In the Barkerville section of the Cariboo District the larger hydraulic companies made a greater output than usual, while an increased number of individuals appear to have been working in a small way; this is also true of the Quesnel and Quesnel Forks sections, which report much larger amounts of gold recovered than has been the rule for some years past.

No authentic news has been received from the Omineca District, where considerable work has been going on, most of which, however, was of a preparatory nature, and it is not expected that any great output was made this year, probably not more than about $12,000 all told.

In the Atlin District the shortage of water was very noticeable, some of the companies being so short as to be only able to work effectively for half the season. On the other hand, some of the companies were evidently working in richer ground; it is not known whether this was by good luck or by intentionally attacking only the richer parts, in an attempt to compensate for the water shortage.

Very little summer rain fell and its absence was much felt during the latter part of the season. Notwithstanding these drawbacks it would appear that a somewhat increased production was made in this district.

In the Liard-Stikine District the Boulder Creek Hydraulic Mining Company had a successful season, taking out about $20,000 from its ground on Thibert creek. Ball and Finn and Mitchell Bros., working in the same vicinity, made small outputs.

Four different partnerships were at work on Dease creek, with success enough to at least pay wages.

This year some gold was taken out of the Tahltan river by Indians and others working in the river-bed.

It is to be noted this year that two or three parties were working down the Liard river, at McDame creek, and on Rosella creek, a section that has been practically abandoned of late years.

The Similkameen and Tulameen rivers produced more gold this year than for some years back and give promise of again being a factor in the placer-gold industry.

Vernon District also yielded some gold from hydraulic operations in Siwash creek.

Yale Mining Division made an unusually good output, owing to the very low water in the rivers exposing the bars.

The Fort Steele Mining Division made a better output than for some years past.

Gold from Lode-mining.

The value of the gold produced from lode-mining in the Province during the year 1915 was $5,167,934, an increase, as compared with the previous year, of $58,930, or about 1.15 per cent. This greater production of lode gold is due to an increased tonnage of ore mined in the Boundary and Rossland Districts, and to new mines recently opened in the Skeena and Omineca Districts.

These increases were, however, somewhat offset by decreases in the Nelson and Coast Districts.

The only large stamp-mill in operation in the Province is at the *Nickel Plate* mine at Hedley, in the Osoyoos Mining Division, which, this past year, milled some 74,265 tons of ore having a value of over $900,000. There are smaller stamp-mills operating at the *Poorman*,

Queen, *Mother Lode*, and other mines in the Nelson Division; and in addition, there are stamp-mills at the *Jewel* mine, Greenwood; *Coronation* mine, Lillooet; and *Engineer* mine, Atlin, which operated during the year.

The following are the values of the gold product of the three most important camps; Rossland, $2,947,439; Boundary, $1,816,273; and Nelson, $190,846. About 76.5 per cent. of the gold production of the Province is obtained from the smelting of copper-bearing ores, the remainder mainly from stamp-milling.

The gold production of the various districts is estimated to have been approximately as follows:—

	Oz.
Rossland	142,595
Boundary	87,870
Nelson	9,233
Skeena	5,034
Coast	2,490
Omineca	1,524
All others	1,275

The production in the Rossland District shows an increase of 4,027 oz. as compared with 1914, which is accounted for by an increase in the tonnage shipped.

The Boundary District shows an increase of 2,962 oz., as compared with 1914. The Granby Company's mines made an increase of about 8,000 oz., but the British Columbia Copper Company, the *Jewel*, and the *Union* show decreases.

The *Nickel Plate* production was higher than the previous year by nearly 6,000 oz. The other properties in this district only contribute small amounts, and of these the *Carmi* and *Dividend-Lakeview* produced less than last year.

A reduction of about 6,000 oz. occurred in the Nelson District, or nearly 40 per cent. This decrease is mainly due to a falling-off in the production of the *Mother Lode* mine on Sheep creek, where the cyanide-mill was only operated a short time owing to the exhaustion of the developed ore reserves at the mine. The mine is at present closed and the future plans of the company are not known.

The *Queen* mine, on Sheep creek, made about the same output as the previous year, and it is said that development-work on the lower levels is proving satisfactory in showing the continuation of the ore-shoots.

The *Second Relief*, near Erie, milled more ore than in 1914, and the *Granite-Poorman*, near Nelson, again entered the list of producers, being operated by leasers.

The production of gold from the Skeena District is practically all from the *Hidden Creek* mine, at Anyox. The increased tonnage mined at this property accounts for the increased gold production in this Division of 75 per cent.

The Coast production shows a slight decrease due to the smaller output from the *Marble Bay* mine.

The Omineca production comes almost entirely from the *Rocher Déboulé* mine, near Hazelton, which is a new property that only commenced shipping this year, The ore is a high-grade copper ore, carrying low gold and silver values.

SILVER.

The total amount of silver produced in the Province during the year 1915 was 3,366,506 oz., valued at $1,588,991, a decrease in amount, as compared with the previous year, of 235,674 oz.; and, owing to the decrease in the market value of this metal, the value of the silver-output in 1915 was $287,745 less than in 1914.

Unlike the other metals, silver declined in price owing to the effect of the war on the market. Unfortunately for the producers, this metal is not used for munitions or war material of any kind. The decline in the price of silver is best seen by comparing the average yearly prices for the last three years, which were:—

1913	59.8	cents an oz.
1914	54.8	"
1915	49.7	"

It is encouraging, however, to see that the market price is now improving, as, having started at 48.8 cents in January and dropping to 47.2 cents in August, it increased to 54.97 cents in December.

The chief demand for silver comes from the Far East, and, as there were some disturbances in China, the demand was less than usual. Silver for use in the arts was less in demand in Europe than in former years, as a result of the war. On the other hand, there was a greater demand for silver for coinage purposes.

The Slocan District—including the Ainsworth, Slocan, Slocan City, and Trout Lake Mining Divisions—produced about 62.9 per cent. of the total Provincial output of silver this year, and the Fort Steele Mining Division about 14.3 per cent., all from argentiferous galena. The remainder is chiefly derived from the smelting of copper-ores carrying silver.

The following table shows the silver production from the different Mining Divisions:—

Slocan and Slocan City M.D.	produced	1,812,550	oz. silver =	53.84	per cent. of total.
Fort Steele	"	481,258	"	14.30	"
Ainsworth	"	289,565	"	8.60	"
Boundary	"	273,795	"	8.13	"
Skeena	"	175,179	"	5.20	"
Trail Creek	"	159,584	"	4.74	"
Omineca	"	79,155	"	2.38	"
Coast	"	66,033	"	1.96	"
Trout Lake-Revelstoke	"	16,740	"	0.49	"
Nelson	"	9,405	"	0.27	"
All others	"	3,242	"	0.09	"
		3,366,506		100.00	

LEAD.

The lead production of the Province for the year 1915 was 46,503,590 lb. of lead having a market value of $1,939,200, showing, as compared with the previous year, a decrease in amount of 4,121,458 lb. of lead, or 8.67 per cent.; but owing to the increase in the market value of this metal, the value of the lead-output in 1915 was $167,323 greater than in 1914.

This amount of lead represents the amount of metallic lead actually received and paid for by the smelters.

Instead of taking account of "loss in slags," we have followed, as has been our habit, the practice of the smelters of deducting 10 per cent. from the market price of the metal, in calculating the value.

The average market price of this metal for the year 1915 was considerably higher than for the previous year, being 4.6 cents a pound as compared with 3.9 cents.

The lead production is this year, as usual, derived chiefly from the Slocan and Fort Steele Mining Divisions, as is shown in the following table:—

Fort Steele M.D.	produced	26,582,050 lb.	lead =	57.20	per cent. of total.
Slocan	"	14,925,345	"	32.10	"
Ainsworth	"	3,436,184	"	7.37	"
Nelson	"	967,775	"	2.07	"
Omineca	"	249,279	"	0.53	"
All others	"	342,957	"	0.73	"
		46,503,590		100.00	

COPPER.

The amount of copper produced by smelting in the Province in 1915 was 56,918,405 lb. fine copper, valued at the average New York market price for copper at $9,835,500. These figures represent the amount of copper actually recovered, as nearly as it is possible to ascertain; the amount of copper really in the ores mined would be approximately 25 per cent. greater.

As compared with the year 1914, these figures show an increased production in amount of 11,908,706 lb., or about 26.46 per cent. and in value the increase is $3,714,181, or 60.7 per cent.

The amount of copper produced during the year 1915 is the largest in the history of copper-mining in the Province; the highest previous production, made in 1912, was 51,456,537 lb., valued at $8,408,513.

The apparently abnormal increase in the value of the production this year is due to the high average market value of the metal for the past year, due to the phenomenal demand for munitions of war.

Owing to this heavy demand for war purposes, principally for brass to be used in shells, the market price of copper increased steadily during the year. The year opened with copper at about 12.7 cents a pound in the New York market, and at the end of December it was 22.25 cents; the average price for the year was 17.275 cents, as compared with an average price of 13.6 cents in 1914. This higher market value of the metal assisted materially in raising the value of the copper produced, thereby greatly stimulating production.

The large increase in quantity of copper produced this year is due to a greatly increased production from the Granby Company's *Hidden Creek* mine, at Anyox, on Observatory inlet, and to a return to a nearly normal output from the Boundary District. A slight decrease occurred at the *Britannia* mine, due to a shut-down for some time owing to a snowslide; but this decrease is more than made up by the output from the *Rocher Déboulé* mine, in the Omineca Division, a new mine. Nelson Division shows a considerable decrease, which is, however, more than compensated by an increase from the Trail Creek Mining Division.

The big mine and smelter of the Granby Company at Anyox were operated continuously throughout the year, and the tonnage treated was gradually increased, until, at the end of the year, 2,000 tons a day was being smelted. The reserves of good-grade ore at this mine are very considerable and are given in the annual report of the company for the fiscal year ended June 30th, 1915, as amounting to 9,620,612 tons, with an average copper content of 2.19 per cent.; in addition to which there is practically an equal tonnage of low-grade ore. The Granby Company this year produced from its mines in Skeena and Boundary 66.5 per cent. of the Province's copper production.

Another important producer of copper in the northern portion of the Province is the *Rocher Déboulé* mine, near Hazelton. After developing for a couple of years this property commenced shipping in June, and by the end of the year had shipped 17,000 tons, carrying 2,788,000 lb. of copper, besides gold and silver values.

In the Boundary district the Granby Company's mines at Phoenix and smelter at Grand Forks were operated to nearly full capacity since the end of January. The recovered copper content of the ore, however, was less than in any previous year, and this fact, together with a slightly lessened tonnage, accounts for a smaller copper-output than in the years 1912 and 1913; in 1914 the smelter was closed for about one-third of the year, and so the output was less than in any of the years previously mentioned.

The explanation of the lowering of the Granby Company's ore is that an electrically driven shovel was used to clean up the pillars which had been blasted down in the large "glory-hole," and that thereby a larger proportion of waste rock was included in the ore, which was justified by the shovel reducing the operating costs in this part of the mine.

The British Columbia Copper Company, which operates the *Mother Lode* mine at Deadwood and a Smelter at Greenwood, was, in former years, another large producer of copper in the Boundary District. During the last two years, however, this company's production has declined very materially. At the smelter one furnace was operated during the last half of 1915 and a production of about 1,340,000 lb. of copper was made.

The following table shows the production of the various districts for the years 1912, 1913, 1914, and 1915:—

	1912.	1913.	1914.	1915.	
Boundary District	33,372,199 lb.	28,621,973 lb.	16,428,959 lb.	17,402,662 lb.	= 30.57%
Rossland "	2,539,900 "	2,538,661 "	3,779,830 "	4,651,681 "	8.17 "
Coast, Omineca, & Cassiar "	15,518,181 "	14,446,967 "	24,199,621 "	34,516,957 "	60.65 "
Yale-Kamloops "	..... "	37,578 "	14,525 "	295,164 "	0.52 "
Nelson and other "	26,257 "	815,126 "	586,764 "	51,941 "	0.09 "
	51,456,537 "	46,460,305 "	45,009,699 "	56,918,405 "	100.00 "

The average assays of the copper ores of the various camps, based upon the copper recovered were as follows:—

Boundary, 0.708 per cent.; Coast, Omineca, and Cassiar, 1.94 per cent.; and Rossland, 0.686 per cent.

Copper-mining is now the most important form of mining in the Province, and this year it practically equalled in value the entire total value of the other lode minerals produced, and exceeded, considerably, the value of the coal and coke production. It forms 47.4 per cent. of the total value of metalliferous mines and 33.4 per cent of the total mineral production. In the working of the large, low-grade copper-deposits and the subsequent smelting of the ores produced, a great number of men are employed and a large proportion of the money value is retained in the country in the payment of wages and purchase of supplies.

All the copper ores carry small amounts of the precious metals, and therefore any increase in the copper production also increases the output of gold and silver. The high price of copper during the past year has stimulated prospecting and the development of copper claims, and there is no doubt that the Provincial output will steadily grow in future years.

At the copper-smelters in the Province the only important development was the installation of copper-converters at the Consolidated Company's smelting-works at Trail, which will soon be in operation. Until now the copper matte from Trail has been converted to blister copper at Tacoma. The question of refining the blister-copper produced in the Province has been considered during the past year by some of the larger companies and also by the Government, and it is possible that a copper-refinery may be established in the near future.

ZINC.

The total quantity of zinc produced in 1915 was 12,982,440 lb., valued at $1,460,524, the average New York price, less 15 per cent., being taken as the basis of valuation.

This shows an increase, as compared with the year 1914, of 5,115,973 lb., or 65 per cent., in amount, and of $1,114,399, or 322 per cent. in value.

These figures are so very much higher than have ever before occurred in the zinc production of the Province that comparisons are almost out of the question.

The former highest recorded productions were in 1909, when 8,500,000 lb. of zinc was produced, worth $400,000, and in 1914, when the production was 7,866,467 lb., valued at $346,125. It will be seen, therefore, that this year's output has been, in value, about four times as great as that of former record years.

This is one of the instances where the war has been a help, the zinc-mining interests having reaped a harvest that was not expected.

The price of spelter in the New York market averaged for the year 1913, 5.65 cents a pound; for the year 1914 it averaged 5.21 cents; but for the year 1915 it averaged 13.23 cents; while the average for the month of June 1915, was 21.2 cents, and for the month of December, 1915, the average price was 15.39 cents.

It can readily be seen that such a very great increase in the market value of the metal would not only serve as a stimulus to the zinc-miner to get to market every ton of ore he possibly could, but would also permit the mining of many ore-bodies which, at the normal price of zinc, could not have been handled at a profit.

One trouble was that there was not enough smelter capacity on this continent to supply the demand for the metal, and these smelters were soon so overstocked with ores that they ceased to accept ore except on outstanding contracts.

The supply of ore brought out by these conditions was so great that such smelters as were equipped to handle it only bought at a very large margin of profit, so that the zinc-miner did not make as great profits as the increased market price of the metal would seem to indicate.

Of the total output of 12,982,440 lb., 8,684,572 lb. came from the Slocan District, 3,127,209 lb. from Nelson Division, 678,940 lb. from Ainsworth Division, and 491,719 lb. from East Kootenay.

The largest producer in the Province was the *Standard*, in Slocan Division, which is credited with 3,778,857 lb., followed by the *H.B.*, in Nelson Division, with 2,387,514 lb., and the Silverton Mines, Slocan, with 1,385,859 lb.; while the *Zincton* mine, in Nelson District, produced 739,695 lb.; the J. L. Retallack Mines, in Ainsworth, 576,000 lb.; the *Lucky Jim*, in Slocan, 788,158 lb.; and the *Rambler-Cariboo*, 540,660 lb.

Descriptive notes on the electrolytic zinc plant, which is now under construction at Trail, will be found in this Report under the Trail Creek Mining Division.

OTHER MINERALS.

Iron Ore. The situation in regard to iron ore remains unchanged, no material advancement having been made in the utilization of the numerous deposits throughout the Province. At present there is no market in the Province for iron ore, and, as a consequence, very little development-work has been done. There are, undoubtedly, a number of iron-ore deposits in different districts which are of considerable size, and which are, as a rule, very free from injurious elements. In considering the possibility

of the successful establishment of an iron and steel industry, other factors besides availability of ore are important—namely, a sufficient market for the products, a supply of fuel near by at a price comparable with what it is in the East, and a steady supply of suitable labour.

So far as is at present known, there is on the Coast no developed body of hæmatite or other ore of iron, such as would be desirable to mix with the magnetites for blast-furnace smelting.

A deposit of hæmatite is being developed on the Zymoetz river, a description of which was given in the 1914 Report.

No iron ore has been used or shipped from the Province during the past year, and as far as can be learned, but little prospecting or development work has been done on iron claims.

Considerable interest has been manifested during the past year in regard to iron-deposits generally, and a bulletin on the subject will be issued this coming year.

Platinum. A small quantity of crude placer platinum has been recovered on the Tulameen river, in the Similkameen District, estimated at about $2,000 in value. This was obtained from placer-gold workings being carried on, and the results are considered encouraging.

Oil. Prospecting for petroleum by means of boreholes has been in progress in South-East Kootenay, on the Queen Charlotte islands, and elsewhere, but oil in commercial quantities has not yet been encountered.

Mica. A small amount of development-work was carried out on the mica claims in the vicinity of Tete Jaune Cache, but no output is yet recorded. Now that the Grand Trunk Pacific Railway has been built within a few miles of these claims, it is pretty well assured that they will be seriously investigated this coming summer.

Molybdenum. Considerable interest has been evinced during the past year in molybdenite deposits, owing to the high price of this mineral, caused by demands for war purposes. This mineral, which is a sulphide of molybdenum, is used in the manufacture of special high-grade steel for guns. The actual output of molybdenite during the year was confined to a shipment from the *Molly* group, on Lost creek, in the Nelson Mining Division, which was sent to the Henry E. Woods Ore Concentrating Company, Denver, Colorado; this shipment amounted to 24 tons and contained by assay 12.26 per cent. of molybdenite. Some development-work was done on the property and it is now under lease and bond to a Vancouver syndicate, which intends to erect in the spring a small concentrator. The market requirements are such that a molybdenite ore must be concentrated up to 85 or 90 per cent. molybdenite (MoS_2) before it is marketable. The Lost Creek property has several thousand tons of from 2 to 4 per cent. ore, so that, with a suitable mill, a small production could be maintained.

Another property, on Alice arm, in the Skeena Mining Division, controlled by J. D. Ross, of Seattle, is reported to have a large showing of molybdenite, and it is said that a mill is being erected on it which will soon be producing a ton a day of high-grade concentrates. Other prospects in the Nelson, Kamloops, and Lillooet Mining Divisions showing some molybdenite have been investigated, but as yet none of them have assumed any great importance.

Molybdenite ore, concentrated so as to contain 85 to 90 per cent. of that mineral, is now worth from $2,500 to $3,000 a ton, delivered in England or New York.

Antimony. Antimony is another metal which greatly advanced in price owing to demands for war purposes. Its principal use in war material is to harden the lead bullets used in shrapnel. During the war the price advanced from about 18 to 55 cents a pound for the best brands, and from 16 to 39 cents for the ordinary brands of antimony.

Antimony usually occurs in nature as stibnite, the sulphide of antimony, and is a common mineral in British Columbia, occurring in association with lead and zinc ores. It does not, however, as a rule, occur in large quantities, but attempts are now being made in a few places to sort it out from its associated minerals. Two cars of antimony ore are reported to have been shipped from the *Alps-Alturas* property on a fork of Carpenter creek, in the Slocan Mining Division; this ore was shipped to Scotland and carried from 50 to 55 per cent. antimony.

Reports of small test shipments from other claims have been heard, but details have not yet been secured.

Magnesite.

A deposit of hydromagnesite near the town of Atlin was worked to some extent this year by Armstrong and Morrison, of Vancouver. It is known that a few hundred tons was shipped, but details regarding the shipment have not yet been received. This occurrence of magnesite was fully described by the Provincial Mineralogist in the Minister of Mines' Report for 1904.

The uses to which the mineral is put are for the manufacture of refractory brick, for furnace-linings, etc.; in the manufacture of paper stock by the sulphite process, and as a non-conducting covering for steam boilers and pipes.

Magnesium Sulphate.

A deposit of magnesium sulphate near Kruger mountain, Osoyoos Division, was worked for a time during the past year. The mineral occurs in a flat depression known as Spotted lake, which is a partially dried-up lake containing alternate circles of water and dry places. The magnesium sulphate occurs as a layer all over the lake-bottom, covering a considerable area and said to be of exceptional purity; the thickness of the deposit has not been definitely ascertained. Some 300 tons was extracted and shipped to new York, where a market at a good price was obtainable. The material is used in the drug trade. The nearest town to the deposit is Oroville, Washington, U.S.A., which is distant about six miles.

COAL.

The gross production of coal in 1915 was 1,972,580 long tons, of which 361,451 tons was made into coke, leaving the net production at 1,611,129 tons. These figures show a decrease, as compared with 1914, of 193,848 tons gross and of 199,838 tons net. The quantity of coke made was 245,871 tons, which is an increase of about 11,294 tons as compared with 1914. For purposes of comparison the following table is shown:—

	1910.	1911.	1912.	1913.	1914.	1915.
Coal, gross.....tons, 2,240 lb..	3,139,235	2,297,718	3,025,709	2,570,760	2,166,428	1,972,580
Less made into coke "	339,189	104,656	396,905	433,277	355,461	361,451
Coal, net..... "	2,800,046	2,193,062	2,628,804	2,137,483	1,810,967	1,611,129
Coke made..... "	218,029	66,005	264,333	286,045	234,577	245,871

These figures indicate a serious decrease, which is, however, only temporary, being mainly attributable to the European war.

Summarizing the Provincial production of coal, the following table shows the output:—

	1912.	1913.	1914.	1915.
Vancouver Island mines ..... tons, 2,240 lb.	1,558,240	973,493	1,072,314	1,020,942
Nicola and Similkameen mines ..... "	206,257	265,542	138,931	99,066
Crowsnest mines..... "	1,261,212	1,331,725	955,183	852,572
Total quantity of coal mined..... "	3,025,709	2,570,760	2,166,428	1,972,580
Less made into coke..... "	396,905	433,277	355,461	361,451
Net quantity of coal produced ..... "	2,628,804	2,137,483	1,810,967	1,611,129

In addition to the above net production of coal, there was made the coke production shown in the following table:—

	1912.	1913.	1914.	1915.
Vancouver Island collieries..... tons, 2,240 lb.	*Nil*	*Nil*	*Nil*	5,450
Nicola and Similkameen collieries... "	*Nil*	*Nil*	*Nil*	*Nil*
Crowsnest District collieries..... "	264,333	286,045	234,577	240,421
Total coke production.. ... "	264,333	286,045	234,577	245,871

As will be seen from the above figures, the net coal production this year is some 199,838 tons less than it was in 1914, and less than it has been for the last eight years.

The consumption of coal in the Province during the past two years has been sadly interfered with by the war, through its retarding or stopping of many industries; this has had a reflex action on the transportation lines, which are the largest consumers of coal.

The market for the Coast collieries was seriously affected by the diminished sales of bunker coal to ocean steamers, as a result of war conditions on the Pacific Ocean steamer trade.

The competition of fuel-oil has been keenly felt, and the adoption of this fuel by the three transcontinental railways for use in British Columbia has removed a steady and growing market for coal.

Coke.—The total production of coke this year, amounting to 245,871 tons, is an increase over that of 1914 of 11,294 tons (2,240 lb.), despite the fact that the Hosmer plant—which last year made an output of over 34,000 tons of coke—was closed down. This total production, while not as great as for the years 1912 and 1913, is nevertheless about 10 per cent. greater than the average output for the last ten years.

The high market price of copper has kept the copper smelting plants of the Interior very busy, with a consequent increased demand for coke, while, on the Coast the copper-smelting plant of the Granby Company at Anyox has occasioned the restarting of the Canadian Collieries coke-ovens at Comox, where this past year 5,450 tons of coke was made.

COLLIERIES OF COAST DISTRICT.

The Collieries of the Coast District, which includes those on Vancouver Island and in the Nicola-Princeton fields, mined 1,120,008 tons of coal in 1915, while 2,053 tons was taken from stock, making 1,122,061 tons distributed from these collieries in 1915. This amount was distributed thus:—

Sold as coal in Canada	582,650 tons.	
" United States	266,038 "	
" other countries	22,918 "	
Total sold as coal		871,606 tons.
Used under companies' boilers, etc.		108,475 "
Used in making coke		17,960 "
Lost in washing, etc.		124,020 "
		1,122,061 "
Minus coal taken from stock		2,053 "
Gross output		1,120,008 "

The total coal sales of the Coast collieries for the year show, as compared with the sales of the previous year, a decrease of 65,784 tons, equivalent to 7 per cent.

The consumption of coal sold in that part of British Columbia served by the Vancouver Island collieries shows this year a decrease of 102,433 tons, or about 17 per cent. from the preceding year; the amount exported to the United States was 50,593 tons greater, and 22,918 tons of coal was exported to other countries.

Only one company in the Coast District—the Canadian Collieries, Limited—has ever made coke, and this year the ovens were again put in operation, after several years of inactivity.

This company produced in 1915 some 5,450 tons (2,240 lb.) of coke, of which 5,383 tons was sold in Canada, 41 tons was consumed for colliery purposes, and 26 tons was added to stock.

On Vancouver Island, four companies produced coal this year—the Canadian Collieries, Limited, the Western Fuel Company, the Pacific Coast Coal Mines, and the Vancouver-Nanaimo Coal Company; the majority of these companies each operate two, or more, collieries. The combined gross output of the Island collieries was 1,020,942 tons.

In the Nicola and Princeton coal-fields of the Coast District, the Middlesboro Colliery Company produced 47,803 tons of coal; the Princeton Colliery, 15,548 tons; the Inland Coal and Coke Syndicate (formerly Coal Hill Syndicate), 34,710 tons; and the Pacific Coast Colliery Company, 1,005 tons.

The total output of this portion of the sub-district was 99,066 tons.

East Kootenay Coalfield.

There were only two companies operating in this district this past year—the Crow's Nest Pass Coal Company, operating two separate collieries, the combined output of which was 790,028 tons; and the Corbin Coke and Coal Company, which made an output of 62,544 tons; making a gross output for the district for 1915 of 852,572 tons of coal. The Hosmer Mines, Limited, has been closed down.

In addition to the coal mined, 3,495 tons was taken from stock, making the amount of coal distributed from the collieries 856,067 tons.

Of this gross tonnage, 343,491 tons was used in the manufacture of coke, of which there was produced 240,421 tons (2,240 lb.).

The coke sold this year amounted to 240,579 tons, of which 158 tons was taken from stock, making the coke production for this year 240,421 tons, as compared with 234,517 tons in 1914.

The following table shows the distribution made of the coal of this district:—

Sold as coal in Canada	82,594 tons.	
" United States	370,020 "	
Total sold as coal		452,614 tons.
Used by the companies in making coke		343,491 "
Used by the companies under boilers, etc		59,962 "
		856,067 "
Minus coal taken from stock		3,495 "
Gross output		852,572 "

The greater part of the gross Provincial production is still being mined by three companies—the Crow's Nest Pass Coal Company of East Kootenay, the Canadian Collieries and the Western Fuel Company of Vancouver Island, which mined, collectively, 82.80 per cent. of the gross output, their respective production representing 40.05 per cent., 21.7 per cent., and 21.07 per cent. of such total.

Of the other collieries: In the Coast District, on Vancouver Island, the Pacific Coast Coal Mines Limited, produced 129,431 tons, and the Vancouver-Nanaimo Coal Company 47,976 tons; and in the Nicola Valley section of the district, the Middlesboro Colliery Company mined 47,803 tons, the Inland Coal and Coke Company 34,710 tons, the Princeton Coal and Land Company 15,548 tons, and the Pacific Coast Syndicate some 1,005 tons of coal.

In the East Kootenay District, in addition to the Crow's Nest Pass Coal Company, which produced 790,028 tons, the Corbin Coal and Coke Company produced 62,544 tons.

In addition to those companies actually shipping, several other companies have been installing plant and have approached the shipping stage, mention of which will be made elsewhere in this report.

The collieries of the Coast District, including the Nicola-Princeton fields, are to be credited this year with about 56 per cent. of the total coal-output.

The gross output of the collieries of the Province for the past year was, as already stated, 1,972,580 tons, and some 5,548 tons of coal was taken from stock, making the gross amount of coal distributed 1,978,128 tons.

Of this gross amount, there was sold for consumption in Canada, 665,244 tons; sold for consumption in the United States, 636,058 tons; sold in other countries, 22,918 tons; making the total coal sales for the year 1,324,220 tons of 2,240 lb.

In addition to the coal sold, there was used in the manufacture of coke 361,451 tons, and used under companies' boilers, etc., 168,437 tons; while 124,020 tons was lost in washing and screening.

The coke sales of the Province for the past year amounted to 245,962 tons, of which 132 tons was taken from stock.

The following table indicates the markets in which the coal and coke output of the Province was sold:—

COAL.	Coast District.	Crowsnest Pass District.	Total for Province.
Sold for consumption in Canada .....tons, 2,240 lb.	582,650	82,594	665,244
" export to United States ..... "	266,038	370,020	636,058
" export to other countries ..... "	22,918	.....	22,918
Total coal sales	871,606	452,614	1,324,220
COKE.			
Sold for consumption in Canada .....tons, 2,240 lb.	5,383	215,982	221,365
" export to United States ..... "	.....	24,597	24,597
" export to other countries ..... "	.....	.....	.....
Total coke sales	5,383	240,579	245,962

BUILDING MATERIALS.

The production of building materials during 1915 was even less than in the year 1914, due no doubt to the continued financial depression and the war, which have retarded construction-work, especially in the Coast cities. The diminution of production has been general in all kinds of material, with the exception of rough building-stone, which shows a gross production for 1915 valued at $267,450, or nearly three times what it was the previous year; this is accounted for by the use of several thousand tons of large granite blocks for the Government piers at the Outer Wharf, Victoria. The outputs of sand and gravel and of brick show heavy decreases, and the cement production is only about one-half what it was in 1914. As far as can be learned, none of the gypsum companies or marble-quarries made any appreciable output.

For the past year, although the statistical returns are not as complete as desired, a production of about $1,571,181 is accounted for, the details of which are given in Table V., on page 9. Approximately 87 per cent. of this output comes from the Coast District, and the larger part of this finds its market in the Coast cities.

Building-stone. Excellent building-stone of various sorts is found in abundance in almost every part of the Province; the fact of its widespread distribution has, however, been somewhat against the establishment of large quarrying industries, as a sufficient local supply could always be obtained, and, except within reach of the larger cities, few regularly equipped quarries have been opened.

On the Coast, chiefly between Vancouver Island and the Mainland, there are several well-equipped quarries taking out granite, sandstone, and andesite, all of excellent quality. These quarries supply the stone building material of the Coast cities, and have also exported to the United States.

A detailed description of the more important quarries was given in the Report of this Bureau for 1904.

Marble. The marble-quarry in the Ainsworth Mining Division is still being developed, but it is not known that any appreciable output was made. Two new marble-quarries were opened up on the southern end of Texada island, but it is too soon as yet to expect anything more than sample shipments. Sample slabs from one of those quarries sent to the Provincial Museum show a marble very pleasing to the

eye and of excellent quality, hard, and taking a good polish. The other quarry in 1914 sent at least one scow-load of large blocks to Vancouver—presumably to be slabbed—but no further work has been done in 1915.

Red Brick. The production of red brick during the past year was about 5,000 M., amounting in value to $45,706. The price of common brick ranges from $8 to $11 a thousand, according to quality and demand. A considerable quantity of brick is still imported into Vancouver, but, as the local plants are now well equipped with modern appliances, they should be able to overcome outside competition.

Firebrick. The only company producing firebrick in the Province is the Clayburn Company, Limited, with a plant at Clayburn, where the beds of clay are of the age of the coal-measures. This company made approximately 1,800 M. firebrick, worth about 50,000, and 250 M. front or face brick, worth over $8,000. Besides this the company made a large number of common brick, paving-brick, tiles, drain-pipes, prepared fire-clay, etc.

Pottery Drain-pipe and Tile. The British Columbia Pottery Company at Victoria West, which manufactures drain and sewer pipes, chimney-tiles, etc., curtailed its production by one-third as compared with 1914. The Port Haney Brick Company, besides manufacturing common brick, also make drain-pipe, partition-block, etc., but made a comparatively small output owing to lack of demand for such products.

Lime. The manufacture of lime is conducted in a small way at a large number of points in the Province, but only on the Coast has any attempt been made at more extensive operations. In the neighbourhood of Victoria, on Esquimalt harbour three kilns are in operation, and there are kilns on Saanich Arm. On Texada island—in addition to the old plant at Marble bay—a new and extensive plant was erected at Blubber bay a few years ago. The limestone being used is of exceptional purity, but in some instances the limestone-beds are cut by igneous dykes which have to be rejected, and this somewhat increases the costs of quarrying.

The consolidated Mining and Smelting Company quarried about 52,000 tons of limestone from the Fife quarries for use as flux in the furnaces at the Trail smelter.

Portland Cement. Two companies manufactured cement in the Province during the past year. The Vancouver Portland Cement Company, with works at Tod inlet, is said to have produced about $200,000 worth of cement. The Associated Cement Company, with works at Bamberton, made a production valued at about $260,000. The cement plant started near Princeton has ceased to operate.

Crushed Rock and Gravel. The returns for crushed rock and gravel indicate a falling-off in the demand for this material. Some of the plants which have been in operation for the past two or three years ceased operations, and others made a smaller output than in the previous year.

Concrete construction has become so extensive on the Coast that a number of plants are well fitted up with crushing and screening machinery to make the various products required.

Near Vancouver and Victoria a number of companies supply washed sand and gravel, properly screened to size. Some of these companies use a system of mining the gravel by hydraulic streams and carrying the product to the screens by the water used. The value of the sand and gravel produced for use in these two cities amounted during the past year to only $80,000, as compared with $300,000 for the year 1914.

BUREAU OF MINES.

WORK OF THE YEAR.

The work of the Bureau of Mines naturally increases year by year, this growing activity being due to the following causes: The extension of the mining area of the Province, with the proportional increase in the number of mines; the increasing desire of the outside public for the free information which the Bureau supplies with regard to the various mining districts and camps, and the appreciation by the prospector of the fact that he may obtain, gratis, a determination of any rock or mineral which he may send to the Bureau.

The routine work of the office, and the preparation and publication of the Report for the year just ended, followed by the examination in the field of as many of the mines and mining districts as the season would permit, together with the work of the Laboratory, fully occupied the staff for the year.

The permanent staff of the Bureau now consists of the Provincial Mineralogist and Assayer, Wm. Fleet Robertson; the Assistant Provincial Assayer and Provincial Analyst, D. E. Whittaker; and John D. Galloway, M.Sc., Assistant Provincial Mineralogist; while H. Nation nominally continues as general office assistant, but he went to the war in August, 1914, and his place has been temporarily filled.

During the season of 1915 the Bureau was allowed the temporary assistance in the field of a private practising mining engineer W. M. Brewer, M.E., who was engaged to make examinations of and report on the mineral properties in certain portions of the New Westminster, Similkameen, Nicola, and Kamloops Mining Divisions.

Provincial Mineralogist.

After the Report for the preceding year had been issued, the Provincial Mineralogist, with assistants, in May and December, held examinations at Victoria of candidates for Certificates of Competency as Assayers, each of which lasted a week. During the season of 1915 the greater part of the time of the Provincial Mineralogist was occupied in attending to work in connection with the publication of reports, and the superintending of the parties in the field, and to the routine work of the Bureau, necessitated by the continued absence for the entire year, on military duties, of his assistant, Harold Nation, which demanded his continual presence in the office, so that he was unable personally to undertake any field-work.

Assistant Provincial Mineralogist.

The Assistant Mineralogist, during the first half of the year, was engaged in the routine office-work, the preparation of the reports on his field-work of the previous field season, and assisting in the statistical work and compilation of the Annual Report. The report on part of his field-work done in 1914 was prepared in bulletin form and issued in March as Bulletin No. 4, 1915, on the Omineca Mining Division.

The field-work of the season 1915 commenced in July, ending the first week in November, and was carried on in the East and West Kootenay Districts.

The first section visited was the Golden Division, where the *Monarch* mine was examined; no other mining or prospecting of importance is being carried on in this Division.

The Windermere Mining Division was next visited, where a month was spent in examining prospects and partially developed properties. This district in former years had several properties working, but very little mining has been carried on lately, and so one object of the field-work was to ascertain the causes for this apparent stagnation. The completion,

during 1915, of the Kootenay Central Railway from Golden, on the main line of the Canadian Pacific Railway, to Bull River, on the Crowsnest branch, has provided transportation in this district and made it more accessible.

A pack outfit was secured at Invermere and all the more important properties were examined; these are mainly situated on Toby, Horse Thief, and Frances creeks.

From the Windermere Division the Assistant Mineralogist proceeded to Cranbrook, in the Fort Steele Division, where properties on Whitefish, Perry, and other creeks and the *Sullivan* mine were visited.

The next district visited was the Nelson Division, where a number of properties in the Bayonne, Sheep Creek, Ymir, and Nelson camps were examined and material obtained for a general report on the district.

A week was spent in Silverton camp, in the Slocan Division, obtaining general information about the more important mines there.

The Trail smelter was also visited, in order to find out about the new work and improvements being made there, especially regarding the new electrolytic zinc plant.

The return to the Coast was made via the new Kettle Valley Railway, which was opened in October.

When coming through the Boundary District, a stop was made for a few days to get statistics and information regarding mining at Grand Forks, Phœnix, and Greenwood.

The Assistant Mineralogist's reports and notes will be found under the heading of each Mining Division in which he examined properties.

ASSAY OFFICE.

The following is a summary of the work of the Assay Office of the Bureau of Mines for the year 1915 as reported by the Assistant Provincial Assayer, D. E. Whittaker:—

During the year 1915 there were made by the staff in the Government Assay Office 2,187 assays or quantitative determinations; of these the majority were for the Bureau of Mines or for the other departments, for which no fees were received.

The fees collected by the office were as follows:—

Fees for analyses	$397 00
" assaying	316 75
" melting and assaying gold-dust and bullion	15 75
" assayer's examinations	90 00
Total cash receipts	$819 50

Determinations and examinations made for other Government departments for which no fees were collected:—

Attorney-General's Department	$130 00
Agriculture Department	510 00
Board of Health	120 00
Treasury Department	205 30
	$965 30
Value of work done outside of Department work	$1,784 80

The value of gold melted during the year 1915 was $37,972 in 80 lots, as against $28,744 in 38 lots in 1914.

Free Determinations.

In addition to the above quantitative work, a large number of qualitative determinations, or tests, were made in connection with the identification and classification of rocks or minerals sent to the Bureau for a report; of these no count was kept, nor were any fees charged, as it is the established custom of the Bureau to examine and test qualitatively, without charge, samples of minerals sent in from any part of the Province, and to give a report on the same. This has been done for the purpose of encouraging the search for new or rare minerals and ores, and to assist prospectors and others in the discovery of new mining districts, by enabling them to have determined, free of cost, the nature and probable value of any rock they may find. In making these free determinations, the Bureau asks that the locality from which the sample was obtained be given by the sender.

EXAMINATION FOR ASSAYERS.

REPORT OF D. E. WHITTAKER, SECRETARY OF BOARD OF EXAMINERS.

I have the honour, as Secretary, to submit the Annual Report for the year 1915 of the Board of Examiners for Certificates of Competency and Licence to Practice Assaying in British Columbia, as established under the "Bureau of Mines Act Amendment Act, 1899."

A meeting of the Board was held at Victoria, in the Government Laboratory, on May 11th and the following day; no candidates came up for examination, but one candidate applied for exemption under section 2, subsection (2), of the Act, and the Board recommended that he be granted a Certificate.

Another examination was held at the Government Laboratory, Victoria, on December 16th. One candidate came up for examination, and obtained the required number of marks. Three candidates applied for exemption under section 2, subsection (2), of the Act, and the Board recommended that Certificates be granted them.

In accordance with the recommendations of the Board, certificates have been duly issued by the Honourable the Minister of Mines to these five candidates.

LIST OF ASSAYERS HOLDING PROVINCIAL CERTIFICATES OF EFFICIENCY UNDER THE "BUREAU OF MINES ACT AMENDMENT ACT, 1899."

(Only the holders of such certificates may practise assaying in British Columbia.)

Under section 2, subsection (1).

Ayres, D. A.	
Austin, John W.	Hazelton.
Backus, Geo. S.	Britannia Beach.
Baker, C. S. H.	
Barke, A. C.	
Bernard, Pierre	Monte Christo, Wash.
Bishop, Walter	Grand Forks.
Buchanan, James	Trail.
Buehman, A. C.	Trail.
Campbell, Colin	New Denver.
Carmichael, Norman	Clifton, Arizona.
Church, George B	
Cobeldick, W. M.	Scotland.
Collinson, H.	Cobham, Eng.
Comrie, George H	Field.
Craufurd, A. J. F.	Rossland.
Crerar, George	
Cruickshank, G	Trail.
Day, Athelstan	Dawson.
Dedolph, Ed.	Nelson.
Dockrill, Walter R.	Chemainus.
Dunn, G. W.	Rossland.
Farquhar, J. B.	Vancouver.
Fingland, John J.	Kaslo.
Grosvenor, F. E.	Vancouver.
Hamilton, Wm. J.	Anyox.
Hannay, W. H	Rossland.
Hart, P. E.	
Hawkins, Francis	Silverton.
Hawes, F. B.	Vancouver.
Hook, A. Harry	Greenwood.
Hurter, C. S.	Prince Rupert.
Irwin, Geo. E.	Vancouver.
John, D.	Haileybury, Ont.
Kiddie, Geo. R.	California.
King, R.	Greenwood.
Kitto, Geoffrey B.	Victoria.
Langley, A. S.	Crofton.
Lee, Fred. E.	Trail.
Lee, Geo. M.	Grand Forks.
Ley, Richard H.	Victoria.
Levy, Frank	Rossland.
Lindsay, W. W	Rossland.
Longworth, F. J	Boyds, Wash.
Laucks, I. F.	Seattle.
Martin, S. J.	Hazelton.
Marsh, Richard	Republic, Wash.
Marshall, H. Jukes	Vancouver.
Marshall, William S.	Ladysmith.
Miles, Arthur D.	
Mitchell, Charles T.	Copper Cliff, Ont.
McCormick, Alan F.	Ruth, Nevada.
MacDonald, Alex. C.	Vancouver.
Morgan, Richard	Trail.

Under section 2, subsection (1).—Concluded.

Nicholls, Frank ..... Norway.
Parker, Robt. H. .....
Parsenow, W. L .....
Perkins, Walter G..... Basin, Montana.
Pickard, T. D..... Vancouver.
Pirrie, Noble W..... Vancouver.
Powell, J. G..... Vancouver.
Prior, C. E..... Hedley.
Richmond, Leigh..... Duncan.
Robertson, T. R.....
Rodgers, Ch. B..... Vancouver.
Rombauer, A. B..... Butte, Mont.
Schroeder, Curt. A.....
Segsworth, Walter ..... Toronto, Ont.
Sharpe, Bert N .....
Sim, Charles John..... Monte Carlo.
Snyder, Blanchard M.....
Steven, Wm. Gordon .....
Stimmel, B. A..... Trail.
Sundberg, Gustave ..... Mexico City.
Tally, Robert E..... Spokane, Wash.
Thomas, Percival W.....
Tretheway, John H.....
Turner, H. A.....
Vance, John F. C. B..... Vancouver.
Van Agnew, Frank..... Siberia.
Vaughan-Williams, V. L.... California.
Wales, Roland T.....
Watson, Wm. J..... Ladysmith.
Watson, Thomas..... Vancouver.
Welch, J. Cuthbert ..... Butte, Mont.
Wells, Ben T.....
West, Geo. G..... Vancouver.
Whittaker, Delbert E..... Victoria.
Widdowson, E. Walter ..... Nelson.
Williams, W. A..... Vancouver.
Williams, Eliot H.....
Wimberly, S. H. ..... Nevada, U.S.A.

Under section 2, subsection (2).

Archer, Allan.....
Blaylock, Selwyn G..... Trail.
Bolton, George E..... Silverton.
Brennan, Charles Victor .... Bingham, Utah.
Browne, R. J..... Rossland.
Browne, P. J ..... Nelson.
Bryant, Cecil M..... Vancouver.
Burwash, N. A.....
Cavers, Thomas W .....
Clothier, George A ..... Hazelton.
Cole, Arthur A..... Cobalt, Ont.
Cole, G. E..... Rossland.
Cole, L. Heber..... Ottawa, Ont.
Conway, E. J..... Vancouver.
Coulthard, R. W..... Blairmore, Alta.
Cowans, Frederick.....
Dawson, V. E..... Trail.
Dempster, R. C..... Rossland.
Dempster, A. S. ..... Rossland.
Dixon, Howard A..... Toronto, Ont.
Eardley-Wilmot, V. L .... Rossland.
Eldridge, Gardner S..... Vancouver.
Galbraith, M. T.....
Gilman, Ellis P..... Vancouver.
Green, J. T. Raoul ..... Blairmore, Alta.
Guess, George A..... Toronto, Ont.
Gwillim, J. C..... Kingston, Ontario.
Harding, Wilson M..... Victoria.
Heal, John H.....
Hearn, Roy D..... Trail.
Hilliary, G. M..... Idaho, U.S.A.
Johnston, William Steele.... Lachine, Que.
Kaye, Alexander ..... Vancouver.
Kendall, George..... Vancouver.
Kilburn, Geo. H.....
Lathe, Frank E ..... Grand Forks.
Lay, Douglas ..... Silverton.
Lewis, Francis B..... South Africa.
Merrit, Charles P.....
Murphy, C. J. .....
Musgrave, William N..... England.
McArthur, Reginald E .....
McDiarmid, S. S .....
McGinnis, Wm. C..... Queen Charlotte Islands.
McKay, Robt. B..... Vancouver.
McLellan, John ..... Queen Charlotte Islands.
McMurtry, Gordon O.....
McNab, J. A..... Thompson, Nevada.
McPhee, W. B.....
McVicar, John..... Edmonton, Alta.
Maclennan, F. W.....
Moran, P. J..... Vancouver.
Newton, W. E..... Sandon.
Oughtred, S. W ..... Ainsworth.
Outhett, Christopher ..... Kamloops.
Pemberton, W. P. D..... Victoria.
Reid, J. A..... Greenwood.
Ritchie, A. B..... Nelson.
Roaf, J. R..... Victoria.
Rose, J. H.....
Rutherford, R. C..... Trail.
Sampson, E. H. S..... Riondel.
Scott, Oswald Norman.....
Shannon, S.....
Sharpe, G. P..... Midland, Ont.
Shorey, P. M..... Trail.
Sloan, David..... Three Forks.
Stevens, F. G..... Mexico.
Sullivan, Michael H..... Trail.
Sutherland, T. Fraser.....
Sutherland, Wm..... Glasgow, Scotland.
Swinney, Leslie A. E.....
Thomson, H. Nellis..... Anaconda, Montana.
Thomson, Robt. W. .....
Watson, A. A..... Olalla.
Watson, Henry .....
Willis, F. S..... Trail.
Winslow, R. H..... Vancouver.
Wilson, Ridgeway R. .... Fernie.
Workman, Ch. W.....
Wright, Richard ..... Rossland.
Wynne, Lewellyn C.....
Yuill, H. H.....

Under section 2, subsection (3).

Carmichael, Herbert..... Victoria.
Galloway, J. D..... Victoria.
(Assistant Mineralogist.)
Harris, Henry..... Tasmania.
Hedley, Robt. R..... Vancouver.
Kiddie, Thos..... California.
Marshall, Dr. T. R..... London, England.
McKillop, Alexander..... Vancouver.
Pellew-Harvey, Wm..... London, England.
Robertson, Wm. Fleet ..... Victoria.
(Provincial Mineralogist.)

PREVIOUSLY ISSUED UNDER THE "BUREAU OF MINES ACT, 1897," SECTION 12.

Pinder, W. J.....
Thompson, James B..... Vancouver.

EXAMINATIONS FOR COAL-MINE OFFICIALS.

The "Coal-mines Regulation Act," as now consolidated and amended, provides that all officers of a coal-mining company having any direct charge of work underground shall hold Government Certificates of Competency, which are to be obtained only after passing an examination before a duly qualified Board, appointed for the purpose of holding such examinations, and known as the Managers' Board.

The certificates granted on the recommendation of such Board and the requirements shall be as follows:—

"(*a.*) If a candidate for a manager, that he is a British subject and has had at least five years' experience in and about the practical workings of a coal-mine, and is at least twenty-five years of age; or, if he has taken a degree in scientific and mining training, including a course in coal-mining at a university or mining school approved by the Minister of Mines, that he has had at least four years' experience in and about the practical working of a coal-mine:

"(*b.*) If a candidate for overman, that he has had at least five years' experience in and about the practical working of a coal-mine, and is at least twenty-three years of age:

"(*c.*) If a candidate for shiftboss, fireboss, or shotlighter, that he has had at least three years' experience in and about the practical working of a coal-mine, is the holder of a certificate of competency as a coal-miner, and is at least twenty-years of age:

"(*d.*) A candidate for a certificate of competency as manager, overman, shiftboss, fireboss, or shotlighter shall produce a certificate from a duly qualified medical practitioner or St John's or other recognized ambulance society, showing that he has taken a course in ambulance-work fitting him, the said candidate, to give first aid to men injured in coal-mining operations.

"For the purposes of this section the experience demanded by such section shall be of such character as the Board shall consider of practical value in qualifying the candidate for the position to which such class of certificate applies.

"Experience had in a mine outside of the Province may be accepted should the Board consider such of equal value."

Any certificate is considered as including that of any lower class.

EXAMINATION FOR MINERS.

In addition to the examinations and certificates already specified as coming under the Managers' Board, the Act further provides that every coal-miner shall be the holder of a certificate of competency as such. By "miner" is meant "a person employed uuderground in any coal-mine to cut, shear, break, or loosen coal from the solid, whether by hand or machinery."

Examinations for a miner's certificate are held each month at each colliery by a Board of Examiners, known as the Miners' Board, and consisting of an examiner appointed by the owners, an examiner elected by the miners of that colliery, and an examiner appointed by the Government.

BOARD OF EXAMINERS FOR COAL-MINE OFFICIALS.

FIRST-, SECOND-, AND THIRD-CLASS CERTIFICATES.

Report of Tully Boyce, Secretary of Board.

I beg to submit the Annual Report covering the transactions of the above Board for the year ending December 31st, 1915.

The Board consists of Thos. R. Stockett, of Nanaimo, Chairman; Andrew Thomson, of Nanaimo, Vice-Chairman; Tully Boyce, of Nanaimo, Secretary; Thomas Graham, of Victoria, Chief Inspector of Mines; Andrew Bryden, of Merritt; and Bernard Caufield, of Coal Creek. The meetings are held in the office of the Board at Nanaimo.

An examination for First-, Second-, and Third-class Certificates was held at Nanaimo, Cumberland, Merritt, and Fernie on May 11th, 12th, and 13th, at which there were 52 candidates, as follows: For first-class there were 9, of whom 5 passed and 4 failed; for second-class there were 19, of whom 12 passed and 7 failed; for third-class there were 24, of whom 18 passed and 6 failed.

There being no apparent demand, the Board decided not to hold any further examinations during the year.

All of the candidates who passed the examination, with the exception of 2 second-class and 6 third-class candidates, have fully complied with the provisions of the Act, and certificates have accordingly been issued to them.

The following successful candidates, mentioned in last year's Report as delinquents, have since complied with the Act, and certificates have been issued to them:—

NAME.	DATE.	NO.
James Gordon Geater	May, 1914	C 573
Albert Radford	"	C 579
Edward Staton	"	C 581
William Angell	"	C 591

The fullest information as to standard of efficiency required and copies of previous question papers in printed form may be had by applying to the Secretary at Nanaimo.

LIST OF CANDIDATES TO WHOM CERTIFICATES WERE ISSUED AT THE EXAMINATIONS HELD IN MAY, 1915, AT NANAIMO, CUMBERLAND, MERRITT, AND FERNIE.

FIRST-CLASS CANDIDATES.

NAME.	DATE.	No.
William Roper	May 13th, 1915	
Richard Cox	"	
Tom Brace	"	
Robert Joyce Brown	"	
Frank Jaynes	"	
	"	

SECOND-CLASS CANDIDATES.

NAME.	DATE.	No.
Dudley Michell	May 13th, 1915	B 187
Clifford Dickenson	"	B 189
Alfred Gould	"	B 190
Wm. Walker	"	B 192
Joseph Mason	"	B 193
James Taylor	"	B 194
Frank Lander	"	B 195
Robert Sheddon Brown	"	B 196
James Blair	"	B 197
Norman Wilson Huby	"	B 198

THIRD-CLASS CANDIDATES.

NAME.	DATE.	No.
Robert Ewing	May 13th, 1915	C 608
John McLeod	"	C 609
Joseph Dean	"	C 611
James McMeekin	"	C 612
James Strang	"	C 614
James Millie Brown	"	C 615
George Frater	"	C 616
John Monks	"	C 618
Herbert Parson	"	C 621
John Arbuckle	"	C 622
John Gillham	"	C 623
Ellis Rogers	"	C 624

DELINQUENTS.—FROM PREVIOUS EXAMINATIONS.

Third-class Candidates.

NAME.	DATE.	No.
James Gordon Geater	May, 1914	C 573
Albert Radford	"	C 579
Edward Staton	"	C 581
William Angell	"	C 591

Registered List of Holders of Certificates of Competency as Coal-mine Officials.

FIRST-CLASS CERTIFICATES.—SERVICE CERTIFICATES ISSUED UNDER SECTION 39, "COAL MINES REGULATION ACT, 1877."

Edward G. Prior.
Thomas A. Buckley.
James Dunsmuir, Victoria.
James Cairns, Comox.

FIRST-CLASS CERTIFICATES OF COMPETENCY ISSUED UNDER "COAL MINES REGULATION ACT, 1897."

NAME.	DATE.
Shepherd, Francis H	March 5th, 1881
Honobin, William	May 1st, 1882
Little, Francis D	" 1st, "
Chandler, William	December 21st, 1883
Priest, Elijah	" 21st, "
McGregor, James	January 18th, 1888
Randle, Joseph	" 18th, "
Matthews, John	" 8th, 1889
Norton, Richard Henry	August 26th, "
Bryden, Andrew	December 30th, "
Russell, Thomas	April 20th, 1891
Sharp, Alexander	October 27th, "
Kesley, John	March 4th, 1892
Wall, William H	May 30th, 1896
Morgan, Thomas	" 30th, "
Wilson, David	" 30th, "
Smith, Frank B	" 30th, "
Bradshaw, George B	June 12th, 1899
Simpson, William G	" 12th, "
Hargreaves, James	February 5th, 1901
Drinnan, Robert G	" 5th, "
Stockett, Thomas, Jr	August 3rd, "
Cunliffe, John	" 3rd, "
Evans, Daniel	" 3rd, "
McEvoy, James	October 17th, 1902
Wilson, A. R	" 17th, "
Simister, Charles	" 17th, "
Budge, Thomas	" 17th, "
Mills, Thomas	" 17th, "
Faulds, Alexander	" 17th, "
Richards, James A	" 17th, "
McLean, Donald	January 21st, 1905
Wilkinson, Geo	" 21st, "
Wright, H. B	" 21st, "
Coulthard, R. W	" 21st, "
Roaf, J. Richardson	" 21st, "
John, John	" 21st, "
Manley, H. L	" 21st, "
Battey, Richard	May 27th, 1913
Baxter, Andrew	June 10th, 1911

FIRST-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."

NAME.	DATE.
Biggs, J. G.	July 22nd, 1908
Bonar, Robert	October 28th, 1911
Brace, Tom	May 13th, 1915
Bridge, Edward	July 22nd, 1908
Brown, David	May 21st, 1914
Brown, Robert Joyce	" 13th, 1915
Caufield, B.	" 1st, 1909
Church, James A. H	June 10th, 1911
Cox, Richard	May 13th, 1915
Crowder, James	June 10th, 1911
Cunningham, John Howard	May 9th, 1912
Darbyshire, James	November 9th, 1907
Davidson, W. A	May 1st, 1909
Davies, David	June 10th, 1911
Davies, Thos. Owen	May 21st 1914
Devlin, Henry	" 1st, 1909
Dixon, James	October 31st, 1912
Elliott, Daniel	November 9th, 1907
Emmerson, Joseph	" 9th, "
Fairfoull, Robert	June 10th, 1911
France, Thos	November 22nd, 1906
Fraser, Norman	March 4th, 1905
Freeman, H. N.	May 1st, 1909
Galloway, C. F. J.	July 22nd, 1908
Gascoyne, Rowland B.	May 21st 1914
Glover, Francis	October 31st, 1912
Graham, Charles	November 14th, 1905
Graham, Thomas	" 9th, 1907
Gray, James	" 27th, 1909
Henderson, Robert	" 27th, "
Hewlett, Howe	May 27th, 1913
Holden, James	" 1st, 1909
Howden, Archibald	" 27th, 1913
Howells, Nathaniel	October 28th, 1911
Humphries, Clifford	June 10th, "
Jackson, Thos. R	November 9th, 1907
James, William.	July 22nd, 1908
Jaynes, Frank	May 13th, 1915
Jemson, Jas. W.	" 27th, 1913
Keith, Thomas	November 9th, 1907
Kellock, George	June 10th, 1911
Kinsman, A. D.	September 10th, 1910
Knox, T. K	July 27th, 1909
Lancaster, W	" 22nd, 1908
Leighton, Henry	May 9th, 1912
Macauley, D. A	June 10th, 1911
McCulloch, J.	September 10th, 1910
McGuckie, Thomas.	July 22nd, 1908
McKendrick, Andrew	May 27th, 1913
McMillan, J. H.	September 10th, 1910
McVicar, Samuel	May 1st, 1909
Mazey, William John	October 31st, 1912
Miard Henry Ernest	May 9th, "
Millar, John K	November 22nd, 1906
Miller, Andrew Anderson	October 31st, 1912
Montgomery, John W	May 1st, 1909
Mordy, Thomas.	September 10th, 1910
Musgrave, J. T.	October 28th, 1911
Newton, John	July 22nd, 1908
O'Brien, George.	May 21st 1914
Ovington, John	" 27th, 1913
Peacock, Frank David	October 28th, 1911
Penman, Hugh	May 21st 1914
Phelan, Arthur	" 27th, 1913
Powell, J. W.	June 10th, 1911

FIRST-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Concluded.*

NAME.	DATE.
Roper, William	May 13th, 1915
Russell, John	" 21st 1914
Saville, Luther	July 22nd, 1908
Shanks, John	May 1st, 1909
Shaw, Alex	November 14th, 1905
Shaw, William	May 9th, 1912
Shenton, T. J	September 10th, 1910
Shone, Samuel	May 1st, 1909
Sloan, Hugh	November 27th, "
Smith, A. E	October 28th, 1911
Smith, Joseph	July 22nd, 1908
Spicer, J. E	October 28th, 1911
Spruston, T. A	November 27th, 1909
Stevens, L. C	" 27th, "
Stewart, R. T.	September 10th, 1910
Strachan, Robert	March 4th, 1905
Strang, James	June 10th, 1911
Thomas, J. D	September 10th, 1910
Thorne, B. L	" 10th, "
Touhey, James	May 21st, 1914
Wallbank, J	September 10th, 1910
Willey, Edward	October 31st, 1912
Williams, Thos. H	November 22nd, 1906
Wylie, John	July 22nd, 1908

SECOND-CLASS CERTIFICATES OF SERVICE.

NAME.	DATE.	Cer. No.
Lee, John S	March 4th, 1905	B 9
Millar, J. K	" 4th, "	B 10
McCliment, John	" 4th, "	B 11
Martin, David	" 4th, "	B 12
Hunt, John	" 4th, "	B 13
Walker, David	" 4th, "	B 14
Powell, William Baden	" 4th, "	B 16
Bryden, Alexander	" 4th, "	B 18

SECOND-CLASS CERTIFICATES OF COMPETENCY ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."

NAME.	DATE.	Cer. No.
Adamson, Robert	September 10th, 1910	B 120
Allan, Alex. McDairmid	May 27th, 1913	B 167
Anderson, Robert	September 10th, 1910	B 119
Barclay, Andrew	July 29th, 1905	B 25
Bastian, John	November 2nd, 1907	B 42
Bevis, Nathaniel	September 10th, 1910	B 123
Biggs, J.	May 1st, 1909	B 94
Biggs, John G	November 2nd, 1907	B 40
Blair, James	May 13th, 1915	B 197
Brace, Tom	November 27th, 1909	B 96
Bridge, Edward	October 23rd, 1906	B 33
Brown, David	September 10th, 1910	B 108
Brown, James L.	October 28th, 1911	B 136

SECOND-CLASS CERTIFICATES OF COMPETENCY ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	Cer. No.
Brown, John C	October 23rd, 1906	B 39
Brown, John Todd	May 9th, 1912	B 150
Brown, R. J.	October 28th, 1911	B 134
Brown, Robert	May 21st, 1914	B 183
Brown, Robert Sheddon	" 13th, 1915	B 196
Bushell, J. P	" 1st, 1909	B 81
Carroll, Henry	July 22nd, 1908	B 62
Caufield, Bernard	October 23rd, 1906	B 30
Cawthorne, L.	May 1st, 1909	B 93
Challinor, Jno. Thomas	" 27th, 1913	B 169
Challoner, Jno. Arthur	" 21st, 1914	B 178
Churchill, James	July 22nd, 1908	B 65
Clarkstone, Wm. W.	May 21st, 1914	B 180
Commons, Wm	September 10th, 1910	B 115
Cook, Joseph	July 22nd, 1908	B 64
Courtney, A. W.	October 28th, 1911	B 138
Cox, Richard	May 9th, 1912	B 143
Crawford, David	" 1st, 1909	B 88
Cunliffe, T.	" 1st, "	B 78
Dando, John	" 27th, 1913	B 164
Daniels, David	November 2nd, 1907	B 53
Darbyshire, James	October 23rd, 1906	B 32
Davidson, Hugh	May 27th, 1913	B 165
Davies, Stephen	September 10th, 1910	B 113
Dennis, Fred. W.	May 21st, 1914	B 174
Devlin, Ernest H	" 21st, "	B 179
Devlin, Henry	November 2nd, 1907	B 44
Dewar, Alexander	October 31st, 1912	B 162
Dickenson, Clifford	May 13th, 1915	B 189
Dunsmuir, John	November 14th, 1905	B 26
Dykes, J. W	May 1st, 1909	B 77
Eccleston, Wm	" 1st, "	B 87
Fairfoull, James	May 21st, 1914	B 186
Fairfoull, R.	" 1st, 1909	B 83
Finlayson, James	July 29th, 1905	B 21
Ford, Allan	May 27th, 1913	B 171
Foster, W. R.	November 27th, 1909	B 102
France, Thos	" 14th, 1905	B 27
Francis, David M.	May 21st, 1914	B 182
Francis, Enoch	" 1st, 1909	B 86
Francis, James	July 22nd, 1908	B 63
Freeman, Henry N.	November 2nd, 1907	B 45
Garbett, Richard	October 31st, 1912	B 161
Garman, Morris Wilbur	" 31st, "	B 155
Gillespie, Hugh	July 29th, 1905	B 24
Gillespie, John	October 23rd, 1906	B 36
Gillespie, John M.	June 10th, 1911	B 126
Gould, Alfred	May 13th, 1915	B 190
Graham, Chas	March 4th, 1905	B 1
Gray, David	May 1st, 1909	B 76
Hamilton, Robert N.	" 21st, 1914	B 175
Henderson, Robert	July 22nd, 1908	B 60
Horrocks, Abner G.	June 10th, 1911	B 130
Howells, N.	November 27th, 1909	B 97
Huby, Norman W.	May 13th, 1915	B 198
Hudson, George	September 10th, 1910	B 121
Hughes, John C.	" 10th, "	B 109
Hutton, Isaac	May 21st, 1914	B 185
Hutton, John	" 9th, 1912	B 154
Jackson, Thos. R	March 4th, 1905	B 5
James, David	November 2nd, 1907	B 58
Jarrett, Fred	May 1st, 1909	B 84
Jaynes, Frank	September 10th, 1910	B 111
John, Howell	" 10th, "	B 122
Johnson, Moses	May 1st, 1909	B 75

SECOND-CLASS CERTIFICATES OF COMPETENCY ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	Cer. No.
Jones, William	July 29th, 1905	B 20
Jones, William T	" 22nd, 1908	B 66
Jordon, Thos	November 27th, 1909	B 104
Joyce, Walter	May 27th, 1913	B 168
Kirkwood, John Robertson	October 31st, 1912	B 160
Knowles, James E.	October 28th, 1911	B 137
Lancaster, William	November 2nd, 1907	B 50
Lander, Frank	May 13th, 1915	B 195
Lane, Joseph	May 9th, 1912	B 142
Lee, Robert John	September 10th, 1910	B 110
Littler, Matthew	October 31st, 1912	B 157
Luck, George	June 10th, 1911	B 128
Manifold, Albert	May 9th, 1912	B 145
Mason, Joseph	May 13th, 1915	B 193
Massey, H	November 27th, 1909	B 99
Mather, Thomas	June 10th, 1911	B 127
Mattishaw, S. K.	October 28th, "	B 135
Matusky, A	May 1st, 1909	B 91
Mayer, Ralph Waldo	" 9th, 1912	B 144
Mazay, W. J	November 27th, 1909	B 101
Merryfield, William	July 22nd, 1908	B 61
Miard, Hy. E	September 10th, 1910	B 107
Michell, Dudley	May 13th, 1915	B 187
Middleton, Robert	July 22nd, 1908	B 72
Monks, James	November 2nd, 1907	B 55
Moore, Wm. H.	May 21st, 1914	B 173
Morgan, John	November 2nd, 1907	B 43
Morris, John	July 22nd, 1908	B 67
Morton, Robert W	" 22nd, "	B 59
Musgrave, J.	May 1st, 1909	B 90
Myers, Peter	" 9th, 1912	B 149
McDonald, J. A.	October 28th, 1911	B 133
McDonald, John	May 27th, 1913	B 172
McFegan, W	November 27th, 1909	B 106
McGarvey, Martin	October 31st, 1912	B 156
McGuckie, Thomas M	" 23rd, 1906	B 35
McKelvie, J.	May 1st, 1909	B 92
McKendrick, And	September 10th, 1910	B 112
McMillan, D.	June 10th, 1911	B 125
McNay, Carmichael	May 9th, 1912	B 151
McPherson, James E.	July 22nd, 1908	B 73
Neen, Joseph	June 10th, 1911	B 129
Newbury, Arthur	May 21st, 1914	B 184
Newton, John	October 23rd, 1906	B 31
Newton, Wm	September 10th, 1910	B 116
O'Brien, Charles	May 9th, 1912	B 148
O'Brien, George	" 1st, 1909	B 82
Ovington, John	November 2nd, 1907	B 52
Parkinson, T	May 1st, 1909	B 80
Parnham, Charles	November 2nd, 1907	B 49
Quinn, James	May 21st, 1914	B 181
Quinn, John	" 9th, 1912	B 146
Rankin, Geo.	November 27th, 1909	B 103
Raynes, M. T.	October 28th, 1911	B 139
Reid, Thomas	July 29th, 1905	B 23
Reid, Wm.	October 28th, 1911	B 132
Renny, James.	" 28th, "	B 140
Richards, Thomas	November 2nd, 1907	B 57
Richards, Samuel	May 9th, 1912	B 152
Rigby, John	July 29th, 1905	B 29
Roberts, Ebenezer	September 10th, 1910	B 117
Robinson, William	July 22nd, 1908	B 69
Rogers, George	May 1st, 1909	B 79
Roper, William	" 9th, 1912	B 141

SECOND-CLASS CERTIFICATES OF COMPETENCY ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Concluded.*

NAME.	DATE.	Cer. No.
Russell, John	November 2nd, 1907	B 47
Saville, Luther	" 2nd, "	B 51
Shanks, David	October 31st, 1912	B 159
Shaw, Alex	July 29th, 1905	B 19
Shaw, Thomas John	May 27th, 1913	B 166
Somerville, Alex	March 4th, 1905	B 4
Spruston, Thos. A	November 2nd, 1907	B 46
Stafford, Matthew	June 10th, 1911	B 131
Stewart, J. M	May 1st, 1909	B 95
Stobbart, Jacob	" 9th, 1912	B 153
Stockwell, William	November 2nd, 1907	B 56
Strang, Thomas	October 31st, 1912	B 158
Taylor, James	May 13th, 1915	B 194
Thomas, J. B	November 27th, 1909	B 105
Thomas, Joseph D	October 23rd, 1906	B 38
Thompson, Joseph	September 10th, 1910	B 114
Touhey, James	May 9th, 1912	B 147
Tonge, Thomas	July 22nd, 1908	B 71
Vanhulle, Peter	November 2nd, 1907	B 54
Virgo, J	May 1st, 1909	B 89
Walker, William	" 13th, 1915	B 192
Warburton, Ernest Leonard	" 27th, 1913	B 170
Watson, Adam G	November 14th, 1905	B 28
Webber, John Frank	March 4th, "	B 3
Wesnedge, W	November 27th, 1909	B 98
White, John	" 2nd, 1907	B 48
Whitehouse, William	October 31st, 1912	B 163
Wilson, Robinson	May 21st, 1914	B 177
Wilson, Thomas	July 22nd, 1908	B 74
Wilson, W	" 22nd, "	B 70
Wood, Thos. James	May 21st, 1914	B 176
Worthington, Joseph	" 1st, 1909	B 85

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."

NAME.	DATE.	Cer. No.
Adamson, Robert	May 1st, 1909	C 323
Aleen, Alexander	October 28th, 1911	C 430
Almond, Alex	" 1st, 1907	C 252
Almond, W.	July 22nd, 1908	C 286
Anderson, John	October 28th, 1911	C 437
Anderson, Robt	" 14th, 1914	C 599
Angell, William	May 21st, "	C 591
Arbuckle, John	" 13th, 1915	C 622
Archibald, Geo	" 21st, 1914	C 569
Archibald, Thomas	October 28th, 1911	C 454
Ashman, Jabez	May 27th, 1913	C 131
Bann, Thomas	October 31st, 1912	C 494
Baggaley, J	July 22nd, 1908	C 300
Bain, James	May 27th, 1913	C 546
Ball, Benjamin	" 21st, 1914	C 583
Barker, Robert	June 10th, 1911	C 415
Barlow, B. R	May 1st, 1909	C 337
Barnes, B. J	" 1st, "	C 346
Bateman, Joseph William	October 28th, 1913	C 551
Bauld, Wm	June 10th, 1911	C 422
Baxter, Robert	October 28th, "	C 450
Baybutt, Thomas	May 27th, 1913	C 548
Beeton, D. H	" 1st, 1909	C 338

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	CER. NO.
Bell, Fred	May 27th, 1913	C 514
Bell, John	" 9th, 1912	C 477
Bennett, John	October 14th, 1914	C 597
Bennie, John	June 10th, 1911	C 411
Beveridge, Wm	" 10th, "	C 396
Biggs, John	March 4th, 1905	C 210
Biggs, Thomas	October 28th, 1911	C 449
Birchell, Richard	" 1st, 1907	C 266
Blair, James	" 31st, 1912	C 502
Blewett, Ernest	July 22nd, 1908	C 298
Bobba, Frank	May 21st, 1914	C 568
Bradley, William	July 22nd, 1908	C 291
Bridge, Edward	July 29th, 1905	C 223
Briscoe, F	" 22nd, 1908	C 309
Broderick, Matthew	January 21st, 1913	C 525
Brown, Arthur A	October 14th, 1914	C 596
Brown, David	November 1st, 1909	C 348
Brown, James	September 10th, 1910	C 364
Brown, James	June 10th, 1911	C 412
Brown, Jas. Millie	May 13th, 1915	C 615
Brown, John	September 10th, 1910	C 392
Brown, Robert	October 28th, 1911	C 451
Brown, Robert D	June 10th, "	C 423
Brown, Robert S	" 10th, "	C 408
Brown, Wm. A	May 21st, 1914	C 576
Brownrigg, J. H	July 22nd, 1908	C 276
Bullen, Thomas	September 10th, 1910	C 379
Bushell, Jas. P	October 1st, 1907	C 264
Cairnes, Andrew	June 10th, 1911	C 420
Cairnes, Robert	May 27th, 1913	C 539
Calverly, Joseph	September 10th, 1910	C 375
Camamile, Hollis	October 28th, 1911	C 443
Carr, Peter	" 31st, 1912	C 497
Catchpole, Charles	July 29th, 1905	C 227
Caufield, J	May 1st, 1909	C 321
Challoner, Arthur	October 28th, 1911	C 433
Cheetham, Ben	July 22nd, 1908	C 311
Chester, John	October 28th, 1911	C 440
Clark, Lewis	June 10th, "	C 405
Clark, Walter Pattison	May 9th, 1912	C 480
Clarkstone, Wm. W	October 28th, 1911	C 431
Cleaves, Walter	May 9th, 1912	C 475
Clifford, William	July 22nd, 1908	C 313
Commons, William	" 22nd, "	C 304
Cooke, Joseph	March 4th, 1905	C 209
Coombe, Alexander	May 27th, 1913	C 533
Cope, Frank	October 28th, "	C 549
Coulthard, James	June 10th, 1911	C 407
Crawford, David	March 4th, 1905	C 208
Cunningham, G. F	November 11th, "	C 229
Cunliffe, Thos	October 1st, 1907	C 265
Dabb, Owen	May 21st, 1914	C 578
Dando, John	" 9th, 1912	C 465
Davidson, Hugh	" 9th, "	C 464
Davies, Evan Thomas	" 9th, "	C 463
Davis, William	" 1st, 1909	C 339
Dean, Joseph	" 13th, 1915	C 611
Derbyshire, A	June 10th, 1911	C 401
Dewar, Alex	September 10th, 1910	C 369
Devlin, Edward	October 23rd, 1906	C 241
Devlin, Ernest Henry	May 27th, 1913	C 538
Dickenson, Clifford	" 27th, "	C 532
Dingsdale, Geo	October 28th, 1911	C 459
Doherty, J. J	May 1st, 1909	C 340
Doney, John	March 4th, 1905	C 211

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	Cer. No.
Donnachie, John	June 10th, 1911	C 425
Doodson, Robert	October 28th, "	C 455
Dorrance, Orlin William	January 21st, 1913	C 517
Douglas, D. B	*October 23rd, 1906*	C 235
Dow, And. Y	May 21st, 1914	C 587
Dunn, Wm	October 14th, "	C 606
Dykes, Isaac	June 10th, 1911	C 409
Dykes, Joseph W	October 1st, 1907	C 248
Edwards, John	May 27th, 1913	C 542
Elliott, John	" 27th, "	C 541
Elmes, George	October 31st, 1912	C 511
Evans, D	July 22nd, 1908	C 284
Ewart, Alex	September 10th, 1910	C 374
Ewing, Robert	May 13th, 1915	C 608
Fairfoull, James	October 28th, 1911	C 453
Fitzpatrick, T. J	October 28th, 1911	C 452
Flockart, David	*January 21st, 1913*	C 531
Ford, Allen	October 28th, 1911	C 445
Fowler, Robert	" 31st, 1912	C 495
Francis, David Morgan	" 28th, 1913	C 558
Francis, James	" 1st, 1907	C 250
Frater, George	May 13th, 1915	C 616
Freeman, H. G	November 14th, 1905	C 230
Frew, A	" 27th, 1909	C 360
Frodsham, Vincent	July 22nd, 1908	C 282
Furbow, John	January 21st, 1913	C 528
Garbett, Richard	September 10th, 1910	C 377
Gascoyne, Rowland B	January 21st, 1913	C 513
Geater, Jas. Gordon	May 21st, 1914	C 573
Gemmell, James	*October 31st, 1912*	C 505
Gillham, John	May 13th, 1915	C 623
Glen, James	October 28th, 1911	C 435
Gordon, Davis John	May 9th, 1912	C 474
Gourley, Robert	" 9th, "	C 470
Gray, George	May 9th, 1912	C 467
Greenhorn, John	" 21st, 1914	C 575
Griffoth, Edward	October 31st, "	C 508
Gunniss, Matthew	May 9th, 1912	C 460
Hallinan, W	" 1st, 1909	C 343
Halsall, J	July 22nd, 1908	C 307
Hamilton, John	October 28th, 1911	C 444
Hamilton, Robert Nesbitt	" 28th, 1913	C 550
Hartley, Thomas	" 31st, 1912	C 510
Harwood, Fred	September 10th, 1910	C 384
Harvey, Thomas	May 9th, 1912	C 466
Harvie, George	September 10th, 1910	C 378
Hayes, Edward	May 1st, 1909	C 320
Heaps, Robert	September 10th, 1910	C 373
Hemer, Herbert	October 14th, 1914	C 595
Henney, Jonathan	June 10th, 1911	C 424
Henry, James	May 9th, 1912	C 471
Hilley, Fred	July 22nd, 1908	C 290
Hilton, R. G	September 10th, 1910	C 376
Hodson, R. H	March 4th, 1905	C 216
Horbury, Joseph W	June 10th, 1911	C 406
Horrocks, A. G	*May 1st, 1909*	C 324
Horwood, S	July 22nd, 1908	C 312
Howells, Nathaniel	May 1st, 1909	C 316
Huby, Norman	June 10th, 1911	C 394
Hutchison, Ben	November 14th, 1905	C 232
Hutchison, F	" 27th, 1909	C 358
Ireson, John	October 31st, 1912	C 507
Irvine, David	June 10th, 1911	C 413
Jack, John	May 21st, 1914	C 582
James, Thos	" 21st, "	C 588

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	Cer. No.
Jardine, George Edward	January 21st, 1913	C 521
Jarrett, Fred. J	October 1st, 1907	C 256
Jaynes, Frank	July 22nd, 1908	C 277
Jemson, J. W	March 4th, 1905	C 205
Jenkins, John	September 10th, 1910	C 390
John, Howel	July 22nd, 1908	C 305
Johnson, Moses	October 1st, 1907	C 258
Johnston, Robert	May 9th, 1912	C 479
Jones, Alf. Geo	" 21st, 1914	C 584
Jones, Samuel	" 27th, 1913	C 518
Jones, William C	January 21st, "	C 556
Jones, William Ernest	October 28th, "	C 221
Jones, W. T	March 4th, 1905	C 544
Joshua, John	May 9th, 1912	C 478
Joyce, W	November 27th, 1909	C 361
Judge, Peter	September 10th, 1910	C 391
Keenan, Wm. James	June 10th, 1911	C 426
Kemp, Wm	October 14th, 1914	C 594
Kingham, Alfred	" 28th, 1913	C 559
Kirkeberg, H S	November 27th, 1909	C 350
Lancaster, William	October 23rd, 1906	C 243
Lane, Joseph	" 1st, 1907	C 254
Leeman, T	May 1st, 1909	C 345
Lewis, Benj. J	September 10th, 1910	C 386
Liddle, John	July 29th, 1905	C 228
Littler, John	June 10th, 1911	C 410
Littler, Matthew	" 10th, "	C 417
Littler, Robert	" 10th, "	C 418
Livingstone, Alex	October 28th, "	C 436
Loxton, George	June 10th, "	C 428
Loxton, John	" 10th, "	C 416
Lynch, Stewart	October 28th, "	C 432
Mackie, John	June 10th, "	C 421
Makin, J. Wm	September 10th, 1910	C 385
Malone, John	May 21st, 1914	C 585
Malone, Patrick	October 1st, 1907	C 247
Maltman, James	" 31st. 1912	C 501
Mansfield, A	May 1st, 1909	C 336
Manson, T. H	July 22nd, 1908	C 280
Marsh, Daniel Parks	May 27th, 1913	C 543
Marsh, John	October 1st, 1907	C 270
Martin, James	June 10th, 1911	C 398
Mason, J	July 22nd, 1908	C 297
Massey, Henry	May 1st, 1909	C 317
Mather, Thomas	July 22nd, 1908	C 293
Mattishaw, Samuel K	October 23rd, 1906	C 237
Matusky, Andrew	" 1st, 1907	C 259
Mawson, J. T	November 27th, 1909	C 359
Maxwell, Geo	May 21st, 1914	C 571
Meek, Matthew	" 9th, 1912	C 484
Mercer, Jas	October 14th, 1914	C 600
Merrifield, George	" 23rd, 1906	C 239
Merrifield, William	" 23rd, "	C 236
Michek, John	May 21st, 1914	C 563
Miles, John	June 10th, 1911	C 414
Millar, Peter	September 10th, 1910	C 388
Mitchell, C	May 1st, 1909	C 322
Mitchell, Henry	September 10th, 1910	C 366
Monks, James	November 14th, 1905	C 234
Moore, George	October 23rd, 1906	C 242
Moore, J	May 1st, 1909	C 335
Moreland, Thomas	July 22nd, 1908	C 299
Morgan, John	" 29th, 1905	C 224
Morris, David	May 9th, 1912	C 472
Murdock, Jno. Y	" 21st, 1914	C 564

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	Cer. No.
Myers, Peter	October 28th, 1911	C 446
McAlpine, John	March 4th, 1905	C 217
McBroom, Al	July 2nd, 1908	C 287
McCourt, John	October 14th, 1914	C 605
McCulloch, James	May 1st, 1909	C 315
McDonald, John	October 28th, 1911	C 448
McFagen, Alexander	May 9th, 1912	C 490
McFegan, W	" 1st, 1909	C 319
McGarry, M	" 1st, "	C 326
McGuckie, Jno. M	" 21st, 1914	C 562
McGuckie, Thomas	July 29th, 1905	C 226
McGuire, Thomas	October 28th, 1913	C 553
McIntyre, Neil	May 21st, 1914	C 574
McKelvie, J	July 22nd, 1908	C 285
McKenzie, Peter	June 10th, 1911	C 427
McKibben, Matthew	May 21st, 1914	C 580
McKinley, John	October 28th, "	C 442
McLaughlin, James	May 9th, 1912	C 485
McLachlan, Alex	June 10th, "	C 419
McLean, M.D	September 10th, 1910	C 389
McLellan, William	March 4th, 1905	C 219
McLeod, James	July 22nd, 1908	C 296
McLeod, John	May 13th, 1915	C 609
McMeekin, James	" 13th, "	C 612
McMillan, D	September 10th, 1910	C 363
McMillan, Edward	October 31st, 1912	C 493
McNay, Carmichael	July 22nd, 1908	C 306
McNeill, Adam T	" 22nd, "	C 281
McNeill, Robert	September 10th, 1910	C 387
Monks, John	May 13th, 1915	C 618
Neen, Joseph	November 27th, 1909	C 352
Nelson, Horatio	October 1st, 1907	C 263
Neilson, William	May 9th, 1912	C 481
Newman, John	October 14th, 1914	C 603
Nicholson, James	May 9th, 1912	C 469
Nimmo, James	" 9th, "	C 461
Norris, Joshua	October 28th, 1913	C 557
Oakes, Robert	" 31st, 1912	C 498
O'Brien, Charles	November 27th, 1909	C 349
Odgers, Alfred	January 21st, 1913	C 529
Odgers, Eli	" 21st, "	C 523
Orr, Alexander	October 28th, 1911	C 434
Osborne, Hugh	" 28th, 1913	C 555
Oswald, Geo. L	September 10th, 1910	C 370
Owen, T	May 1st, 1909	C 347
Park, Alexander	January 21st, 1913	C 519
Parker, L	May 1st, 1909	C 341
Parkinson, T	July 22nd, 1908	C 289
Parrott, Jas. E	May 21st, 1914	C 590
Parson, Herbert	" 13th, 1915	C 621
Pearson, Jonathan	" 9th, 1912	C 473
Penman, Hugh	October 28th, 1913	C 552
Perry, James	March 4th, 1905	C 215
Philips, T	November 27th, 1909	C 356
Pickup, A	July 22nd, 1908	C 310
Picton, W	May 1st, 1909	C 333
Plank, Samuel	November 14th, 1905	C 233
Poole, Samuel	May 27th, 1913	C 536
Potter, Robert	October 31st, 1912	C 503
Price, Walter	September 10th, 1910	C 371
Puckey, Wm. R	" 10th, "	C 368
Quinn, James	October 28th, 1911	C 441
Quinn, John	" 28th, "	C 429
Radford, Albert	May 21st, 1914	C 579
Rallison, R	July 22nd, 1908	C 279

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Continued.*

NAME.	DATE.	CER. No.
Rankin, George	July 22nd, 1908	C 275
Rankin, Wm. Shaw	May 9th, 1912	C 489
Ratcliffe, Thomas	October 1st, 1907	C 253
Raynor, Fred	" 1st, "	C 257
Reid, Robert	September 10th, 1910	C 383
Reid, Thos.	May 21st, 1914	C 592
Reid, Wm	June 10th, 1911	C 403
Reilly, Thomas	July 22nd, 1908	C 303
Renny, Jas	November 27th, 1909	C 354
Richards, James	" 1st, 1907	C 249
Richards, Samuel	October 23rd, 1906	C 244
Richardson, J. H.	" 28th, 1911	C 458
Rigby, John	July 29th, 1905	C 225
Roberts, E	May 1st, 1909	C 327
Robinson, M.	" 1st, "	C 332
Robson, Thomas	" 21st, 1914	C 566
Rogers, Ellis	" 13th, 1915	C 624
Roper, William	July 22nd, 1908	C 274
Rowan, Alexander	October 31st, 1912	C 500
Rowan, John	" 14th, 1914	C 602
Rowbottom, Thomas	" 31st, "	C 492
Royle, Edward	" 31st, 1912	C 506
Russell, Robert	November 27th, 1909	C 351
Rutledge, Edwin	July 22nd, 1908	C 302
Scott, Henry	" 22nd, "	C 294
Saunders, Eustace L.	January 21st, 1913	C 520
Seggie, Robert	" 21st, "	C 524
Shanks, David	September 10th, 1910	C 372
Sharp, James	May 1st, 1909	C 325
Sharples, J. T	September 10th, 1910	C 380
Shearer, L.	May 1st, 1909	C 330
Shenfield, W	November 27th, "	C 357
Shipley, John W.	October 28th, 1911	C 456
Shooter, Joseph	" 1st, 1907	C 261
Shortman, J	May 1st, 1909	C 331
Simister, J. H	November 27th, "	C 353
Simister, W	May 1st, "	C 334
Simms, Hubert Allan	January 21st, 1913	C 526
Sinclair, William	" 21st, "	C 527
Skelton, Thos.	May 1st, 1909	C 344
Smith, A. E.	September 10th, 1910	C 367
Smith, Joseph	March 4th, 1905	C 207
Smith, Richard Beveridge	October 28th, 1913	C 561
Smith, Thos. J	" 1st, 1907	C 271
Smith, Thomas	May 9th, 1912	C 486
Sopwith, Reginald Scott	January 21st, 1913	C 512
Sparks, Edward (C 314 issued in lieu of C 255 destroyed by Fernie fire)	October 1st, 1907	C 255
Spencer, G	May 1st, 1909	C 329
Sprusten, R. L	November 27th, "	C 355
Spruston, Thomas A	March 4th, 1905	C 206
Stafford, M	September 10th, 1910	C 382
Starr, Wallace	May 9th, 1912	C 488
Staton, Edward	" 21st, 1914	C 581
Steele, James	" 9th, "	C 462
Steele, Walter	October 28th, 1911	C 439
Stewart, George	May 27th, 1913	C 534
Stewart, James M.	October 23rd, 1906	C 240
Stockwell, William	" 23rd, "	C 238
Strachan, John	" 14th, 1914	C 604
Strang, James	May 13th, 1915	C 614
Strang, Thomas	June 10th, 1911	C 409
Strang, Wm.	" 10th, "	C 395
Suik, George	May 1st, 1909	C 318
Sutherland, John	" 27th, 1913	C 545
Taylor, Charles M	March 4th, 1905	C 213

THIRD-CLASS CERTIFICATES ISSUED UNDER "COAL MINES REGULATION ACT FURTHER AMENDMENT ACT, 1904."—*Concluded.*

NAME.	DATE.	Cer. No.
Taylor, Hugh	January 21st, 1913	C 530
Taylor, James	May 21st, 1914	C 567
Taylor, J. T.	October 28th, 1911	C 447
Taylor, Leroy	September 10th, 1910	C 381
Taylor, Thomas	May 21st, 1914	C 577
Thacker, Geo	" 27th, 1913	C 537
Thomas, Thomas	September 10th, 1910	C 365
Thomas, John B	November 14th, 1905	C 231
Thomas, Joseph	March 4th, "	C 220
Thomas, Warriett	October 1st, 1907	C 273
Thompson, Thomas	" 1st, "	C 267
Thompson, John	" 31st, 1912	C 509
Thompson, Joseph	" 1st, 1907	C 269
Thomson, Duncan	March 4th, 1905	C 218
Trehearne, Gomer	October 14th, 1914	C 601
Touhey, William	May 27th, 1913	C 547
Tully, Thomas	" 9th, 1912	C 468
Tune, Elijah	" 9th, "	C 476
Turnbull, Matthew	October 14th, 1914	C 598
Vardy, Robt	May 21st, "	C 570
Vaughan, John Henry	October 28th, 1913	C 560
Walker, Jas. Alexander	" 31st, 1912	C 496
Walker, Wm	May 21st, 1914	C 586
Wallace, Fred	October 1st, 1907	C 260
Warburton, Ernest Leonard	June 10th, 1911	C 399
Wardrop, James	October 31st, 1912	C 504
Watkins, William	May 9th, "	C 483
Watson, Adam G	March 4th, 1905	C 212
Watson, Arthur W.	May 27th, 1913	C 535
Watson, George	July 22nd, 1908	C 288
Watson, Joseph	January 21st, 1913	C 515
Watson, William	October 22nd, 1906	C 246
Webb, Herbert	" 28th, 1911	C 457
Weeks, John	March 4th, 1905	C 214
White James	October 31st, 1912	C 499
White, John	" 22nd, 1906	C 245
Whitehouse, Wm	June 10th, 1911	C 402
Wilcock, J	July 22nd, 1908	C 308
Wilkinson, Edward	October 28th, 1911	C 438
Williams, John Sam	June 10th, "	C 404
Williams, Watkin	" 22nd, 1908	C 301
Wilson, Robinson	" 10th, 1911	C 397
Wilson, Thomas	October 1st, 1907	C 272
Wilson, William	" 1st, "	C 262
Winstanley, H.	July 22nd, 1908	C 283
Wintle, Thomas A	" 29th, 1905	C 222
Witherington, George	October 28th, 1913	C 554
Wood, Thos. James	" 31st, 1912	C 491
Worthington, J	July 22nd, 1908	C 295
Wright, John	May 21st, 1914	C 593
Wright, Robert	" 21st, "	C 589
Wright, William	January 21st, 1913	C 522

COAL-MINES OFFICIALS.

Third-class Certificates issued under "Coal Mines Regulation Act Further Amendment Act, 1904," sec. 38, subsec. (2), in exchange for Certificates issued under the "Coal Mines Regulation Act Amendment Act, 1901."

Name.	Date.	Certificate No.
Adam, Robert	Oct. 12, 1904	C 42
Addison, Thos	Dec. 10, 1904	C 52
Aitken, James	Oct. 24, 1904	C 44
Allsop, Harry	Oct. 11, 1904	C 34
Auchinvole, Alex	March 29, 1905	C 89
Barclay, Andrew	April 27, 1904	C 19
Barclay, James	April 27, 1904	C 20
Barclay, John	April 17, 1905	C 111
Bickle, Thos	Oct. 11, 1904	C 37
Biggs, Henry	April 10, 1905	C 110
Black, John S	April 3, 1905	C 108
Bowie, James	May 13, 1905	C 116
Briscoe, Edward	Oct. 10, 1906	C 129
Campbell, Dan	March 29, 1905	C 93
Carr, Jos. E	Oct. 11, 1904	C 36
Carroll, Harry	March 29, 1905	C 98
Clarkson, Alexander	April 27, 1904	C 18
Collishaw, John	Feb. 7, 1905	C 68
Comb, John	March 23, 1904	C 2
Cosier, Wm	March 29, 1905	C 86
Courtney, A. W	Nov. 2, 1904	C 45
Crawford, Frank	April 6, 1904	C 7
Daniels, David	April 27, 1904	C 12
Davidson, David	April 3, 1905	C 106
Davidson, John	March 29, 1905	C 87
Devlin, Henry	Oct. 12, 1904	C 41
Dobbie, John	Nov. 27, 1905	C 126
Dudley, James	March 22, 1905	C 114
Duncan, Thomas	Aug. 29, 1906	C 128
Dunlap, Henry	Nov. 21, 1904	C 51
Dunn, Geo	Dec. 19, 1904	C 56
Dunsmuir, John	March 29, 1905	C 90
Eccleston, Wm	March 15, 1905	C 80
Evans, W. H	March 14, 1905	C 79
Fagan, David	April 6, 1905	C 109
Farquharson, John	April 27, 1904	C 17
Findlayson, James	June 6, 1904	C 25
Fulton, Hugh T	April 3, 1905	C 105
Gibson, Edward	May 30, 1905	C 118
Gilchrist, Wm	March 29, 1905	C 85
Gillespie, Hugh	April 6, 1904	C 8
Gillespie, John	April 6, 1904	C 5
Gould, Alfred	April 17, 1906	C 112
Green, Francis	Oct. 11, 1904	C 38
Handlen, Jas	June 16, 1904	C 122
Harmison, Wm	Feb. 3, 1905	C 65
Haworth, Geo	March 29, 1905	C 88
Hescott, John	Jan. 16, 1905	C 62
John, David	Nov. 8, 1904	C 49
Johnson, Geo	May 9, 1904	C 124
Johnson, Wm. R	March 1, 1905	C 75
Kerr, Wm	March 29, 1905	C 91
Lander, Frank	Jan. 9, 1905	C 61
Lanfear, Herbert	Jan. 27, 1905	C 63
Lewis, Thos	Oct. 11, 1904	C 35
Malpass, James	Nov. 7, 1904	C 113
Marsden, John	May 3, 1904	C 21
Marshall, Howard	Dec. 6, 1905	C 127
Matthews, Chas	April 27, 1904	C 9
Miard, Harry E	March 3, 1905	C 76
Middleton, Robt	Feb. 11, 1905	C 71
Miles, Thos	Aug. 10, 1904	C 31
Miller, Thos. K	Feb. 21, 1905	C 74
McKenzie, John R	Oct. 12, 1904	C 40
McKinnon, Arch'd	April 3, 1905	C 102
McMillan, Peter	March 29, 1905	C 94
McMurtrie, John	March 29, 1905	C 96
Moore, Wm. H	June 17, 1905	C 119
Morris, John	Dec. 27, 1904	C 57
Myles, Walter	April 3, 1905	C 100
Nash, Isaac	June 1, 1904	C 120
Neave, Wm	Oct. 12, 1904	C 43
Nelson, James	April 27, 1904	C 16
Newton, John	Oct. 12, 1904	C 39
Nimmo, Jas. P	April 3, 1905	C 103
O'Brien, Geo	Feb. 6, 1905	C 66
Perrie, Jas	March 15, 1905	C 81
Perry, James	June 13, 1904	C 27
Price, Jas	Nov. 8, 1904	C 50
Rafter, Wm	March 29, 1905	C 95
Reid, Thos	Nov. 3, 1904	C 47
Reid, James	March 23, 1904	C 1
Reid, Wm	Dec. 15, 1904	C 54
Richards, Thos	April 27, 1904	C 14
Ross, John	April 3, 1905	C 101
Roughead, George	Jan. 30, 1907	C 130
Ryan, John	Dec. 28, 1904	C 59
Sanders, John W	April 3, 1905	C 107
Shenton, Thos. J	July 25, 1904	C 30
Shepherd, Henry	June 13, 1904	C 26
Smith, Ralph	March 7, 1905	C 77
Smith, Geo	March 29, 1905	C 84
Somerville, Alex	March 24, 1904	C 3
Stauss, Chas. F	Feb. 9, 1905	C 69
Steele, Jas	March 29, 1905	C 92
Stewart, Duncan H	March 28, 1904	C 4
Stewart, John	April 3, 1904	C 104
Stewart, Daniel W	May 16, 1904	C 23
Stoddart, Jacob	Feb. 21, 1905	C 73
Strachan, Robt	April 27, 1904	C 15
Strang, James	April 27, 1904	C 10
Thomas, John	March 29, 1905	C 97
Vass, Robt	Dec. 12, 1904	C 53
Vater, Charles	April 6, 1904	C 66
Webber, Chas	Sept. 13, 1904	C 32
Webber, Charles F	Sept. 13, 1904	C 33
Whiting, Geo	May 29, 1905	C 117
Wilson, Austin	Feb. 7, 1905	C 67
Wilson, Thos	April 27, 1904	C 11
Woodburn, Moses	March 29, 1905	C 83
Yarrow, Geo	Nov. 3, 1904	C 46

CARIBOO DISTRICT.

CARIBOO MINING DIVISION.

REPORT BY C. W. GRAIN, GOLD COMMISSIONER.

I have the honour to submit herewith my report on the progress of the mining industry in the Cariboo Mining Division for the year ending December 31st, 1915.

Owing to certain office changes I am now unable to travel around the district as formerly, and to so gather data for my report at first hand. I am therefore forced to confine my report to the industry as carried on in that part of my district which constitutes the Cariboo Mining Division. Even with regard to that part of my district, I am now unable to go over it as I should, so as to be able to give a really reliable and comprehensive report.

As regards climatic conditions, as it turned out they could hardly have been better from the hydraulic miner's point of view. As spring opened up it looked hopeless for a good water season; only 8 feet of snow had fallen during the winter, instead of the 20 feet or more. However, what snow there was melted just right; as the snow-water petered out the rain started to come, and kept falling at frequent intervals during the piping season, this keeping up a very fair head of water. The ground never had a chance to get dry after the snow went; if it does, I have noticed that any rain that falls is practically useless as an addition to the water-supply; apparently the ground soaks it all up. Thus, although there was never what a hydraulic miner would call a "full head," nevertheless it was a real good water season.

This reduction in the snowfall also caused a great reduction in the spring expenses, as usually all ditches have to have a channel shovelled in the snow; often this channel has to be cut 5 feet deep to allow the water to run freely, otherwise the snow dams up the ditch, which soon overflows, making a large cut in the ditch-side. This year very little shovelling had to be done; what shovelling there was was not deep, and in many cases it was enough to walk the ditches ahead of the water.

Thus with a considerable reduction in working expenses and a water season of somewhat longer duration than usual, the hydraulic miner put in a very profitable season.

As can be readily understood, the prevailing hard times had their effect on the mining industry as well as other industries. Yet, whilst they had a harmful effect on the industry, by making capital hard to get, they also had a beneficial effect.

The lack of capital caused some properties to remain idle and others to be worked in a much smaller way than the original intentions. On the other hand, owing to the scarcity of work, many men went prospecting; this I learn was the case throughout the entire district, both in the case of whites and Chinese.

This state of affairs resulted in a very considerable amount of gold being recovered, which in ordinary years would not have been the case. Several small storekeepers in the district have informed me that, whereas in past years they have only taken in a few hundreds in gold-dust, this year they have taken in one or two thousand and in some cases even more.

Thus, in a way, hard times have had a somewhat beneficial effect on the mining industry in the Cariboo District; it has driven the men back to the land and shown them that the country is still worth prospecting, and that there is still a living to be obtained by working the placer-ground in this country, as many have made good wages all summer, and some have done even better. I may add that considerable of the gold recovered has been from creeks which the old-timers claim to have been long since worked out.

Considerable drilling was carried on this year in this district with Keystone drills. The Yukon Gold Company operated one machine and J. T. Towers, representing Boston capital, the other.

The drill owned by the Yukon Gold Company first operated on Antler creek, on the old *Nason* and *Lothair* Crown-granted claims and some adjoining leases, where several cross-sections were obtained. The machine was then moved over to Williams creek, the first cross-section to

be drilled being practically over the upper line of the old *Tinker* and *Cameron* claims, two of the richest claims in the old days. It was out of these two claims that the late "Cariboo Cameron" took so many thousands of dollars in the early days. Two cross-sections were then put down farther down the creek. The machine was then moved up into the town of Barkerville, where a cross-section was put down about the spot which in early days was the lower line of the old *Barker* claim.

This drill was then moved to Willow river and some few holes sunk in that vicinity. From there the drill was moved to Stanley, and several cross-sections put down on Lightning creek on the properties of the Lightning Creek Hydraulic Company.

J. T. Towers operated his drill on Willow river in the vicinity of Mosquito and Cornish creeks, and on the lower Willow river below Slough creek.

For reasons needless to mention, the results of the drilling are not made public; however, I do not think that they were discouraging, and feel fairly confident that results proved that there was a considerable yardage of dredging-ground in this vicinity.

However, I am convinced in my own mind that very little will be done in that way of mining until railroads are very much nearer Barkerville than they are at the present moment.

The records of placer claims show a slight increase this year, as is the case with the number of leases granted, but mineral locations show a considerable decrease.

As regards the actual revenue paid into my office during the past year, you will note that there is a substantial increase, which, in itself, is encouraging, considering the great scarcity of money during the past year.

In July of last year somewhat of an excitement was caused by two prospectors striking a fairly good prospect on Swamp river, which flows southward into Cariboo lake, and owing to the amount of pay struck being greatly exaggerated, somewhat of a stampede was started, which, as long as it was confined to local men, did no harm, but, when it appeared that men on the outside might be affected thereby, I did all in my power to publish the strict facts of the strike, considering that in these days of financial stringency and the scarcity of jobs many men might give up good jobs with the hope of "striking it rich," of which, knowing the facts, I knew there was very little hope. The two prospectors mentioned certainly discovered a nice little pocket of gold, but, after working for a considerable time, failed to recover any more; however, I understand they intend to go back to their claim next year.

The properties owned by John Hopp on Stouts gulch, Mosquito creek, and Lowhee creek were worked as usual during the continuance of the water season; Lowhee creek and Mosquito creek giving excellent results.

On the old *1st of May* claim, on Williams creek, James Joules and partner did considerable work while water lasted, and the claim is in good shape for next season's work, when they hope to again get into the pay.

No work was done this year on the property owned by the West Canadian Deep Leads, an English company, on Little Valley creek.

On Shepherd creek, near Eight-mile lake, R. D. Rees worked a good long season, and, as far as I can learn from him, with paying results; however, he is still working at great disadvantage owing to lack of dump.

On Slough creek the *Point* claim, owned by Loo Gee Wing, worked as usual under the management of Joseph Wendle; this claim, however, suffered somewhat owing to the poor snowfall of the preceding winter, the summer rains not helping them so much as it did the claims in the immediate vicinity of Barkerville.

On Antler creek and tributaries the China Creek property, owned by B. A. Laselle, was under bond to C. W. Moore, who worked it with a small force; only a short season was put in, as work was not started until all need for shovelling the ditches was past. I understand that the results were hardly up to expectations.

Higher up on Antler creek John Campbell and Houser Bros. struck some very good ground on leases held by them, and at the time of writing they are still working the ground by drifting, but as yet have been unable to get on to a true channel, the gold obtained by them last summer being evidently only a pocket.

On Chisholm creek and tributaries J. A. Macpherson, who owns some six or seven leases, has succeeded in interesting Toronto capitalists in his property, who have had the property inspected by two engineers and have expended considerable money in prospecting.

Mr. Macpherson sends me the following statement: "As you are well aware, the work done on the deep ground of Chisholm creek by the late David Edwards, in the nature of a shaft 203 feet deep sunk to bed-rock and a drive up-stream for 1,200 feet, breaking out from the shaft at the 100-foot level, resulted in no prospects as regards gold. The result of Edwards's work and the information we obtained from the late William Wormald with regard to the operations of the Vulcan Company at the junction of Chisholm and Lightning creeks led us to believe that the deep ground of Chisholm creek was prospected. In 1914, with the assistance of Toronto capital, we began boring on the West branch, having the idea that the gold lead belonging to Chisholm creek was there; the results of our boring proving successful and the ground being too wet to sink a shaft, we are now running a drain-tunnel of 1,200 feet to tap the channel.

"From time to time patches of the surface gravel on Chisholm creek have been worked, principally by rocking, resulting in considerable gold being recovered, pieces weighing as much as 1 oz. having been found. We have been prospecting these surface gravels as to their course and values, and have succeeded in locating the main run above the old *Snowden* shaft, where it apparently divided, one part continuing in the present channel of the creek, and other parts up the East and West branches.

"We are installing a small hydraulic plant to work these surface gravels and will know more about them by next fall. We have also done considerable prospecting on benches 250 feet higher than the present creek; on one we sunk six shafts from 20 to 50 feet in depth, besides considerable tunnel-work."

On Perkins gulch, a tributary of Lightning creek, I. I. Felker with a small staff has operated on and off on this creek for several years since the year 1911, thoroughly prospecting the ground and always finding gold-bearing gravels, but in no continuous run.

This year he has uncovered a bank of auriferous gravel 25 feet deep and at least 150 feet wide; this leads Mr. Felker to believe that at last he has evidently struck a part of the old Perkins Gulch channel. I understand that this year there has been a considerable increase in the amount of gold recovered. Mr. Felker also informs me that this year they have constructed 1,000 feet of new ditch, moving their penstock and pipe-line, which gives them an added pressure of 75 feet; they also built 150 feet of new flume, which gives them a dump of 50 feet. The reservoir in connection with this claim was also considerably enlarged, giving two hours' more piping at each filling. Piping was started on April 3rd and stopped on October 31st; during the season 10,000 yards of material was moved.

The Lightning Creek Hydraulic Mining Company worked the properties owned by it on Lightning creek near Stanley. This ground is the same ground as held by the old South Wales Company in the early days of Cariboo. In those old days, when it was a drifting proposition, much trouble was caused by slum, but now that it is worked as a hydraulic proposition the lack of dump is almost a greater trouble. An elevator was installed to overcome this difficulty, and this year a second elevator was installed, but the work was not completed until somewhat late in the season, and thus the best part of the water season was lost, and, consequently, I understand, no clean-up was made this season.

With regard to the property owned by the Lightning Creek Gold Gravels and Drainage Company on lower Lightning creek at Wingdam, S. J. Marsh, the engineer in charge, sends me the following report:—

"A Keystone drilling-machine was started on June 18th, which is still in operation. Two cross-sections of the valley have been completed, the drill now being at work on the third; nine holes have been completed to bed-rock, the deepest of which is 173 feet. In some of these holes very encouraging prospects have been recovered.

"A detailed survey of the creek-valley from the workings up-stream, a distance of 7,500 feet, has been made, and a preliminary survey of about two miles down-stream.

"A dam and weir has been constructed and a measurement of the water made for a period of forty-nine consecutive days during the low stage, showing a mean flow for the period—which is probably the low stage for the year—of 2,092 cubic feet a minute. A site for a dam and pipe-line to convey the water to a power plant has also been surveyed.

"The sawmill has been moved farther down-stream, and 115,000 feet of lumber and timbers cut, including a complete set of timbers for a new shaft.

"The drilling-work has employed a crew of four men, and the sawmill and logging ten men, for a period of two months.

"Considerable new machinery and repair parts have been shipped in and the plant put into good shape for next season."

The following is a report (supplied by Dougald Cameron) of the work performed during the season of 1915 on the Cameron-Ewing leases on Government creek:—

"The Cameron-Ewing leases are located on Government creek, thirty-five miles north of Quesnel and four miles east of the Pacific Great Eastern Railway, now under construction from Vancouver to Prince George.

"Government creek follows a southerly course to its junction with Hixon creek, crossing a four-mile belt of slates and schists, in which numerous quartz veins and stringers occur. This belt is covered by the eight leases; during the year 1915 each lease was prospected by means of test-pits and trenches, and a number of benches were tested by ground-sluicing.

"The gold recovered was good, heavy gold, the smallest particles being caught in the first 24 feet of the sluice-boxes. Nuggets ranging from 25 cents to $25 were recovered during the season; the latest assay giving $18.08 to the ounce. By careful measurements, including the overburden, the average value obtained with ground-sluicing was 42 cents a cubic yard.

"A water licence has been secured, granting the use of 1,000 inches of water, and a dam-site located in a granite canyon one mile north of the property.

"It is the intention of the lessees to continue prospecting the gravels of the higher benches, with the view of interesting capital to more thoroughly prospect or work the ground."

OFFICE STATISTICS—CARIBOO MINING DIVISION.

Free miners' certificates (individual)	501
Free miners' certificates (company)	9
Placer claims recorded	52
Placer claims rerecorded	32
Mineral claims recorded	76
Certificates of work issued	60
Placer leases granted	72
Leaves of absence	19
Conveyances and other documents recorded	130

Revenue.

Mining receipts, general	$10,300 85
Free miners' certificates	2,055 25
Leaves of absence	47 50
Water revenue	452 40
Miscellaneous receipts	6 50
Total	$12,862 50

QUESNEL MINING DIVISION.

REPORT BY ARTHUR SAMPSON, MINING RECORDER.

I have the honour to submit herewith my report on mining operations in the Quesnel Mining Division of the Cariboo District for the year ending December 31st, 1915.

The mining industry in this district has been exceptionally quiet as compared with former years, this being no doubt due to the war and the general financial stringency.

In the Quesnel Forks section very little work has been done. The *Bullion* mine and the various dredging and hydraulic companies have been practically inactive as regards extensive operations.

In the Keithley section Harrison & Worth have been driving a tunnel on their lease with a view to further development.

In the Harpers Camp section the Horsefly Hydraulic Mining Company, operated by E. J. West, employed only a small crew; however, extensive development-work is taking place on the claims operated by Mr. Loveridge, and it is probable this work will be continued next year on at least as large a scale.

In lode-mining there has been a certain amount of development-work carried out in the Timothy Mountain section, where many claims have been located at the headwaters of Boss creek; a road is in course of construction to these claims, and with transport facilities thus assured, next season should show further development.

A number of claims have also been staked in the Vavenby section, but no reliable information has been as yet received as to how these claims are developing.

Note by Provincial Mineralogist.—The Provincial Mineralogist is in receipt of recent information from an authentic source that there is a strong probability of the old *Bullion* property being opened up again this coming year by a new organization of financial ability to carry out the work.

The Quesnel Company, on Twenty-mile creek, during 1915 did considerable exploratory work on its property, which proved so successful that the company has decided to operate again in 1916. It would appear that, in the great width of gravel exposed in the creek, a more defined channel has been demonstrated, with more definite bed-rock and more concentrated values, and on this the work will be resumed.

OFFICE STATISTICS—QUESNEL MINING DIVISION.

Free miners' certificates	141
Mineral claims recorded	56
Placer claims recorded	34
Placer claims rerecorded	9
Certificates of work	29

CASSIAR DISTRICT.

ATLIN MINING DIVISION.

REPORT OF J. A. FRASER, GOLD COMMISSIONER.

I have the honour to submit my report on mining operations in the Atlin Mining Division of Cassiar District for the year ending December 31st, 1915.

The mining season of 1915 opened from one to three weeks earlier than usual, and the prospects for a long and successful period of operation were very promising, but the unusually light snowfall during the previous winter, coupled with a very limited rainfall during the summer, soon produced a scarcity of water that seriously embarrassed the operators on nearly all of the creeks and compelled a complete cessation of operations on some of them before the season was more than half over.

The general result was a diminished output on all but three or four of the creeks, but the increase on these three was sufficient to place the aggregate output considerably above that of 1914. This was some compensation for the general disappointment, which was the greater since in several cases the operators appeared to be working in more remunerative ground than for some seasons previously, and a still greater increase of the aggregate output would doubtless have been realized under normal conditions as to water-supply.

There was a somewhat general falling-off in revenue, but this must not all be regarded as having been unearned, for if all the mineral and other taxes legitimately due and owing for the season's operations, etc., had been paid in time to be brought to account, the deficit, if any, between this and some previous seasons and years would hardly be noticeable.

The war has been, and will doubtless continue to be, responsible for diminished revenues in various ways, but confidence in the future importance of the Division as a productive mineral district is firm, being encouraged by the results of development being prosecuted.

MCKEE CREEK.

On this creek the Delta Gold Mining Company, under the management of George Adams, operated as usual throughout the season, commencing piping on May 5th and ceasing on October 19th. Notwithstanding the lengthy period of operation, the water-supply was so meagre that instead of piping from twenty to twenty-four hours a day, continuous piping was impossible, and at times only two to four hours a day was possible, with the result that considerably less bed-rock was stripped than in 1914 and a somewhat reduced output realized.

During the previous winter timber and material for the construction of a dam on McKee creek was assembled, and in May and June the dam was built at a point about four miles up-stream from camp and a good-sized reservoir provided for future use. Had it not been for the extra supply of water thus provided, small as it was, piping must have been abandoned probably two months earlier than it actually was. There was a force of from eleven to thirty-two men employed, or an average of eighteen throughout the season.

This company, or its predecessor in title, was the first in this district to use manganese-steel plates in its sluices, and this season a further supply was secured which will be installed next spring, so that, with the additional water-supply which a normal snowfall will assuredly provide, a much-increased output may confidently be expected. Everything is in good shape for an early start next season.

PINE CREEK.

On this creek the Columbian Mines Company, under the superintendence of J. Frank Breeze and the general managership of Paul W. Greyer, and representing the North Columbia Gold Mining Company, the Pine Creek Power Company, Limited, and the Atlin Consolidated Mining Company, operated throughout the season with a force varying from thirty-two to fifty men, or an average of thirty-eight, commencing on April 10th and finally closing down on November 8th.

Although the general scarcity of water left even this outfit—which has Surprise lake for a reservoir—without sufficient water to permit of flushing out the creek for dump purposes, etc., still seven monitors were kept pretty constantly employed and a large area of bed-rock was uncovered. About 325,000 cubic yards of gravel was moved, and whilst a portion of the ground worked was rather barren owing to the limit of "pay" in that direction having apparently been reached, the greater portion of the ground worked gave very good returns, and the results of operations in that field, on the whole, were apparently quite satisfactory.

The Pine Creek Flume Company, Limited, did not do any work during this season, but some of its ground was operated by "laymen," from whom, however, no returns were obtainable up to the close of the season.

A number of individual miners were operating along Pine creek and Gold Run with varying success, and they are still continuing. Several small outfits are drifting along Pine creek this winter, and, altogether, from twenty to twenty-five men are so employed. There was a considerable increase in output on this creek over that of last season.

SPRUCE CREEK.

On this creek there were from 110 to 120 people engaged in mining and prospecting during the summer, whose operations extended over about five miles, or more, of the creek.

On the Spruce Creek Power Company's leasehold properties A. D. Hughes, with a force of from six to fifteen men, or an average of twelve men, carried on drifting operations from April 20th to October 20th with very fair success. He had some men drifting and prospecting on the ground throughout the winter of 1914-15 and has a few similarly engaged this winter.

On the *Gladstone* bench lease James McCloskey had some men drifting, chiefly for prospecting purposes, during last winter and commenced sluicing as early as weather conditions permitted, and continued until September 1st, when he closed down. The results of his sluicing operations were, as usual, very satisfactory while they continued, but his "lay" arrangement with his partners having expired he suspended operations until such can be renewed. In the meantime, a few men are driving prospect-tunnels in unexplored portions of the property. His maximum force was twelve men, minimum four, with an average of eight.

On this section of the creek J. R. Clay, with a small outfit, secured very good returns from resluicing old "tailings" in the creek-bed, an operation which he has been following for several seasons.

On the *Peterborough* bench lease and adjacent holdings H. O. Morse, with an average of five men, continued his drifting operations throughout the year with very fair results in the aggregate. He is continuing the same system this winter, but with a larger force.

On the *Lovell* group of leases, comprising the *Poker*, *Joker*, and *Croker* bench leases and the *Olalla* creek lease, Isaac Matthews continued drifting operations with very excellent results, a goodly portion of the gravel encountered being unusually rich. There has been employed on his holdings during the year a maximum force of sixty-two men, a minimum of fifteen, or an average of almost thirty-eight men.

There has been installed 700 feet of ground or sluice flume; 400 feet of top or supply flume; 300 feet of trestles and inclines; four water-wheels; four wheel-houses; and two steam pumping and hoisting plants, and more are likely to be added as other openings into the hillside are made by his "laymen."

An elaborate system of underground or "covered-in" water-supply ditch with sunken water-wheels for power purposes was installed last fall in the hope and expectation of being able to sluice uninterruptedly all winter, but the unusually severe weather experienced recently blocked this water-supply and caused a suspension of operations for a time. The increased output on this group compensated for the falling-off from the *Gladstone* lease in consequence of the early suspension of operations on that property.

Otto Miller & Co. and William Foley were also very successful during the season and increased their bank deposits materially.

On *Discovery* claim J. M. Ruffner undertook to prove a theory which he had entertained for some time as to the existence or presence of the "old" original channel of Spruce creek under the high banks on the north side of Spruce creek, and to this end sank a shaft, well equipped with modern appliances, and at a considerable depth found every evidence of the

existence of such channel as he supposed; but, while he found some very good "pay" in parts, he had not encountered anything phenomenal up to the time of writing, although he is still hopeful and persisting.

Surprises have been in order, for a short distance up-stream Otto Koppacher was securing very good "pay" from the grass-roots to bed-rock, which at this point appeared to be an indurated hard-pan.

Considerable work was done in the vicinity of Blue canyon with but indifferent results, and above Blue canyon, where the gravel was found to be richer, the operators were compelled to close down very early for want of water.

Spruce creek supplied the largest aggregate output of all the creeks in the district this season, and more than doubled that of 1914.

There are upwards of one hundred people living on Spruce creek this winter.

Nothing worth mentioning was done on Rose creek for want of water, although a few individual miners did very well for the short time water for sluicing purposes was available.

BIRCH CREEK.

About fourteen men were operating on this creek during the season, but, owing to scarcity of water, the amount of gravel moved and the amount of gold won was the smallest for several years. This season's operations confirmed the theory suggested last season as to the pay-channel being under the high banks on the right limit, and it will require a good water-supply to remove the heavy overburden so as to permit of profitably operating the pay-gravel.

Considerable dead-work was performed in removing and rebuilding flumes, penstock, pipe-lines, etc., farther up-stream, and establishing a new reservoir, thus providing about 100 feet more pressure-head. A good supply of water next season will probably enable the operators to repeat the successes of former years and redeem the disappointed hopes of this past season.

The operations were under the management of H. Peploe Pearse, as in former years.

BOULDER CREEK.

From twelve to fifteen people worked on this creek during the season, and with the usual satisfactory results, as a whole, but they were handicapped, as on other creeks, for want of water. The output was about the same as last year.

The pay-streak on the upper part of the creek appears to be running under the high banks on the right limit, as on Birch. There are several outfits drifting on the creek this winter.

During the early summer the former holdings of the Société Minière de la Colombie Britannique were acquired by other parties and some prospecting done by them, and the probabilities are they will undertake extensive operations next season, and that more will be doing than for several years past.

RUBY CREEK.

On this creek the Placer Gold Mines Company, under the management of T. M. Daulton, commenced operations on April 13th and continued until October 8th, when they closed down for the winter.

A force of from seventeen to twenty men, with a minimum of seventeen, was employed throughout the season. Owing to shortage of water and for other reasons, about 20 per cent. less gravel was moved this season than in 1914, yet the proceeds were some thousands of dollars in excess of the output for 1914, so that it is obvious they were operating in richer ground, and the company and manager were correspondingly gratified at the results. The output averaged over $2 per square foot of bed-rock uncovered.

This company, having tested the efficacy of manganese-steel plates in its sluices, is moving a fresh supply on to the creek this winter for installation next spring.

A number of outfits are drifting on the creek this winter, and about thirteen people are wintering on the creek.

I may say that, encouraged by the results realized by the company, a few men have undertaken development on holdings higher up the creek, but up to date no new strikes have been reported.

WRIGHT CREEK.

Not more than four men were operating on this creek, and as the results secured were not particularly encouraging, when water began to fail they shut down, so that little or nothing was done there after midsummer.

OTTER CREEK.

On upper Otter creek J. E. Moran continued his sluicing operations, and with a force of five men on an average moved about 20,000 cubic yards of gravel and uncovered over 10,000 square feet of bed-rock. The results were rather disappointing, but by accident "*pay*" was discovered during the season on higher ground that was being worked and where it was not anticipated, and it is Mr. Moran's intention to devote his attention to the operation of this ground during the coming season.

During the season a dam about 120 feet in length and about 10 feet in height was built to assist in the manipulation of the water-supply.

Operations were commenced on April 25th and piping on May 13th, and continued until October 20th, when the approach of winter compelled them to close down and move to a lower altitude.

On lower Otter creek the Mines d'Otter, under the superintendence of W. H. Brethour and the general management of Henry Maluin, continued advancing its sluice-boxes up-stream about 750 feet and its flumes down-stream for dump purposes, and in so doing cut through banks averaging about 60 feet in height and moved approximately 150,000 cubic yards of material, but the season closed upon them before they had quite got the upper end on to bed-rock. Towards the end of the season, however, a prospect-hole was sunk in the pit which revealed bed-rock and good pay at a very short distance below the grade of the sluice-boxes, so that it is *confidently anticipated by the management that they can operate on bed-rock and in good* pay-gravel for the greater part of next season, and so begin to recoup themselves for their heavy outlay.

Other work done during the season was the building of a by-wash, deepening ditches and strengthening dams, of which they have three, sawing riffle-blocks, and building about a mile of wagon-road from the Government wagon-road to the actual seat of main operations.

This outfit has now in operation about 9,500 feet of supply-ditches, three good dams and reservoirs and a long line of flumes and sluices, a sawmill and other plant, all of which, with the labour expended, represents an investment of many thousands of dollars, and it is gratifying to learn that bed-rock is so nearly accessible and that the "pay" is there.

As those operations were dependent upon French (Parisian) capital, I regret to say that they have been somewhat hampered in consequence of the war, but they have never actually been suspended as yet.

A force comprising an average of nine men was employed during the season of 1915, which covered the period from May 3rd to October 28th. Drifting operations were carried on last winter and again this winter—prospecting—and about ten men are thus engaged.

No returns have been received from the Lincoln Creek Syndicate, although I have reason to believe that development-work is being prosecuted on a small scale on their group of leases, and has been for over a year. They have had their leases (ten in number) surveyed during the *past season, which is a further evidence of bona-fide intentions.*

On Consolation creek the same desultory work reported for some years past has apparently been in progress, but no returns have been made. There are two or three men there this winter.

On Davenport creek also some prospecting-work has been in progress, but no results have been reported.

On Cracker, Hemlock, and Horse creeks, which are all tributary to Surprise lake, some prospecting development-work has been in progress for some time, and although no results have been reported some new locations have been made, particularly on Cracker creek, which indicates that some encouragement is being received as a result of said operations.

Parties have been prospecting on Wilson, Burdette, Slate, Feather, Bull, Fox, and other tributaries of O'Donnel river, but no results have been reported, and I think it may be safely assumed that the lack of a sufficient supply of water was largely responsible for the absence of

results worth reporting, for I know it is the intention of some of the said parties to vigorously and systematically prosecute further development on some of those creeks this coming season, where encouraging surface prospects have been discovered in the preliminary examination.

O'DONNEL RIVER.

I regret to have to report disappointing returns and reports from the operations along this stream, allegedly due in great measure, if not altogether, to the exceeding scarcity of water.

On this stream the O'Donnel Placers Company, which controls a large number of leases, commenced operations on May 1st, and with a force of thirty-four maximum, eight minimum, and an average of fifteen men, continued until October 8th, when the almost total disappearance of their water-supply compelled discontinuance, leaving a considerable area of bed-rock, from which the overburden had been removed earlier in the season, uncleaned and the values thereon, as yet, unrecovered. From May 1st to September 1st the work was all of a constructive nature, and comprised an extension of the water-conduit from Canyon creek, laying of pipe-lines, building flumes, pressure-boxes, etc., for the purpose of utilizing the waters from Berry and Canyon creeks, etc. From September 1st to 15th the water was utilized in piping off the overburden from a considerable area, which it was hoped could be swept clean later on, but, as already stated, the water-supply failed and that "sweeping" remains to be completed next season.

This company has expended a large amount in preliminary installations with comparatively little return as yet, but it is claimed that everything is in very good shape for an early start next season, and anticipation of a good season's operation with satisfactory results is confidently entertained by the management.

The O'Donnel Partnership, operating on *Gold Hill No. 3* bench lease, which contains the phenomenally rich ground reported in 1913 and 1914, has been unable to operate even half-time, allegedly for lack of water, and their reported output did not amount to one-half of that of the previous season, although apparently they were operating in similar ground.

The experiences of this season simply emphasize the opinion expressed in the last two years' reports, to the effect that the problem of water-supply is a serious one, particularly for the small operator, not so much because of the absence of water, but for lack of conservation and the difficulty and expense of bringing it upon the benches at such an elevation as to be useful.

A good deal of systematic prospecting-work was performed by some leaseholders, but no installations, such as were anticipated in my previous report, were undertaken, and a number of the leaseholders are, I fear, doing the "Micawber act" in awaiting developments—by the other fellow.

However, as the present indications seem to assure a plenteous snowfall and consequently a good supply of water for next season's operations, it is quite possible, and indeed probable, that a more satisfactory report will be forthcoming a year hence.

Some systematic prospecting was done on Graham creek during the season, and the indications at present are that it will be continued next season and until a plant is installed on the creek or it is finally abandoned.

On Volcanic creek some leases were located last season and a few men are operating thereon this winter.

On Union and Quartz creeks, which are tributary to Surprise lake, some prospecting-work has been done intermittently for some years, and some leases have been located on them, but no formal report of results has been supplied, and I am unable to say more than that good prospects were alleged to have been found in the gravel on both.

Other outlying creeks have been receiving the usual cursory examinations, but any discovery made by such examinations would be accidental and none have been reported.

I may say, in passing, that the summer was warmer than usual, and the glaciers and deposits of snow in the mountains, which ordinarily appear to be almost perpetual, were very much reduced, and in many instances dissipated altogether, and in consequence the water in Atlin lake was unusually high notwithstanding the light rainfall and lack of moisture in the hills.

MINERAL CLAIMS.

Not much was done in the way of development of quartz claims throughout the district, beyond the assessment-work necessary to keep them in good standing, except in the Big Horn valley, upon the *Engineer* mine and the *Silver Queen* and *Ruby Silver* properties near Pavey station (White Pass and Yukon route) on Lake Bennett.

In the Big Horn valley Fred Lawson continued to operate his small stamp-mill for prospecting purposes, as well as keeping up development-work upon his claims, almost continuously during the summer months.

On the *Engineer* mine the owner, Captain J. Alexander, kept a force of from six to twenty-eight men employed practically throughout the year, sinking, driving tunnels, and in open cuttings as well, and he has a small force engaged on development-work this winter.

During the period since last report about 150 feet of sinking, 300 feet of tunnel-work, and about 80 feet of upraise—all in solid rock—was accomplished, with very satisfactory results.

The work appears to be designed for the general development and prospecting of the property, and the ledge-matter encountered is milled on the property, where a 2-stamp mill and small rolling-mill are installed. The concentrates are shipped to the smelter as opportunity or occasion suggests, but last season's concentrates were not shipped because they were overtaken by an early frost and could not be moved. Most of the tailings were lost.

Apart from the ore which was treated as above described and from which a snug clean-up in bullion was recovered, it is estimated that the above-mentioned development-work resulted in the blocking-out of about 6,000 tons of ore which is conservatively estimated to average $150 to the ton. Of course, there are rich streaks throughout that show many thousand dollars to the ton. In fact, the result of part of the work done this winter is that at a depth of 175 feet the rich ledge is found to be more than three times the width shown on the surface, and rock taken therefrom is estimated to run high in gold.

Development seems to justify the belief that a valuable mine has been discovered, and that all the valuable ground in that vicinity is not by any means confined to the area covered by this mine.

On the *Ben M'Chree* and *White Moose Mountain* groups nothing has been done in the way of development by the owners, Partridge & Egerton, owing to the fact that the Hon. Mr. Egerton is engaged in a very responsible position and service on behalf of the Imperial Government, and his time and means are fully devoted to the service.

On the *Silver Queen* and *Ruby Silver* properties, above mentioned, considerable development has been prosecuted under the management of Fred H. Storey, and a prospecting and shipping tunnel is this winter being run in at a level calculated to intersect the main ledge at a considerable depth from the surface outcropping, and if the surface values and quantities are found at that depth it is expected that arrangements for shipping ore will at once be consummated, and the property is so conveniently situated as to make this a very simple matter, apart from the cost of constructing aerial tram and bunkers.

There are deposits of antimony on Lake Bennett and Taku arm of Lake Tagish which have received some attention during the past season, but whether capital has become sufficiently interested to undertake development I have not learned.

A deposit of molybdenum has been discovered between Lakes Bennett and Tutchi not far from Pavey Station, but I am not in possession of sufficient information to be able to say much about it, except that the locators believe they have it in quantities and values sufficient to render it commercially valuable.

In the Rainy Hollow section not much development-work has been done; in fact, not more than sufficient to protect un-Crown-granted properties; but the price of copper has directed the attention of capitalists to that camp anew, and the present disposition of the owners to consider and entertain any reasonable proposition on a working basis will probably lead to the commencement of actual development within the next few months.

The question of transportation is the most formidable one from the capitalistic standpoint, as it involves the building of fifty-five to sixty miles of railroad, which in itself would not be formidable, as the grades are easy and no engineering difficulties are presented, and as the existence of commercial values has been demonstrated the problem narrows down to the question of whether or not there is a sufficient quantity of marketable or "pay" ore to warrant the outlay.

Some new discoveries in quartz near Pleasant camp, on the Klehini river, have been reported, where a well-defined ledge, said to carry high values, has been found, and a number of claims located thereon have been recorded.

Nothing has been done in the way of development of the coal which had previously been located in this district, the war and the sudden death of G. W. Mitchell last spring having put a damper upon that for the time being.

The hydromagnesite deposits situated partly within Atlin townsite received some attention during the summer, when Armstrong & Morrison, of Vancouver, shipped several hundreds of tons of the material to Vancouver for experimental purposes. I have not learned what the results were.

Between Pike and O'Donnel rivers and less than twenty miles from Atlin there is a ledge of rock of considerable extent which was described as "dolomite" when first located some three or four years ago, but I understand now it is described as being high-grade magnesite. This ledge can be traced from very near the east shore of Atlin lake eastward for a considerable distance, and a number of locations made upon it have been recorded. No development has been undertaken that I have heard of, but it is to be hoped it is as valuable as it is claimed to be.

There were only from 300 to 350 men engaged in mining in this district this year, so that the aggregate *per capita* output from the district will probably compare favourably with that from most other districts in the Province, notwithstanding our embarrassment for lack of water.

Following is a statistical report of work done and revenue collected at this record office during the year 1915:—

OFFICE STATISTICS—ATLIN MINING DIVISION.

Free miners' certificates (individual)	435
Free miners' certificates (company)	6
Placer records	16
Placer rerecords (representing 274 claims)	257
Leases located	25
Leases issued	21
Leaves of absence (representing 163 claims)	36
Filings	6
Bills of sale (placer)	18
Bills of sale (hydraulic)	67
Bills of sale (mineral)	26
Mineral records	52
Certificates of work	118
Filings	11
Certificates of improvements (recorded)	9
Certificates of improvements (advertised, not yet issued)	8
Crown grants issued	8
Gold reported (individuals)	$147,014 00
Gold reported (companies)	190,160 00
Total	$337,174 00
Royalty paid by individuals	$2,483 20
Royalty paid by companies	2,173 45
Total	$4,656 65

Revenue collected during 1915.

Land sales	$ 81 75
Land revenue	4 00
Water revenue (rentals)	829 00
Free miners' certificates (individual)	2,063 25
Free miners' certificates (company)	550 00
Mining receipts (lease rentals)	5,015 00

Mining receipts (lease deposits)	500 00
Mining receipts (other sources)	2,225 10
Licences (liquor)	515 00
Licences (trade)	300 00
Licences ("Game Act")	100 00
Fines and forfeitures	266 00
Probate duty	11 00
"Marriage Act"	25 00
Law-stamps	12 90
"Taxation Act"—	
Real-property tax	3,154 55
Personal-property tax	30 25
Wild-land tax	23 55
Income-tax	16 95
Mineral-tax	4,656 65
Acreage-tax	978 50
Interest	2 80
"Motor-traffic Regulation Act"	94 00
Miscellaneous receipts	74 25

STIKINE AND LIARD MINING DIVISIONS.

REPORT OF H. W. DODD, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining operations in the Stikine and Liard Mining Divisions of Cassiar District for the year ending December 31st, 1915.

Notwithstanding the unsettled condition, the office revenue shows an increase over that of 1914. The amount of gold recovered was greater than that of 1914 and is due to more individual mining.

On Thibert creek the Boulder Mining leases taken over by the Dease Syndicate made a very good showing, although hampered by a shortage of water due to the unusually dry summer. I am indebted to F. M. Fenton, the manager, for the following report:—

"On April 22nd, with a force of eighteen men, the preliminary work commenced, such as getting our flume in order and relaying pipe-lines; water was turned into the pipes on May 5th in order to clear the cuts of ice and other material which had accumulated during the winter, this requiring three days; on May 8th a double shift was put on and actual mining commenced; by July 18th the water had fallen off to such an extent that the source barely supplied a head for a 6.5-inch nozzle, and by August 17th it was necessary to store the water for a time each day in order to get a full head; this arrangement naturally increased the operating expenses for the season, but at the same time increased the output to a great extent, as up to this date the washing had been mostly on top gravel and very little bed-rock had been exposed. The temperature for these months averaged 88, and reached 100 several times, which is unusual.

"Although starting a month earlier than the previous season, the total running-time was 108 days out of a possible 158 with a reduced head of water, as against 104 days with a full head in 1914. This work was distributed as follows:—

"*Pit No. 1.*—Bed-rock cut advanced 212 feet, average depth 8 feet; sluice extension, 156 feet; running-time for season, 40 days of 24 hours a day; yardage moved, 102,350 cubic yards.

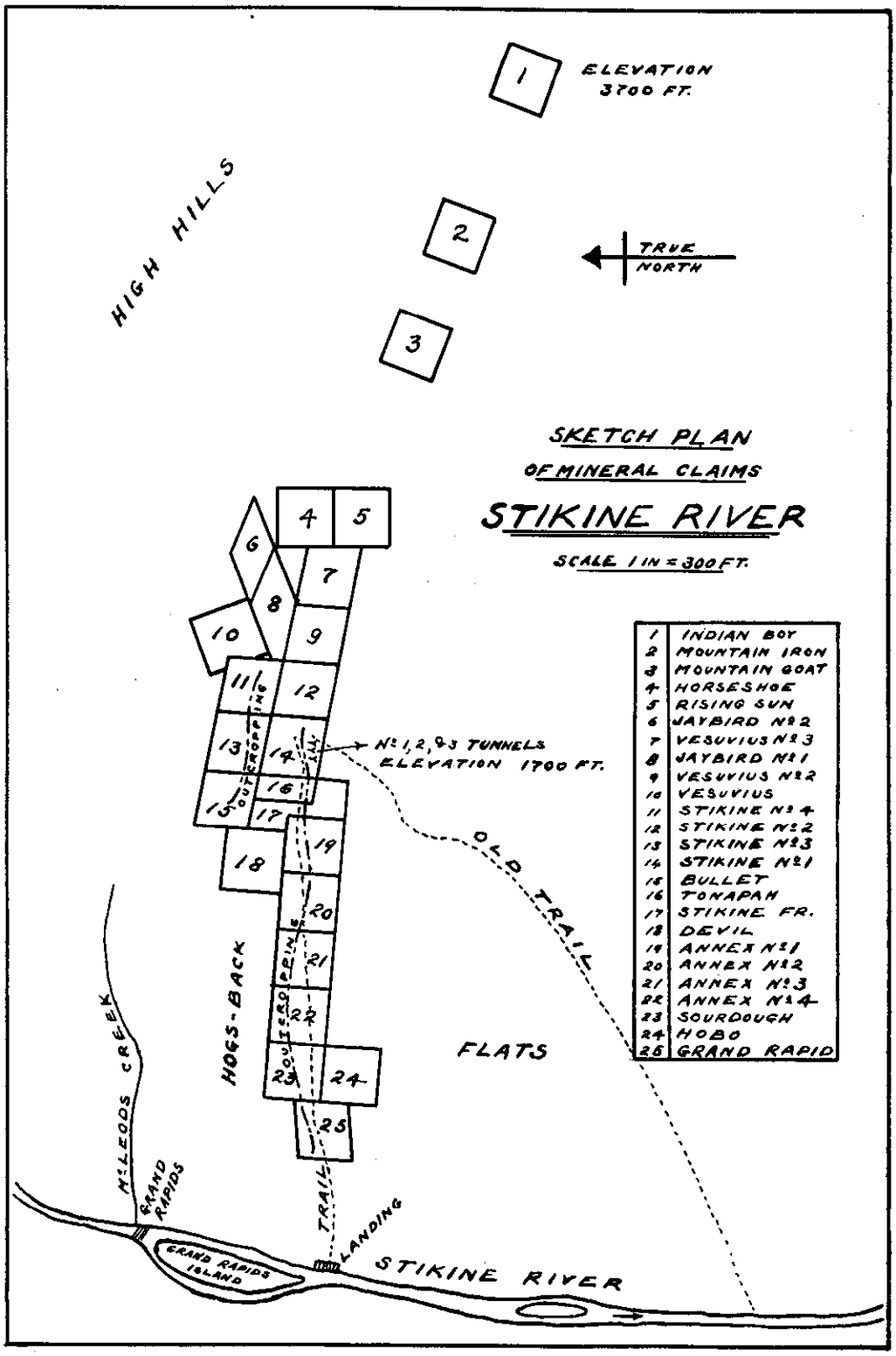
"*Pit No. 3.*—Bed-rock cut advanced 70 feet, average depth 9 feet; running-time, 10 days.

"*Pit No. 4.*—Bed-rock cut advanced 100 feet, average depth 5 feet; running-time, 16 days.

"*Pit No. 5.*—Bed-rock cut advanced 200 feet, average depth 16 feet; running-time, 42 days.

"Running-time for pits 3, 4, and 5, 68 days. Total yardage moved, pits 3, 4, and 5, 352,427 cubic yards. Total running-time each month: May, 22 days; June, 30 days; July, 27 days; August, 18 days; September, 10 days; October, 1 day; total 108 days.

"The total yardage moved for the season was 452,777 cubic yards, an average of 4,210 cubic yards a day, or about 4.5 cubic yards for each miners' inch of water used. Owing to the non-arrival of powder earlier in the season, the opening of No. 5 pit was delayed nearly a month, which greatly retarded the movement of gravel."


ELEVATION 3700 FT.
HIGH HILLS
TRUE NORTH
SKETCH PLAN
OF MINERAL CLAIMS
STIKINE RIVER
SCALE 1 IN = 300 FT.
Nº 1, 2, 3 TUNNELS ELEVATION 1700 FT.
OLD TRAIL
HOGS-BACK
FLATS
McLEODS CREEK
GRAND RAPIDS
GRAND RAPIDS ISLAND
TRAIL
LANDING
STIKINE RIVER
1 INDIAN BOY
2 MOUNTAIN IRON
3 MOUNTAIN GOAT
4 HORSESHOE
5 RISING SUN
6 JAYBIRD Nº 2
7 VESUVIUS Nº 3
8 JAYBIRD Nº 1
9 VESUVIUS Nº 2
10 VESUVIUS
11 STIKINE Nº 4
12 STIKINE Nº 2
13 STIKINE Nº 3
14 STIKINE Nº 1
15 BULLET
16 TONAPAH
17 STIKINE FR.
18 DEVIL
19 ANNEX Nº 1
20 ANNEX Nº 2
21 ANNEX Nº 3
22 ANNEX Nº 4
23 SOURDOUGH
24 HOBO
25 GRAND RAPID

Dease, Mosquito, and Deloibe Creeks.

On these creeks considerable individual mining was carried on, with some success.

On McDame creek O. L. Anderson and associates have done considerable on the *Princess May* lease in the installation of machinery, etc., but owing to lack of transportation in this section progress has been slow.

Coal.

No new applications for coal have been received this season.

Mineral Claims.

Considerable activity has taken place in quartz-mining. The mineral claims *Stikine Nos. 1, 2, 3—a silver-lead group—has been taken over by the Stikine Mining Company, of Seattle* (a company registered under the "Companies Act" of British Columbia). These claims are situated about thirty-five miles down-river from Telegraph Creek and two miles distant from *the river-bank, on the east side, at an elevation of 1,700 feet.* Twenty-five claims have been recorded; these run from the river to an elevation of 3,700 feet. The Stikine Mining Company had a force of fourteen men at work all summer, building trails to the property and developing; two tunnels were run—one 50 feet and chambered, the other 90 feet, both showing a good percentage of ore throughout. At present there is about 200 tons of ore on the dump, valued at $100 a ton, awaiting shipment in the spring. A force of ten men under the direction of C. R. Burley is at work opening up No. 3 tunnel.

All these properties appear to be very promising, and no doubt will be the scene of much activity during the coming spring.

Office Statistics—Stikine and Liard Mining Divisions.

Revenue collected from free miners' certificates	$ 544 75
Revenue collected from mining receipts	1,465 90
Revenue collected from other sources	2,876 10
Total	$4,886 75

SKEENA DISTRICT.

SKEENA AND BELLA COOLA MINING DIVISIONS.

BY J. H. MCMULLIN, GOLD COMMISSIONER.

I have the honour, as Gold Commisisoner, to submit the annual report of mining operations in the Skeena and Bella Coola Mining Divisions for the year ending December 31st, 1915.

Mining generally throughout the Skeena Division shows a decided improvement as compared with 1914. A number of very promising properties are under bond, and considerable development-work has been carried on continuously during the year.

The most important mining enterprise was the taking-up of the option given by the Surf Inlet Mines, Limited, to the Tonopah Belmont Mining Company, of Philadelphia, of the property situated at Surf inlet, Princess Royal island; a cash payment of $150,000 having been made in December, 1915. The Surf Inlet Mines, Limited, still retains a one-fifth interest in the property. The following report on the year's operations was furnished by F. W. Holler, superintendent:—

"During the year 1915 work in this district was limited to the continued development of the Surf Inlet mine by the Belmont Canadian Mines, Limited, and assessment-work on surrounding claims. No new discoveries were made, but the ore-bodies in the Surf Inlet mine were proven to extend an additional 350 feet in depth, and on that level they averaged almost as large and of the same grade as in the upper levels.

"The Surf Inlet mine was optioned to the present owners early in 1914, and on April 1st of that year work was started, building roads to the mine, constructing camp buildings, and installing a steam and air-compressor plant. On July 1st work was started in both of the upper tunnels started by the first owners, and also in a new tunnel 350 feet vertically below. From that date operations have been carried on continuously with a crew of from fifty to sixty men, and over 7,000 feet of drifts, crosscuts, and raises driven.

"The ore area in the upper tunnels have been somewhat enlarged by the new work and their outlines more accurately located. In the new tunnel, 350 feet below, the same ore-bodies have been developed. They average about the same in size and value as on the upper levels and exhibit similar characteristics.

"In this district the ore is a white pyritiferous quartz, carrying principally gold with a little copper and silver. It occurs in lenticular masses along well-defined sheared zones in gneissoid granite. The general strike of the main sheared zone is north and south and the dip about 40 degrees west. In places the sheared zone is as wide as 250 feet; but the quartz-lenses are rarely over 30 feet wide and they will average about 10 feet, with a maximum length of usually under 400 feet. As a rule, the larger and the greater number of ore-lenses are found near the foot-wall of the sheared zone, but some ore has been found near the hanging-wall, and with further exploration more may be found.

"On December 31st the Belmont Canadian Mines, Limited, exercised its option on the Surf Inlet mine, and during the present year will build a dam at the outlet of Cougar lake in connection with a hydro-electric plant on tide-water. Some method of transportation between the mine and the head of Surf inlet will be needed at once, and it is possible that a narrow-gauge electric road will be constructed. At the mine a modern mill for the extraction of the gold from the ore will be built and a new mine plant installed to ensure a steady output. New camp buildings will be built as soon as possible."

GRANBY BAY.

The Granby Consolidated Mining, Smelting, and Power Company, Limited,* has furnished the following particulars as to the year's operations at the Anyox mines for the year ending December 31st, 1915: Crude ore shipments, 645,989 dry tons; of which the assay contents were: Copper, 24,760,112 lb.; silver, 244,013 oz.; gold, 9,881 oz.

* Further reference to the operations at Anyox, taken from the annual report of the Granby Company, will be found under the heading of "Boundary District."

ALICE ARM.

The *Dolly Varden* group, consisting of six claims, owned by Ole Evindsen *et al.*, is under bond to R. B. McGinnis, of San Francisco. The following report is furnished by Hugh C. Ingle, superintendent:—

"Considerable activity has been shown during the past year on the *Dolly Varden* group of claims, which is situated sixteen miles from the head of Alice arm, on the Kitsault river.

"To the end of 1915 the work had been confined, almost entirely, to exploratory work, consisting of, besides considerable open-cut work, about 550 feet of tunnels and crosscuts and over 4,500 feet of diamond-drill work. Work was started the first part of March and has been carried on continuously ever since then.

"This work has shown up a considerable tonnage of very fine silver ore, with indications of greater depth. The values are largely in the forms of brittle, ruby, and native silver in varying proportions, and of some horn-silver.

"Tunnel-work has been carried on at four different levels for a vertical distance of over 200 feet. Drill-work was carried on at intermediate levels. Good ore was found at all levels. The ore apparently occurs in several bodies, probably all, from an original deposit which has been broken up by a series of step-faults.

"Winter work is being carried on by two shifts of hand-miners in the driving of a lower working-tunnel, and is progressing rapidly. This tunnel will be driven for a distance of about 500 feet.

"The scale of operations at present is necessarily restricted by lack of adequate transportation facilities from tide-water, the freight expense at present being a very big item. It is the intention to remove this handicap during the coming year by the building of a freight-road following a water-grade up the Kitsault river. Work was started on this last fall after the completion of an official survey, but was interrupted by inclement weather."

The *Wolf* group, consisting of four claims, owned by D. W. Cameron, is under option to R. B. McGinnis; this property is situated about two miles and a half north of the *Dolly Varden* group. Surface indications on two big ledges there are very promising, and would seem to indicate a large body of a fine grade of ore similar to that of the *Dolly Varden* group.

Work is being carried on during the winter by two shifts of men on a development tunnel. This is the first work to be done on this property, as it was but recently located.

The *Monarch* group, consisting of four claims, owned by J. E. Stark and F. E. Juggins, situated at the head of the Illiance river, is under bond to T. F. Hopkins, of Seattle, Wash. A small force of men will continue development-work during the winter. It is the intention to open up the property on a larger scale the coming season.

In addition to the above, there are a number of very promising-looking properties in this district, and the indications are that several of the properties will be bonded in the near future.

BELLA COOLA DIVISION.

Mining appears to be at a standstill in this Division, no applications for records or certificates of work having been made during the year.

OFFICE STATISTICS—SKEENA AND BELLA COOLA MINING DIVISIONS.

Free miners' certificates (individual)	351
Free miners' certificates (company)	2
Free miners' certificates (special)	2
Mineral claims recorded	276
Certificates of work issued	517
Bills of sale, etc., recorded	85
Filings	25
Certificates of improvements recorded	27

Revenue.

Free miners' certificates	$1,903 50
Mining receipts, general	3,447 65
Total	$5,351 15

PORTLAND CANAL MINING DIVISION.

REPORT BY P. S. JACK, MINING RECORDER.

I have the honour to submit herewith my annual report for the Portland Canal Mining Division for the year ending December 31st, 1915.

In the month of September John Conway resigned as Mining Recorder. Mr. Conway had been associated with Stewart for a number of years and had been Mining Recorder since 1910.

A number of new locations have been made and the assessment-work is being well kept up. On several properties, which have been bonded to reliable parties, work has been carried on during the summer, and on the *Bush* property, on Salmon river, work was continued to the end of the year.

GEORGIA RIVER.

Georgia River Property.—Development of this property was undertaken by the Georgia River Mining Company, Limited, on May 1st, 1915, and continued up to October 10th. Work was closed down at that time owing to the fact that a permanent camp had not as yet been established. It is the intention to construct proper buildings this coming spring, when development-work will be resumed. From seven to nine men were continuously employed during the summer.

There is now, in addition to considerable trenching and open-cut work, 315 feet of underground working on the property. There are several veins on the ground held by the company, but the chief showings are to be found on the large quartz vein called the "Main," and a smaller intersecting vein known as the "Bullion."

The principal working consists of a tunnel on the Bullion vein which is now advanced to the point of intersection, a distance of 245 feet beyond its portal. Here development bore excellent results, considerable ore containing gold values being uncovered.

At a point 115 feet from the portal of the tunnel a raise has been put up to connect with the shaft, which had been previously sunk, a total of 35 feet to the surface.

The development-work on the Main vein consists of stripping and several open-cuts. A cross-cut also, 38 feet of which is in vein-matter, was driven at a point approximately 450 feet horizontally and 225 feet vertically from the intersection. The result of this work was very encouraging. A considerable portion of the vein was found to carry gold values, and, apart from this, a seam 18 inches in width contained some excellent free-gold ore. (Report furnished by W. Beaton, Esq.)

MARMOT RIVER.

On the property of Bruggy & Magee, the *Montana* group, consisting of seven claims, leased to Bruggy & McLeod, a 30-foot tunnel crosscutting the ledge was driven; a shaft also was sunk 30 x 20 feet. Sixteen tons of ore was taken out and shipped to the Tacoma smelter. A small aerial tram was erected to facilitate the handling of the ore. Forty feet of stripping was done on a new vein which produced values running over $100 in gold, silver, and lead.

SALMON RIVER.

The following brief description of the Salmon-Bear River Mining Company's property and the work that has been done during the past twelve months has been furnished by H. R. Plate:—

"I will not go into the geological features, as Mr. McConnell has given these in former reports.

"The property is located about a mile and a half from the International Boundary-line on Cascade creek, a tributary of the Salmon river, the distance from Stewart by trail being about fifteen miles.

"*Geology.*—The rock formation in this section is greenstone, grading from the massive to schistose. To the south of the *Bush* property (Salmon-Bear River Mining Company) the granodiorite comes in contact with the greenstone, and on the property there is what appears to be an offshoot of the main diorite-mass that intrudes itself into the greenstone.

"*Ore-deposition.*—On both sides of the dyke for a distance of between 20 to 50 feet the schist has been mineralized to some extent. The intensity of the mineralization varies greatly where the zone has been exposed, there being spots that are almost solid sulphide ore, and again within a short distance from these the ore is quite sparse. The impregnation, or replacement,

of the schist has not been uniform, but evidently occurred along channels through which the mineral-bearing solutions could more easily circulate. The ore is composed of iron pyrite, zinc-blende, and galena. These three minerals are all more or less gold and silver bearing, but, in all probability, the galena bears most of the precious metals.

"*Development.*—During the present year (1915) we have exposed two ore-zones, each about 500 feet in length. As yet we have not connected them, so at present they are considered separately. The lower zone has been prospected by a number of surface cuts and three short adits, which do not gain much depth in the zone. In a general way these workings show a mineralized zone about 50 feet wide on the foot-wall side of the dyke and about 25 feet wide on the hanging-wall side. The value of the zone will probably average between $3 and $3.50 a ton in gold and silver, with a small percentage of lead and zinc.

"The upper zone is not sufficiently prospected to determine the extent and value of the ore. Numerous surface cuts and one shallow adit show the zone to be about 25 feet wide, which will probably average around $4 a ton. There are spots in this zone, however, that assay quite high.

"In July we started a lower adit level, which will gain about 500 feet depth on the lower zone. A drive of nearly 500 feet is necessary to encounter the zone. To date we have not reached the objective point. The work is being carried on by hand, with three shifts of two men each. A monthly advance of between 85 to 95 feet has been made since the start.

"The property is still in the prospective stage and will be for some time to come. Should our present work establish the fact that the ore-zone continues to the level of the lowest adit, and that there is an appreciable lateral extent to the zone, we will in all probability install a small compressor and power plant to continue the prospecting-work."

The *Big Missouri* group, under bond to the Gastineau Mining Company, of Juneau, Alaska, comprises eight claims. Most of the work was done on the *Province*, *Laura*, and *Golden Crown* claims of the above group.

On the *Province* a number of new cuts, covering a large area, were opened up, every one showing ore.

On the *Laura* cuts amounting to 42 feet were made, showing up large bodies of ore composed of galena, iron, chalcopyrite, and zinc.

On the *Golden Crown* the tunnel was extended and some cuts made, showing ore of the same character as the *Laura*. On this claim gold values are higher than any other claim in the group.

On the *Big Missouri* samples were taken from 120 boulders on the slide, giving assays of: Gold, $2.60; silver, 20 cents.

During the season 5½ tons of ore was shipped to the company's laboratories at Salt Lake City, Utah, for experiment as to the best methods of extracting values. Further work will be commenced as early as possible in the coming spring. The group has been surveyed and applications for Crown grants will be made at an early date.

On the *Yellowstone* group and Cascade Falls Mining Company's property only the annual assessment-work was done.

BEAR RIVER.

The *Prince John* group, comprising the *Prince John No. 1*, *No. 2*, and *No. 3*, is owned by Nesbitt & Archie. On this property 90 feet of tunnel has been driven, 40 feet through ore-body. Further development-work will be done on this property in the coming year, as indications of a good ore-body are in sight.

George Copper-mines.—This property, formerly known as the *Royal* group, consists of nine claims, viz.: *Copper King*, *Copper Queen*, *Gold Crown*, *Royal*, *Copper Lord*, *Helena*, *Castle Rock*, *Mamie*, and *Bessie*, and is owned by W. B. and R. George and associates. The property is located near the head of the Bear river and about four miles from the divide between that and the Nass river. The nearest shipping-point is Stewart, B.C., at the head of the Portland canal, an estuary which forms the boundary between British Columbia and Alaska.

The mining claims lie on the north slope of a steep mountain which rises from the valley of the Bear river at an average of from 40 degrees from the horizontal. The highest point of this mountain is nearly 6,000 feet above the sea and the claims extend from its base almost to its top. The altitude of the cabin in the valley is about 900 feet.

Geology.—The country-rock on the property is greenstone, in which two forms of intrusives form dykes. One, the elder, is pre-mineral and basic in composition, possibly a diabasic porphyry. The other, of subsequent intrusion, is post-mineral and probably augite porphyrite. The line of contact between the greenstones and argillites is in the immediate neighbourhood, and may even exist on the upper parts of the claims.

Ore-deposit.—Extending through the property is a sheared, altered, and more or less mineralized zone of from 500 to 1,000 feet in width. This zone has a general strike of N. 70° E. and dips into the hill south-easterly. Owing to its irregular boundary and dips, observations are likely to be misleading, and the general course given is the result of platting the claims and extending the zone through known points to them. This zone continues through the *Copper Lord*, *Copper King*, *Copper Queen*, *Gold Crown*, *Castle Rock*, and possibly through the *Mamie* and *Bessie* claims. As a fairly well-defined line of mineralization appears on both the hanging- and foot-wall sides of the zone, the former description of the deposit has included two veins. The area between these is, however, fairly well impregnated with iron and some copper, and the veins which are peculiar to this zone traverse this area. It seems, therefore, proper to consider it as a whole in considering the general conditions. The zone is iron-stained throughout, highly silicified in places, and in places shows the sulphides of copper and iron, chalcopyrite and bornite, carrying gold and silver values.

Veins.—Within the zone and extending in various directions are a number of quartz veins carrying copper, gold, and silver values in a much greater degree of concentration than elsewhere. These vary greatly in width, from a "knife-blade" seam to several feet, and all dip rather steeply, generally into the hill. As a rule they are well mineralized and may easily be the most important feature of the deposit. Whether any portion of the zone outside of them is sufficiently enriched to produce merchantable ore remains to be demonstrated.

The following list of assays shows the values carried by samples taken from the property:—

Sample.	Gold.	Silver.	Copper.		Total Value a Ton.
			Per Cent.	Value.	
No. 1	$2 40	$0 30	5.5	$16 50	$19 20
No. 2	3 20	30	2.94	8 82	12 42
No. 3	6 80	10	2.3	6 90	13 80
No. 4	80	85	4.72	14 16	15 81
No. 5	Trace	Trace	0.24	72	...
No. 6	"	"	0.3	90	...
No. 7	$0 60	$1 00	1.5	4 50	6 10
No. 8	2 80	70	2.9	8 70	12 20
No. 9	40	30	4.1	12 30	13 00

NOTE.—The values figured on a basis of: Gold, $20 per ounce; silver, 50 cents per ounce; copper, 15 cents per pound. (Taken from report made by W. J. Elmendorf, Esq.)

Considerable development-work has been done on this property and it will be continued in the coming year.

D. J. Rainey has received the following report from the assayers on three sacks of molybdenite ore shipped from the *Molly B.* claim, situated on the east side of Bear river: "The grade of ore sent runs about 9 per cent. molybdenite."

As soon as weather permits Mr. Rainey intends going ahead with the development of this property.

GLACIER CREEK.

In doing assessment-work on the *Florence* group, Watkins & Harper opened up a good body of ore, averaging 16 feet in width, assaying: Copper, 5 per cent.; silver, $3.

J. McKay, owner of the *Lakeview* group, has run a tunnel 500 feet, crosscutting two ledges, giving results which are extremely gratifying. No ore was shipped this year.

On the *Ruth and Francis* group, owned by Nesbitt & Archie, work this year has been confined to outside work. Several open-cuts have been made and all the way through have given satisfactory results.

A small open-cut on the *Copper King* vein opened up a ledge about 20 feet, giving good copper and gold showings.

AMERICAN CREEK.

T. Collison and J. Watkins shipped from the *Kansas* group 20 tons of silver-lead ore to the Trail smelter, which is expected to average $150 a ton.

OFFICE STATISTICS—PORTLAND CANAL MINING DIVISION.

Free miners' certificates (individual)	112
Free miners' certificates (company)	2
Mineral claims recorded	108
Certificates of work issued	218
Bills of sale, etc., recorded	37
Filings	3
Certificates of improvements recorded	14

Revenue.

Free miners' certificates	$ 681 25
Mining receipts, general	1,199 80
Other sources	132 00
Total	$2,013 05

QUEEN CHARLOTTE MINING DIVISION.

REPORT OF E. M. SANDILANDS, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining operations in the Queen Charlotte Mining Division for the year 1915.

During the past year mining on the Queen Charlotte islands has been very quiet and hardly any prospecting has been done, although towards the end of the year things seemed to be getting better and some inquiries for properties were made, with the result that several deals are pending.

COLLISON BAY.

No work of any importance has been done in this section, with the exception of the annual assessments on some of the better showings. The *Treasure Vault* mineral claim, owned by the Collison Bay Mines, has been Crown-granted.

IKEDA BAY.

The *Ikeda* mines have worked continuously the past year under the management of A. Ikeda, employing on an average from fifteen to twenty men. During the year 355 tons of first-class ore (copper) has been shipped to the Granby smelter, the average assay values of which, from the smelter returns, were: Copper, 15.87 per cent.; silver, 4.28 oz.; gold, 0.284 oz. In addition to this, some 400 tons of second-class ore is now ready for shipment, having been obtained from the sorting of the first-class ore.

The drift from No. 3 tunnel has been driven in 125 feet and a shaft sunk 40 feet from same level, as well as a large amount of stoping necessary to obtain the above shipments of ore. The mine is looking well and shipments will be increased and more men employed the coming year.

JEDWAY AND HUSTON INLET.

Nothing more than the usual assessment-work has been done around Jedway. In Huston inlet Thompson & Wilds have some Vancouver parties interested in the *Gold Bug* group, and have a small force of men at work. It is early, as yet, to ascertain the result of the work.

LOCKEPORT AND TASU.

There are rumours of deals being made on the *Swede* group and other claims, but both at Lockeport and Tasu nothing further than the usual assessment has been done. It is reported that a deal is pending on the Tasu properties, owned by J. E. Corlett.

CUMSHEWA AND LOUISE ISLAND.

On Louise island the annual assessment has been done on the iron-ore properties, and preliminary surveys have been made for proposed wharves and tramways. The iron ore on Louise island is of a very good grade. On the Cumshewa Mines, Limited, nothing has been done this year; there is talk of a mill being built to treat the ore blocked out.

SKIDEGATE.

The *South Easter*, adjoining the Skidegate Indian Reserve and owned by McLellan & Gordon, has been under lease the past year to Leighton & Hickey. The result of the work has been entirely satisfactory, and in consequence several tons of high-grade ore is ready for shipment. The property has a quartz vein about 5 feet wide, carrying good values in gold, associated principally with the galena. At some points remarkably rich gold ore has been found, but the extent of it has not as yet been proven.

The lessees have sunk a 25-foot shaft on the main vein, and crosscut from the bottom of this shaft to a parallel fissure about 15 feet distant; this latter vein is 4 feet wide and also shows fair values; a great deal of surface and prospecting work has also been done during the year.

What is apparently a continuation of the *South Easter* vein is exposed on the Skidegate Indian Reserve, and the Indians have done some surface work on it; 140 lb. of the ore, carefully selected, from this exposure was shipped to the smelter, and gave values of some $582 in gold.

GOLD HARBOUR (WEST COAST).

The *Early Bird* group, situated at Gold harbour, on the west coast, and owned by McLellan & Bourne, was worked under lease for a short time during the first part of the year; some 5 tons of ore was milled and values of about $100 a ton received; more work will be done on this property the coming year.

COAL AND OIL.

Very little work has been done prospecting for oil at Otard bay, on the west coast, the past year. At present time the property is idle and no drilling going on. No work this year has been done on the coal properties at Camp Wilson.

OFFICE STATISTICS—QUEEN CHARLOTTE MINING DIVISION.

Claims recorded (quartz)	15
Certificates of work recorded	115
Certificates of improvements	1
Bills of sale, etc.	15
Free miners' licences issued	55

Revenue.

Free miners' certificates	$ 460 50
Mining receipts	337 00
Liquor and trade licences	480 00
Police fines, etc.	64 21
Total	$1,341 71

OMINECA MINING DIVISION.

REPORT BY STEPHEN H. HOSKINS, GOLD COMMISSIONER. (OFFICE AT HAZELTON.)

I have the honour, as Gold Commissioner, to submit the annual report for the Omineca Mining Division for the year ending December 31st, 1915.

Although the mining revenue in this Division for the year just closed shows a decrease, the actual amount collected being less than for any year since 1910, it is a great satisfaction to know that the interest in mining in the vicinity is not on the wane. The causes for the decrease stated may be twofold: Firstly, the scarcity of money; and, secondly, very many of the prospectors in this Mining Division are absent from the country, and now serving in various capacities with His Majesty's Forces. It may truly be said that during the year 1915 there has been more real mining development in the Omineca Mining Division than ever before.

GLEN MOUNTAIN.

After lying idle for nearly a year, work was recommenced on the *Silver Standard* group. All the first-class ore, totalling 141 tons, on the dump and in the sheds, which had been mined during the year 1914, was shipped for treatment to the smelter at Trail. There are now twenty-five men regularly employed upon this property, and additional men are being taken on so soon as room can be made for them to work.

Fifteen tons of ore, which had also been mined from the *Black Prince* group in the year 1914, was shipped to the smelter at Trail.

The annual assessment-work was performed on the *Surprise* and *Mammoth* groups.

NINE-MILE MOUNTAIN.

Many of the properties in this vicinity have received attention during the past summer, having been worked on lease.

From the *Silver Cup* group 70 tons of ore has been shipped to the smelter, the predominating mineral being galena carrying silver.

From the *Sunrise* group about 74 tons of ore was shipped to the smelter, the predominating mineral being argentiferous galena.

Sixteen tons of ore was shipped to Trail from the *Barber* group of claims; this ore was taken from open-cuts on the surface.

From the *Silver Bell* group 10 tons of galena ore was shipped to the smelter. This property was opened up last summer and a tramway installed to carry the ore from the mine to the wagon-road. A sample of ore, about 10 tons, taken from this property assayed 110 oz. in silver and 70 per cent. lead, with a small zinc content.

The *American Boy* property, owned by the Harris Bros., of Hazelton, this year has been held back through lack of capital, although one small shipment of ore, consisting of about 15 tons, was sent to the Trail smelter, which assayed: Gold, 0.04; silver, 98 oz.; lead, 30 per cent.; zinc, 14 per cent.

About 600 tons of $35 ore is now on the dump, and 3,000 tons of the same class of ore in the mine, developed and ready to stope out and handle through a mill.

Twenty-five new locations were recorded in this vicinity.

It is regrettable that no smelter returns of ore shipped from any of these properties are at present available, but it is understood that the ore shipped from each of these groups ran high in silver and lead.

The Government wagon-road which has been under construction to the Nine-mile basin during the past few years was completed in 1915, thereby greatly facilitating the development of these properties.

ROCHER DÉBOULÉ MOUNTAIN.

This vicinity has again shown its popularity, and several properties on this mountain have attracted outside attention; among these may be mentioned the *Chicago* and *Hazelton* groups. The *Red Rose* group is now being developed in a systematic manner, and a few tons of ore

has been transported from the property to the wagon-road to await favourable conditions to forward to the smelter. The *Comeau* group was during last summer bonded to outside capitalists and received some attention at their hands.

From the Rocher Déboulé Copper Company's mine, under lease to the Montana Continental Development Company, it is learned that from May 17th to December 12th, inclusive, 17,000 tons of ore was shipped to the Granby smelter at Anyox, averaging about 8 per cent. copper, $1.65 in gold, and 50 cents in silver to the ton.

New installations upon this property, which are now completed, consist of: A two-story bunk-house accommodating ninety-six men, steam-heated and electric-lighted, with two large reading-rooms, also two rooms devoted to drying clothes and equipped with shower-baths; a new compressor building and machine-shop; a 175-horse-power distillate engine to take care of the water shortage during the winter months; and an electric hoist to take the men and supplies from the camp to the mine. A steam locomotive to handle the ore from the mine to the aerial tramway has been added to the plant; also many minor improvements, such as a laundry and new mine and office buildings.

In the mine itself about 2,000 feet of development-work has been done, and work is now being done preparatory to sinking to the 500-foot level.

D. J. Williams, the manager of the company, reports that "in all, the operations of this company cover a distance of about twelve miles. The equipment has worked out very satisfactorily and development-work has been encouraging."

The *Great Ohio* group has been regularly and systematically developed throughout the past year by a small force of men, details of which I have been unable to obtain.

On the various other groups of claims in this vicinity assessment-work only has been performed during the past year.

SKEENA MOUNTAINS.

This mountain lies to the west of the Rocher Déboulé mountain and of the Kitsequekla river, upon which the *Helen* group of five claims has been recorded during the past year. An option has been taken on these claims for the sum of $10,000.

HUDSON BAY MOUNTAIN.

In this vicinity the annual assessment-work has been performed on fifty-five claims, and thirty-two new locations have been recorded.

In the early part of the year about 60 tons of galena ore was shipped to the smelter from the *Coronado* group, for which no returns are available.

BABINE RANGE.

On Dome mountain, the most southerly of the high peaks in the Babine range, about twelve miles east of Telkwa, the annual assessment-work has been performed on several groups of claims. It is stated that average samples of ore taken from any of these run very high in gold values. Most of the prospectors interested in this vicinity believe the formation to be granodiorite and schist. Thirty new locations have been recorded in this vicinity.

The Babine Bonanza Mining and Milling Company has been steadily developing its properties during the entire season, and is still so employed. A quantity of machinery has been shipped in to the property, concerning which no details have come to hand.

The *Debenture* group, upon which the showing is stated to be particularly good, both as regard to quality and quantity, has been acquired by Chicago interests, who have outlined an aggressive plan for development during the year 1916.

TAKLA LAKE.

In the vicinity of Takla lake the annual assessment-work has been recorded on thirty-seven claims divided into six groups and twelve new locations have been recorded.

TELKWA.

In the vicinity of Telkwa annual assessments have been recorded on twenty-eight claims and twenty-six new locations have been recorded.

OWEN LAKE.

Annual assessment has been recorded upon five claims in the vicinity of Owen lake and thirteen new locations have been recorded.

BLUE GROUSE MOUNTAIN.

This vicinity has claimed a good deal of attention during the past summer, and one group of claims known as the *Copper Crown* has been bonded to a syndicate in Portland, Oregon, which has made extensive preparations for continuous work thereon throughout the winter months.

Twenty-two new locations have been recorded in this vicinity.

BARRETT'S, OR "THE GOVERNMENT RANCH."

Annual assessments on ten claims in this vicinity have been recorded, and samples taken from the *Grafter* group, it is said, assay high in copper, and also samples taken from the *Lone Pine* group, it is stated, assay very high in silver.

Thirteen new locations have been recorded in this vicinity.

MOUNT SELWYN.

Annual assessments on existing locations and seventeen fresh locations have been recorded in this vicinity.

SIBOLLA CREEK.

Annual assessments and fifty-five new locations have been recorded in this vicinity.

FIDDLER CREEK.

Annual assessment-work and seventeen new locations have been recorded in this vicinity. The *Fiddler* group, from which some very satisfactory assays have been obtained, is now under bond, and the erection of a concentrator on this property is contemplated.

Interests have been acquired by Toronto capitalists in the *Brantford* group of claims, who, it is understood, have laid out an extensive programme for development-work in the spring.

KITSALAS.

The annual assessment-work has been recorded on fifty-seven claims in this vicinity and twenty-one new locations have been recorded.

COPPER CITY.

The annual assessment-work has been recorded on thirty claims in the vicinity and thirty-four new locations have been recorded.

PLACER-MINING.

Owing to the scarcity of money, placer-mining has been very quiet throughout this Division, and I regret there is nothing new to report regarding same.

OFFICE STATISTICS—OMINECA MINING DIVISION.

Free miners' certificates (ordinary)	693
Free miners' certificates (special)	4
Free miners' certificates (company)	3
Mineral claims recorded	466
Certificates of work issued	702
Certificates of improvement issued and recorded	7
Bills of sale and other documents of title	160
Powers of attorney	15
Documents filed	57
Placer claims recorded and rerecorded	14
Applications for placer-mining leases received	2
Placer-mining leases granted	5
Crown grants obtained	7

Revenue.

Free miners' certificates	$ 3,731 50
Mining receipts	6,725 85
Total	$10,457 35

PEACE RIVER MINING DIVISION.

REPORT BY STEPHEN H. HOSKINS, GOLD COMMISSIONER. (OFFICE AT HAZELTON.)

I have the honour, as Gold Commissioner, to submit the annual report for the Peace River Mining Division for the year ending December 31st, 1915.

During the past summer a number of prospectors were working on the bars of the Peace river, but, on account of the scarcity of water, very little of material value was accomplished.

Six parcels of ground were staked on the Peace river below Carbon river as placer-mining leases, and the notices, as required by section 105 of the Act, were duly posted in the office of the Mining Recorder at Fort St. John, but no further action has been taken by the locators in this behalf.

I regret the statistics of the Mining Recorder's office are not available.

NORTH-EAST KOOTENAY DISTRICT.

GOLDEN MINING DIVISION.

NOTES BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

Monarch.

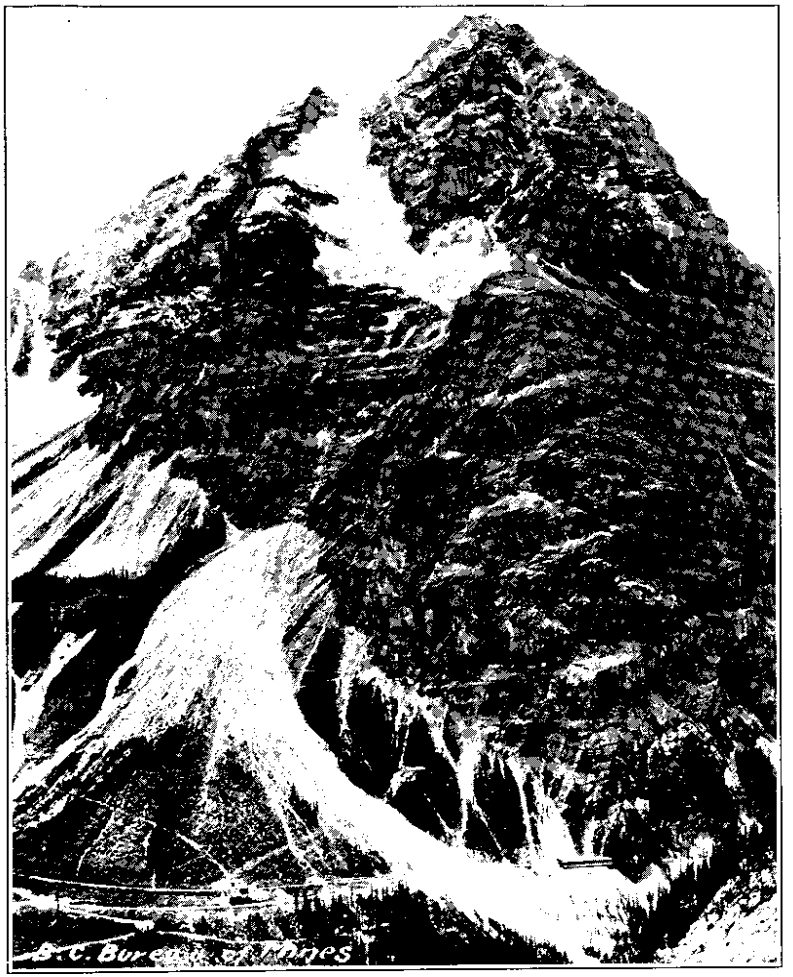
The *Monarch* mine is situated about 1,000 feet directly above the main line of the Canadian Pacific Railway, at a point three miles east of the station at Field. This is in the heart of the Rockies, and the mine itself is on the precipitous face of Mount Stephen, one of the high peaks surrounding Field. The property was staked in 1876 and was one of the earliest lode mines in the Province to be worked. It has changed hands many times, but is now controlled by a Vancouver company, the Great Western Mines Company, Limited. The Mount Stephen Mining Syndicate had it for a time, and about 1911 put up a concentrator and worked it for a year or two. These operations were unsuccessful from a financial standpoint and the mine was closed down for a couple of years. The great increase in the price of zinc in 1915 induced a group of Vancouver men to take over the property and recommence work about April of that year. It is not known just what sort of interest the Great Western Mines Company has on the property, but it is believed some of the shareholders in the old company have an interest in the new one. The property is now being worked steadily. Newton W. Emmens, M.E., was instrumental in arranging the deal and was manager at the mine for several months, but later severed his connection with the company.

The mill and camp buildings are at the level of the railway-track, while the mine-workings are 1,000 feet above and connected to the mill by an aerial tramway of the Leschen 2-bucket type, over 1,000 feet in length.

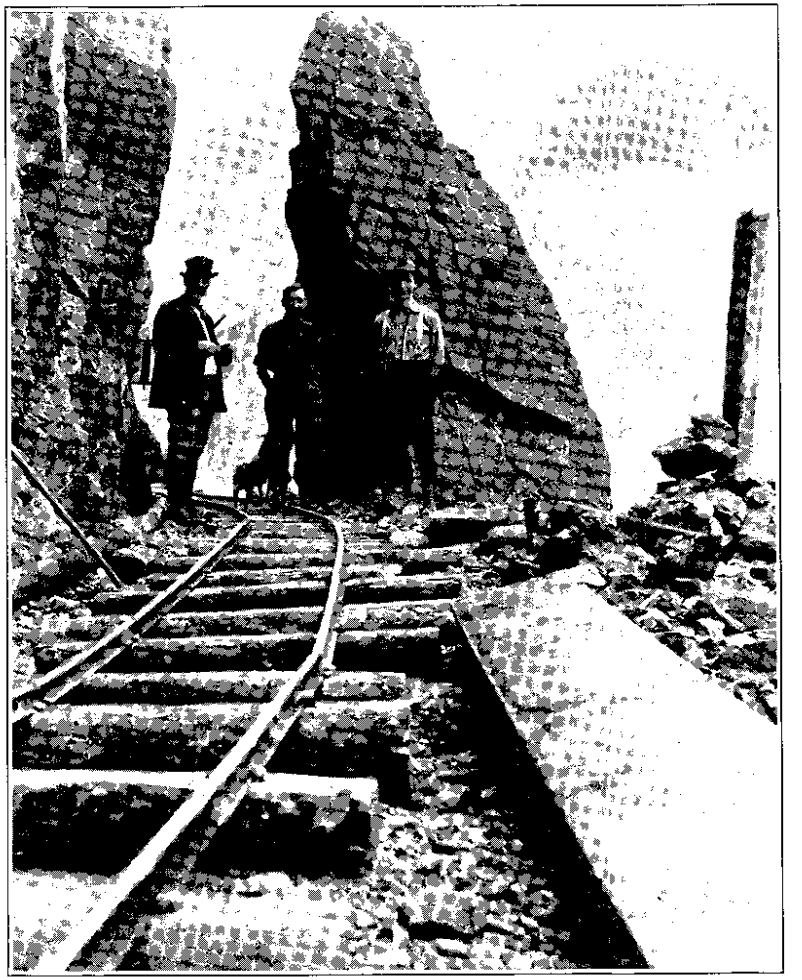
The mine had been opened up in a somewhat inefficient manner by the former company, with the result that the handling of the ore entails greater costs than should be the case. The ore is taken down a raise, out a tunnel, dumped down another raise, and trammed out to the receiving terminal of the aerial tram, thus making several handlings, some of which could have been dispensed with. Of course, the mine is very inconveniently situated on the face of an almost perpendicular mountain, and the opening-up of the ore-body presented difficulties, so that it is much easier to criticize the work afterwards than to have done it better at first.

The ore-body is a replacement deposit of sulphides in a limestone-band, which is from 15 to 30 feet thick. This band extends along the face of the mountain, with a slight dip into it, and thus the ore-body has the appearance of a blanket deposit. The actual origin of this ore-body is obscure, as there are no igneous rocks in the near vicinity to account for any possible heated, magmatic waters to carry the sulphides in solution. In his report on the Field Map-area, Memoir 55, Geological Survey of Canada, Dr. J. A. Allan includes a description of this mine and others, but gives very little opinion as to the genesis of the ore-bodies. He does say, however, "It has been suggested that the presence of these widely separated, mineralized areas may indicate a broader extension of igneous rock not yet exposed." The inference to be drawn is that hypothetical, igneous rocks, underlying the limestone measures, have supplied the mineralized solutions or gases. There is, however, no development in the *Monarch* deposit of the usual lime-silicate minerals, such as garnetite, epidote, wollastonite, etc., which are commonly found in a lime-band which has been mineralized by solutions carrying sulphides or sulphates from a near-by igneous rock.

The band of limestone in which the ore-deposit is found is sheared in several directions, and it is evident that the shearing of the rock in this way was an important factor in the formation of the ore-body, as it would have allowed the passage, circulation, and permeation of the mineral-laden solutions to effect the replacement of the limestone. In many places the replacement has been incomplete, and fragments of limestone are cemented together by calcite or sulphides, so as to give it the appearance of a breccia. The sulphide minerals are galena, sphalerite, and pyrite, of which the first two are important as being ore-minerals. The pure galena carries about 3 to 4 oz. of silver to the ton, but there is practically none in the sphalerite; the pyrite carries no appreciable values in gold or silver.



Cathedral Mountain, showing Location of Monarch Mine.



Monarch Mine—Golden M.D.—Tram on Bluff.

Some very pure, crystallized "resin-blende" is found in this mine; this is zinc-blende practically free from isomorphous iron and having the true, resin-yellow colour of pure sphalerite. The blackish colour of ordinary sphalerite is due to the presence of iron, and it is this latter kind that is of common occurrence in British Columbia, being commonly known as "black-jack" by the miners.

To the east of the *Monarch* there is an important north-and-south fault, known as the Stephen-Cathedral fault (so called because it is best exposed between the mountains of the same name), which is said by Allan to have a displacement of more than 3,000 feet, with the down-throw to the west. It seems very possible that the mineralizing solutions which formed the *Monarch* ore-body had their origin in an igneous body situated at some distance under this fault-plane, and by it gained access to the overlying rock.

The mill on this property is an ordinary lead-zinc concentrator, of about 70 tons daily capacity, and needs no extended description here. It is equipped with the usual bins, jaw-crusher, coarse and fine rolls and trommels, for crushing and sizing. The concentrating machinery consists of jigs, classifiers (for regrading), and Deister and Wilfley tables. A Huntingdon mill is used for regrinding the jig middlings or tailings if found advisable. Some experiments were carried out by Emmens in treating the final table tailings by means of an oil-flotation process, but it is not believed that anything has been done beyond the experimental stage. The extraction of the present mill is about 75 to 85 per cent., and there seems no reason why this should not be materially increased by the addition of a small oil-flotation plant to treat the table tailings. The zinc concentrate assays from 45 to 50 per cent. zinc and the lead concentrate from 55 to 65 per cent. lead. Some experiments were also carried out by Emmens in roasting the zinc concentrate before shipping. The analysis of this material before roasting is about as follows: Zinc, 48 per cent.; lead, 3 per cent.; sulphur, 29.5 per cent.; iron, 4.1 per cent.; and the balance insoluble. By a slight roast 13.8 per cent. of the sulphur was driven off and the zinc content raised to 55 per cent., with a corresponding loss in gross weight. As the freight rate to St. Louis, where the zinc concentrate is sold, is $10 a ton, and also as the higher the grade of the zinc concentrate shipped the better proportionate price is paid for it, there would seem to be an advantage in thus giving the ore a preliminary roast. As far as is known, nothing further has been done along this line.

The mill-feed varies between wide limits, but a lot of it contains from 15 to 25 per cent. zinc. When a pocket of galena is struck the lead contents may be quite high. As the mill was at first run, all jig tailings went to waste and no special attempt was made to save the zinc contents, with the result that the tailings-dump contains from 15,000 to 20,000 tons of material carrying from 15 to 20 per cent. zinc. When the price of zinc advanced so greatly last year, Mr. Emmens conceived the idea of retreating this tailings-dump in the mill to secure the zinc contents. With this idea in view the present company secured the property, but it is not believed that any of the tailings-dump has been handled as yet; sufficient ore having been found in the mine—largely zinc, but containing some lead—to keep the mill going so far. The tailings-dump is about 200 feet or more below the mill, in the bed of the Kicking Horse river, and would have to be elevated back up to the mill for retreatment; this, however, should not present any serious difficulties. But as long as the mine can produce sufficient ore to keep the mill running, it will hardly be worth while hauling up the old dump.

The power plant consists of a water-power plant and an auxiliary steam plant for use when the water fails, as it does in winter when the glacial-fed stream supplying the water becomes frozen up. The water is taken in a pipe 1,700 feet long and delivered under a head of 280 feet to a 4-foot Pelton wheel, capable of developing 140 horse-power. The steam plant consists of a 100-horse-power engine and boiler of similar capacity. A 5-drill air-compressor is situated in the mill building and the compressed air taken up to the mine in a 6-inch pipe. An auxiliary gasolene-hoist (12 horse-power) is situated near the top tram station, to haul up material from the railway on a gravity-track.

The main working in the mine is a tunnel about 400 feet long, going in nearly on the pitch of the ore-body, and on either side the ore has been stoped out for some distance, so that now the workings are like a long, wide, very flat gallery. Pillars are left here and there to hold up the roof. The width or thickness of ore is up to 10 feet in some places. The galena and sphalerite are generally intimately mixed, but sometimes occur in solid bunches of each mineral

separately. The irregularity of distribution of the ore makes systematic development impossible and perhaps inadvisable. The scheme adopted is to stope out the ore in sight and to follow up every indication of mineralization along any seam.

The mine employs from twenty to thirty men and, at the present price of zinc, should have no difficulty in operating at a profit.

WINDERMERE MINING DIVISION.

REPORT OF W. A. LANG, MINING RECORDER.

I have the honour to submit the annual report on mining operations in the Windermere Mining Division for the year ending December 31st, 1915.

The usual amount of assessment-work has been done, all mining claims in the district having been kept in good standing; some prospecting has been done in new ground.

War conditions must be blamed for lack of capital for large promotions and for greater development, and for the very large exodus of miners and prospectors who have joined the colours or are in training.

The completion of the Kootenay Central branch of the Canadian Pacific Railway places the district in a much more favourable position as to transportation. Under former conditions there were only the river-boats running north for a few months of the year, whereas the new line gives an outlet both north and south, as well as making a very material reduction in freight charges. Greater development in the mining industry may therefore reasonably be looked for.

The Lead Queen Group.—This is a group of five claims on Frances creek, on which some considerable work was done. The group was bonded by Vancouver parties and work started in August; twelve miles of wagon-road was built at a cost of about $10,000, and a similar amount was spent in mine-development. Five cars of silver-lead ore was shipped to the Trail smelter, and the smelter returns were highly satisfactory. Work had to be discontinued on account of heavy snow, but will be resumed as early as weather conditions will permit. The season's work on this group would seem to indicate that it gives splendid promise of becoming a good dividend-payer.

The Nip and Tuck.—The old *Tecumseh*, under the new name of the *Nip and Tuck*, on McDonald creek, made a trial shipment of 10 tons, taken out under very unfavourable conditions, in bad weather and over bad trails, and shipped by L.C.L. rates, but in spite of these adverse circumstances the net returns gave over $60 to the ton.

The Silver King.—A 1-ton shipment of silver-lead ore carefully selected was sent out and gave a net return of $122. This property is a silver-lead-zinc one. In August a 7-ton shipment was made, the smelter returns from which showed 17 per cent. zinc, and the penalty of $4.50 a ton on account of the zinc reduced the net returns to $55.

The B.C. and Tilbury.—There is considerable ore on the dump, and during the year four miles of trail from the wagon-road was constructed, which will enable the owners to carry on the work to the shipping stage next year.

The Isaac.—A wagon-road connecting this property with the road to the *Lead Queen* group was built and cabins constructed, and all materials placed on the ground for the construction of an aerial tramway. Energetic work will be continued on this property next season, as it gives good promise.

OFFICE STATISTICS—WINDERMERE MINING DIVISION.

Free miners' certificates	69
Locations recorded	48
Certificates of work	55
Bills of sale and transfers	17

WINDERMERE MINING DIVISION.

REPORT BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

INTRODUCTORY.

The Windermere district is a section of British Columbia which, although it was partially settled many years ago, is but little known to the rest of the Province. In the summer-time it is indeed a beautiful country, and when its charms become more widely known it should become one of the most popular districts in the Province for the tourist.

The beautiful Windermere valley was largely acquired a few years ago by several large land companies, which have farmed out the land in acreage and put in extensive irrigation systems. Apple-growing was to be the main business, but it would seem now as if the country were better adapted to mixed farming. Mining, too, was commenced in the district many years ago, but latterly the industry has been dormant. During the past year the Kootenay Central Railway has been completed from Golden, on the main line of the Canadian Pacific Railway, to Colvalli, on the Crowsnest branch, and this railway, running as it does through the great north and south valley occupied by the Columbia and Kootenay rivers, should materially assist in the development of the country.

During the field season of 1915 the writer spent one month—July 27th to August 26th—in the district, with the object of examining a number of the more important properties worked in former years, and to ascertain, if possible, the reasons for the practical abandonment of mining in the district. While in the district only one property was being operated, but a few were examined on which work had recently been done, and others on which a resumption of development was anticipated shortly.

To briefly sum up the salient facts in regard to mining in this district, it may be said:—

(1.) The claims are mainly situated at considerable distances from rail or river transportation and are generally at high elevations—up to 10,000 feet.

(2.) Owing to their inaccessibility, many claims are only workable for a short season and operating expenses are also unduly high.

(3.) The deposits generally occur in bedded fissure-veins, and are, as a rule, small and pockety. The ore-minerals are galena, sphalerite, and grey-copper, with oxidation products, and the values are confined to silver and lead.

(4.) The ores are not exceptionally high grade, but are about the usual average of such character of ores throughout the Province. The presence of grey-copper sometimes, however, causes very high values in silver.

(5.) The character of the ore-bodies is such that many of the claims should prove very attractive to leasers. Small pockety bodies of high-grade ore can often be worked in a small way and made to pay handsomely when larger operations by a company are unsuccessful.

(6.) The opening-up of the Kootenay Central Railway will to some extent assist mining in the district, but not as much as has been anticipated.

(7.) In conclusion, it may be said that what the district is in greatest need of is an influx of prospectors and small mining operators, and the writer believes that the district warrants the further attention of such men.

HISTORY.

Fort Steele, Windermere, and Golden Mining Divisions are grouped together as forming East Kootenay District, and all the old Annual Reports of this Department deal with the district as a whole. Mining first commenced with placering in the early sixties on Wild Horse and Perry creeks in what is now Fort Steele Division. In 1885 a "placer rush" took place on Toby creek, and about this time placering also commenced on Findlay creek; both of these creeks are in Windermere Division. All the creeks flowing into the Columbia and Kootenay rivers have been placer-mined to some extent, but Wild Horse and Perry creeks are the only ones from which large outputs have been made.

Prospecting for lode minerals commenced throughout the district in the years from 1885 to 1889, the first locations on Toby creek having been made in the latter year. Many claims were staked all through the East Kootenay District, but were mainly confined to the Purcell

range, the Rockies never having as yet shown much indication of mineral. In the Windermere Division claims were staked on Toby, Horse Thief, Law, Boulder, McDonald, Frances, Dutch, and Findlay creeks. From 1898 to 1907 a number of properties were worked and ore was shipped, but since the latter year mining has dwindled away to practically nothing.

LOCATION.

The Windermere Mining Division is situated in the south-eastern part of the Province, and is bounded on the south by the Fort Steele Mining Division, on the west by Ainsworth Division, on the north by the Golden Division, and on the east by the Alberta-British Columbia boundary-line. The area of the Division is about 5,500 square miles. The western boundary-line between this Division and Ainsworth follows the watershed of the Purcell range, while the north and south boundaries are arbitrary lines, crossing mountain ranges in a general east-and-west direction.

All travel into the district is via the main north and south valley, along which runs the wagon-road from Fort Steele to Golden. The Kootenay Central Railway, which was opened last summer, also follows this valley. From Windermere (town) an auto-road has been projected and partly built to Banff, Alberta; this road goes through an east-and-west pass in the Rockies and then swings north to Banff. From the main road there are branch roads and trails going up many of the creeks which come in from the Rockies and Purcells.

Near the geographical centre of the Division there are four towns, all close together, which may be said to form the business centre of the district. Windermere is the oldest of these, and it is beautifully situated on the eastern side of Lake Windermere, four miles from its northern end; it has now dwindled in population to a very few. The next town to be started was Wilmer, distant six miles northerly from Windermere and about two miles from the north end of Windermere lake. This town is now the seat of the Government offices for the district and has a population of perhaps 250. It is situated on a flat bench overlooking the Columbia river, but nearly a mile back.

At the northern end of Lake Windermere, at what was formerly known as the "Salmon Beds," the town of Athalmer has been laid out. This town has the railway running through it and a station from which the business of the surrounding district is transacted. Swampy ground is perhaps the most unfortunate feature of this place, but otherwise it is a neat, well-laid-out little town, with a population of a few hundred. On the bench above the railway-station (western side) and distant nearly a mile from the centre of Athalmer is the town of Invermere. This place has a very pretty situation overlooking Windermere lake and possesses a good tourist hotel. A short distance from the hotel a nine-hole golf-course has been laid out, which skirts round the lake-shore in a most artistic fashion. Tennis-courts and croquet-greens are also kept up. Bathing, canoeing, motor-boating, fishing, duck-shooting, and larger game hunting can all be had here at their proper seasons, while, by going up Toby creek, as fine mountain scenery may be found and as good mountain-climbing indulged in as anywhere in the Province. Hot springs are found fifteen miles to the south at Fairmont and ten miles to the north at Sinclair, to which are attributed, by the Indians and others, great medicinal value.

The writer regrets his inability to adequately describe the many and varied enticing features of this district for the tourist, but it is sufficient to say that the combination of valley, lake, and mountain scenery cannot be surpassed in British Columbia. Added to this almost ideal summer weather and some very fine motor-roads, and there seems nothing lacking to make this an ideal section for tourists.

A Dominion Government Experimental Farm is situated at Invermere, and a visit to this place shows the possibilities of the Windermere valley from an agricultural standpoint. The large land companies, which now control the bulk of the land in this valley, have brought out many settlers in the last few years from Great Britain. In most cases these people have had to pay so much for the land and at the same time they have not been a class who were naturally farmers, with the result that farming has not prospered as it should have. Many of them were retired army officers, who, at the outbreak of the war, immediately returned to the Old Land, with the result that now the country is becoming temporarily deserted. Some of the large land companies are now in bad shape financially through having paid high prices for the land,

expensive irrigation schemes, and extravagant office staffs during boom times. It is possible that these companies will, before long, arrange to let the land go at reasonable prices to intending settlers, when a rapid revival of production will take place.

GENERAL GEOGRAPHIC AND GEOLOGICAL FEATURES.

The Windermere Mining Division consists essentially of a portion or cross-section of two mountain ranges and a broad valley between. The mountain ranges are the Rockies on the east and the Purcells on the west, and the broad valley is part of the Rocky Mountain Trench, which is here occupied by the Columbia and Kootenay rivers. This valley runs through the centre of the Division, and in it is situated Columbia and Windermere lakes, which are the sources of the Columbia river, which then flows northerly into Golden Division. The Kootenay river rises to the east of the Columbia in a north-and-south valley in the main range of the Rockies, and flows south-westerly through a transverse valley into the Windermere valley, and thence southerly into Fort Steele Division.

The main drainage is thus north and south, while the secondary drainage from the mountain ranges is east and west. The principal streams rising in the Purcells and flowing into the Columbia are the Salmon river, Frances, Horse Thief, Toby, Dutch, and Findlay creeks. From the Rockies the creeks flowing into the Columbia are short, small, and unimportant, the main drainage being by means of the Kootenay river, which absorbs numerous small creeks coming in from the east and west. The Kootenay, in crossing into the Windermere valley, comes within half a mile of the upper end of Columbia lake, the ultimate source of the Columbia river. At one time a canal was cut between the two, thus allowing the waters of the Kootenay to flow into the Columbia, but after a short time this canal was closed up again, as the influx of the Kootenay water flooded the lower stretches of the Columbia. A small village known as Canal Flats has been built at this place.

The character of the Rocky and Purcell mountain ranges is too well known to require any extended description here. In both of them the relief is very great, consisting of deeply carved valleys with towering peaks reaching far above timber-line. In the Purcells the highest mountains are Mount Farnham (13,342 feet), Mount Hammond (10,772 feet), and Boulder mountain (10,558 feet). Many others are nearly as high, and in the Rockies still higher elevations are reached. Glaciation has been intense and is evidenced by the universal U-shape of the valleys, the numerous hanging valleys, and the glacial cirques at the heads of nearly all the creeks.

Viewed from the Windermere valley, the Rockies rise abruptly or wall-like, with foot-hills very inconspicuous or almost entirely lacking. These mountains consist mainly of limestone, and viewed from a distance the rock-sculpture and glacial carving is on a grand scale. The Purcells present a distinct contrast to the Rockies in the rather gradual rise from valley land to steep mountains. The valley first of all gives way to benches and terraces, and then low, rounded hills appear, and very gradually and almost imperceptibly, at a distance of twenty to thirty miles from the Columbia river, the heart of the Purcell range is reached where the scenery is alpine in character.

When the International Boundary-line survey of the 49th parallel was made, from 1901 to 1906, Dr. R. A. Daly was attached as geologist to the International Boundary Commission. The area covered by this geological investigation was a belt 400 miles long and from five to ten miles wide, forming a complete cross-section of British Columbia at its southern boundary-line. This work by Dr. Daly has been issued by the Geological Survey of Canada as Memoir No. 38, entitled "North American Cordillera, Forty-ninth Parallel," and is an exhaustive and voluminous monograph in three volumes. In it a thorough investigation and tabulation of the nomenclature of the different mountain ranges in southern British Columbia has been gone into and the different mountain systems and individual units have been classified and named, following, as a rule, the older names and eliminating, where possible, duplication of names for different parts of the same ranges. The names "Selkirk mountains," "Selkirk system," and "Selkirk range" have, in the past, been more or less indiscriminately used and sometimes taken to include the Purcells. Furthermore, the name "Purcell" is sometimes used to designate a small section of the main Purcell range lying to the east of the Yahk river. It is not necessary to outline all Daly's arguments for applying the name "Purcell" to the large mountain system, as anybody interested can consult his memoir, but the following quotation shows just what is intended by

the name "Purcell range": "In summary, then, the great range unit here called the Purcell range is bounded by the Rocky Mountain Trench, the Purcell Trench, and the portion of the Kootenay valley stretching from Jennings, Montana, to Bonners Ferry, Idaho."

The Rocky Mountain Trench, as before indicated, contains the north-flowing Columbia river and the south-flowing Kootenay river. The Purcell Trench is occupied by the north-flowing Kootenay river where it returns into British Columbia, Kootenay lake, and Duncan river.

The Cranbrook Map-area* lies entirely within the Purcell range, and a further discussion and description of the topography and physiography of the range will be found therein. The mineral-bearing area of the Windermere Division embraces a section of the eastern watershed of the Purcell range, considerably north of the Cranbrook Map-area and near the northern limit of the range. Speaking generally, the character of the Purcell range at this point is about the same as it is farther south, except that the heart of the range is more rugged, higher elevations are found, glaciers are much more frequent, and the effect of recent glaciations are much more pronounced.

The rocks in the Purcell range consist dominantly of sedimentaries of Pre-Cambrian (Beltian) and Palæozoic ages, together with some intrusive rocks of those and probably later periods. These sedimentaries consist largely of quartzites, together with argillites and metargillites. The folding and faulting in this range have been intense, the mountains mainly consisting of large fault-blocks.

The sedimentaries are all squeezed and folded to such an extent as to be now generally metamorphic rocks. Quartzites and argillites are the most abundant, but there are also some limestones, slates, and shales. The general strike of these measures is north-westerly along the axis of the range, but strikes and dips at all possible angles are seen.

The igneous rocks in this part of the Purcell range, consisting mainly of basic, hornblendic dykes, ranging from diorites to gabbros. Narrow gabbroid sills were noted in some places, which are probably similar to the Purcell sills in the Cranbrook Map-area, as described by S. J. Schofield, but quite incomparable in size. Small granitic intrusions are said to occur in places, but none were noted by the writer. Near the junction of McDonald with Horse Thief creek there is a small bluff composed of granitic rock, but it is very evident that this is not in-place. It is probably a glacial erratic on an enormous scale, but has evidently not travelled very far. Practically speaking, the whole area consists entirely of the metamorphic rocks.

The ore-bodies are, as a rule, bedded fissure-veins, and are generally quite small. These veins strike and dip at all angles, conforming to the local strikes and dips of the bedded rocks in which they occur. The gangue is quartz, altered wall-rock, calcite, siderite, and barytes, and the ore-minerals are galena, lead carbonate, lead sulphate, zinc-blende, pyrite, chalcopyrite, copper carbonates, and tetrahedrite. Values are mainly in silver and lead, with occasionally copper contents.

The origin of these ore-bodies is somewhat obscure. It is generally assumed now that veins carrying such minerals are formed by ascending hot waters and gases which hold the minerals in solution; these minerals are precipitated out and deposited as the waters and gases approach the surface. These hot waters and gases are generally postulated as coming from a body of igneous rock in the vicinity, but in the Windermere district no batholithic mass of sufficient size is visible to account for the widespread mineralization. The same difficulty exists in the Fort Steele Division in accounting for the origin of the *St. Eugene*, *Sullivan*, and other ore-bodies. In his discussion on the genesis of these deposits, Schofield comes to the following conclusion, which may be regarded as a hypothesis based on a long study of field conditions: "It is therefore concluded that the Purcell series of East Kootenay, in part, rests upon an intrusive basement of granite, which was the source of the ore solution, resulting in the formation of the *Sullivan* and *St. Eugene* ore-masses."

This granite is further supposed to be contemporaneous with the West Kootenay granite batholith. Ore-bodies are found in the Purcell range all the way from Fort Steele Division at the southern end, through the Windermere Division and on into Golden Division at the northern end of the range. This mineralized belt is therefore nearly 150 miles long, and, while there are wide divergencies in the characters of some of the ore-bodies, there is a similarity in a great many of them. The great majority of them can be classed as silver-lead-zinc deposits, with

* Memoir by S. J. Schofield, Geological Survey of Canada.

copper minerals of much less importance. The ore-bodies in the Fort Steele Division are the only ones of this large area whose origin has been carefully studied, but, from the facts disclosed there, it seems possible that the silver-lead mineralization of the Windermere Division has a similar origin and was derived from an underlying, granitic magma.* It should also be pointed out that on the western side of the Purcell range sloping down to Kootenay lake, and along the eastern shores of that lake, large areas of West Kootenay granite are exposed, and it is therefore quite possible that this granite does underlie, and is intrusive into, the heart of the Purcell range. From this conclusion the period of ore formation in the Windermere Division would be contemporaneous with that of the Fort Steele Division. The intrusion of the West Kootenay series of granitic batholiths is ascribed to the Jurassic age, and therefore the ore-bodies were formed in that period.

The veins in the Windermere Division, while similar in a general way to the ore-bodies of the Fort Steele Division, differ to quite an extent in the minerals found. In the latter deposits garnet, diopside, and lime silicate minerals are found in the gangue, and pyrrhotite, sphalerite, and magnetite are associated with the galena in large amounts to form the ore-minerals; in places also galena is almost absent and only sphalerite and pyrrhotite are found. These minerals (excepting galena) are all formed under conditions of high temperature and pressure, and in the Windermere ore-bodies, with the exception of sphalerite, they are almost entirely absent. Quartz, siderite, and galena are, however, abundant, and these are minerals deposited under low temperature and pressure conditions. These deposits, therefore, were probably for the most part formed by comparatively cold solutions, which may have travelled long distances from the parent magma before delivering their burden of mineral to form these veins. From this it follows that it is not necessary to postulate a near-by body of igneous rock, but it is sufficient to have one underlying at great depth or at a considerable distance in any direction.

In several places in the Windermere Division there are large veins of white, glassy quartz, almost devoid of any metallic minerals. These do not carry any appreciable gold content and are quite valueless. In a few instances these quartz veins appear to have been slightly sheared after formation and to have had a later slight mineralization, along the seams, with galena and pyrite. These veins also are of but little economic importance. In the commercially important veins quartz is less abundant and the sulphide and carbonate minerals are plentiful.

CLIMATE, TIMBER, AGRICULTURE, ETC.

Very little need be said here in regard to the climate, as it is very similar to that found throughout the interior valleys of southern British Columbia. The spring, summer, and autumn are all delightful, and great extremes of heat in the summer months are rare. The precipitation is not great, and hence irrigation for the land is necessary to secure the best results in farming. Snow lies on the ground for two or three months in winter, but excessive cold weather is infrequent. Up in the mountains the snowfall is as a rule quite heavy, thus providing material for the numerous snowslides in spring.

Timber is plentiful and consists of all the usual varieties, pine, fir, spruce, hemlock, tamarack, birch, poplar, etc. Logging operations are carried on in the main valleys and up many of the side-creeks. For mining purposes timber is plentiful in most places, although there are some claims above timber-line and others where most of the timber has been cleaned off by snowslides.

DESCRIPTION OF CLAIMS.

The writer examined claims situated on the following creeks: (1) Toby creek; (2) Spring creek; (3) Jumbo creek; (4) North fork of Toby creek; (5) Boulder creek; (6) Law creek; (7) Horse Thief creek; (8) McDonald creek; (9) Frances creek; (10) Findlay creek.

Invermere was found to be a suitable place to use as a headquarters and to fit out a camping outfit. Horses and pack outfit were obtained here and a guide was found who knew the country thoroughly. The writer wishes to here acknowledge his indebtedness to Frank Stockdale, a hardware merchant of Invermere, for valuable assistance and information in his work. Mr. Stockdale did a lot of mining in the district in former years and is thoroughly familiar with the country, and he, at some personal sacrifice, consented to guide the writer over some of the more important claims.

* The copper-deposits of the Purcell sills are not included in this discussion, as they are quite different, being of Pre-Cambrian age.

Leaving Invermere, the first trip was made up Toby creek to near its head, and up its branches, Spring and Jumbo creeks and the North fork. A return was made to Invermere and a fresh supply of provisions obtained, and then claims on Horse Thief, Boulder, Law, and Frances creeks were examined. Returning to Invermere, the pack outfit was broken up, and, hearing that some placering was going on at Findlay creek, the writer rode there to see the workings. The Windermere district was then left and the writer proceeded by the Kootenay Central Railway to Cranbrook.

Toby Creek.

The wagon-road up Toby creek leaves the main road midway between the towns of Invermere and Wilmer, and goes up the creek for twenty-five miles, or nearly up to the divide. Branch roads run up Jumbo creek for a few miles, up Spring creek to its head (at which is situated the *Paradise* mine), and up the North fork. From the main roads trails go up the various side-creeks to claims situated high up; many of these trails have not been used for years and are nearly obliterated by slides and overgrown with brush.

Toby creek is a typical mountain torrent, almost large enough to be called a river, which cuts transversely through the Purcells from the summit of the range to the Columbia river. It occupies quite a broad valley in most places and is flanked on either side by towering, glacial-capped mountains, many of which rise to 10,000 feet and more. The scenery in this part of the country is not surpassed by any section of the Province.

Paradise.

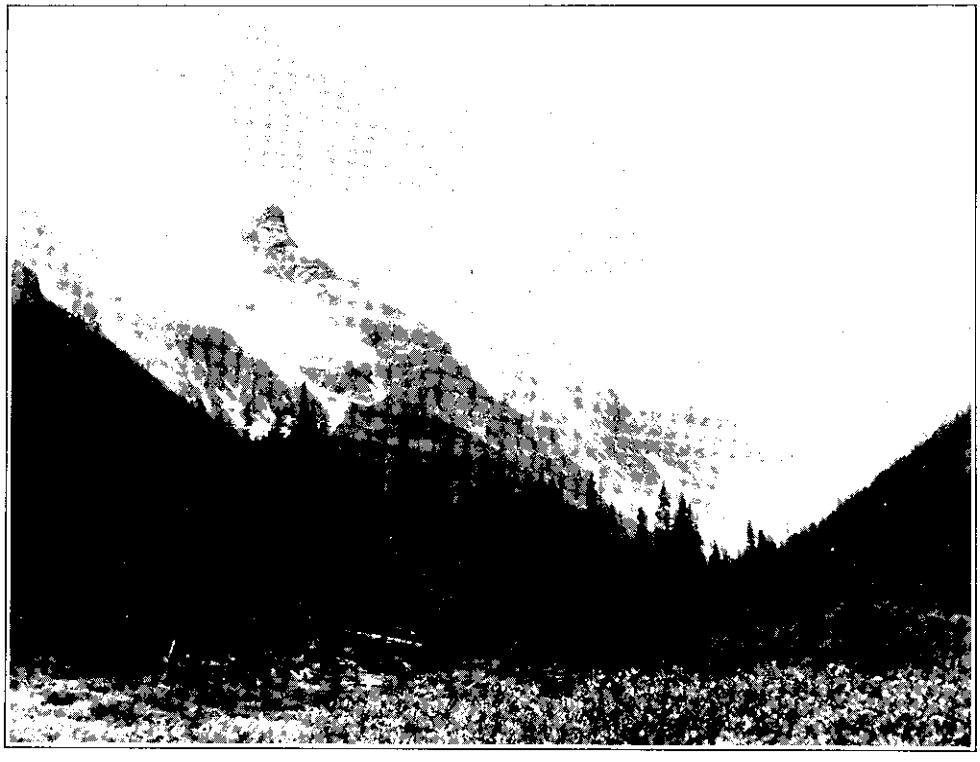
Spring creek is a small tributary of Toby creek, taking its source from near the foot of Mount Nelson, and, flowing nearly due east, joins Toby creek at Pinehurst, about nineteen miles from Athalmer. A number of properties have been staked in the basin at the head of the creek, the most important of which is the *Paradise* mine. A fairly good wagon-road extends up to this mine from the main road going up Toby creek; numerous switchbacks were necessary in this road, and even then the grade is quite severe. The *Paradise* mine was very completely described by the Provincial Mineralogist in the 1903 Report of this Department, and but little can now be added to that description. It will be well, though, to summarize the salient features regarding the mine.

The *Paradise* is situated near the head of Spring Creek basin at an elevation of from 8,400 to 8,800 feet, well above timber-line. The mine camp, consisting of bunk-houses, cook-house, office, storehouse, etc., is situated on level ground in the basin, and the mine-workings lie on the sloping hillside to the north. Camp buildings were also erected at Pinehurst, as this was a half-way point between the mine and Wilmer when ore was hauled out in former years. Offices were also maintained at Wilmer. The company owning the property is controlled by the estate of the late Mr. Hammond, of Toronto; R. R. Bruce, Wilmer, is the local agent, and S. S. Fowler, Riondel, is consulting engineer. Ore was shipped from the property from 1901 to 1906 in the following amounts:—

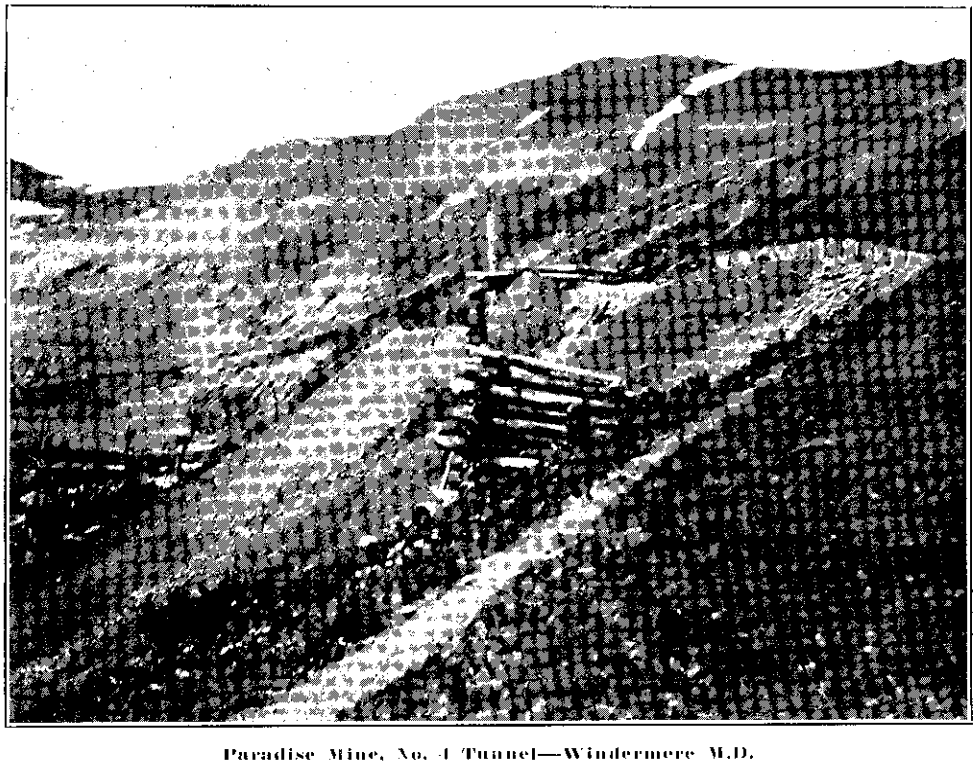
Year.	Tons.	Silver.	Lead.
		Oz.	Lb.
1901	755	30,194	774,946
1902	133	7,694	178,476
1903	723	46,025	943,636
1904	285	13,295	351,326
1905	54	2,430	54,000
1906	46	3,146	66,588
Totals	1,996	102,784	2,368,972

This shows an average metallic content of 51.4 oz. silver to the ton and 59.3 per cent. lead.

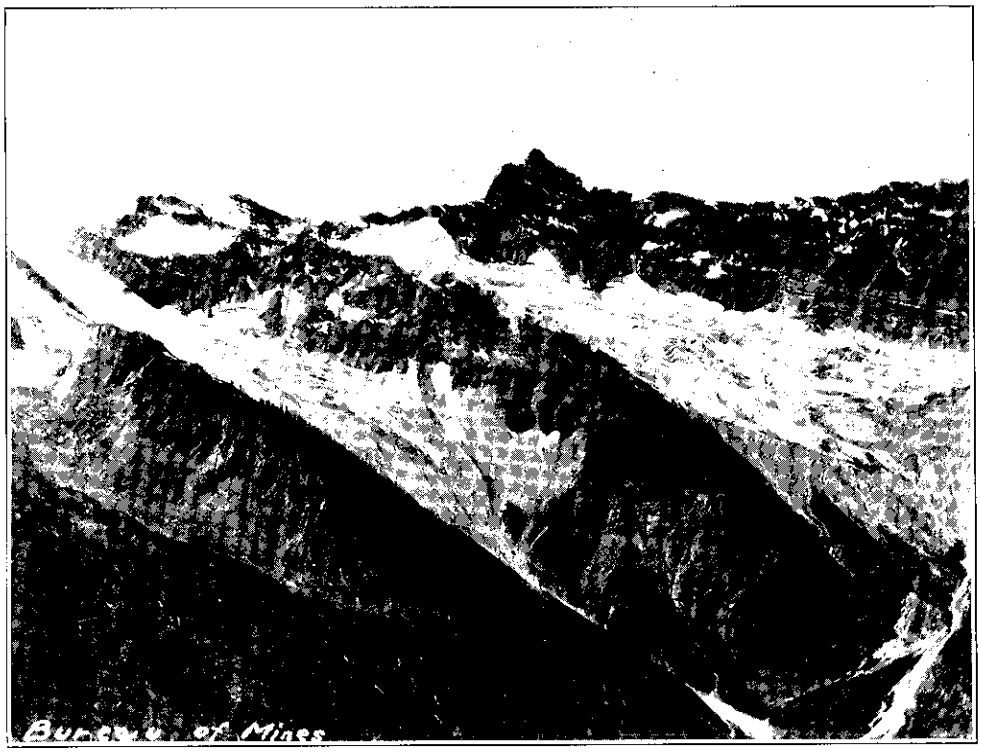
In 1903 the company had plans formulated to put in an aerial tramway from the mine to Pinehurst, and there to erect a small smelter to treat the ore, shipping the product as lead matte. These ambitious plans were never consummated, and since 1906 the property has remained idle. Developments on the lowest level are said to have been somewhat disappointing, and this made it impracticable to spend the money involved in erecting a smelting plant.



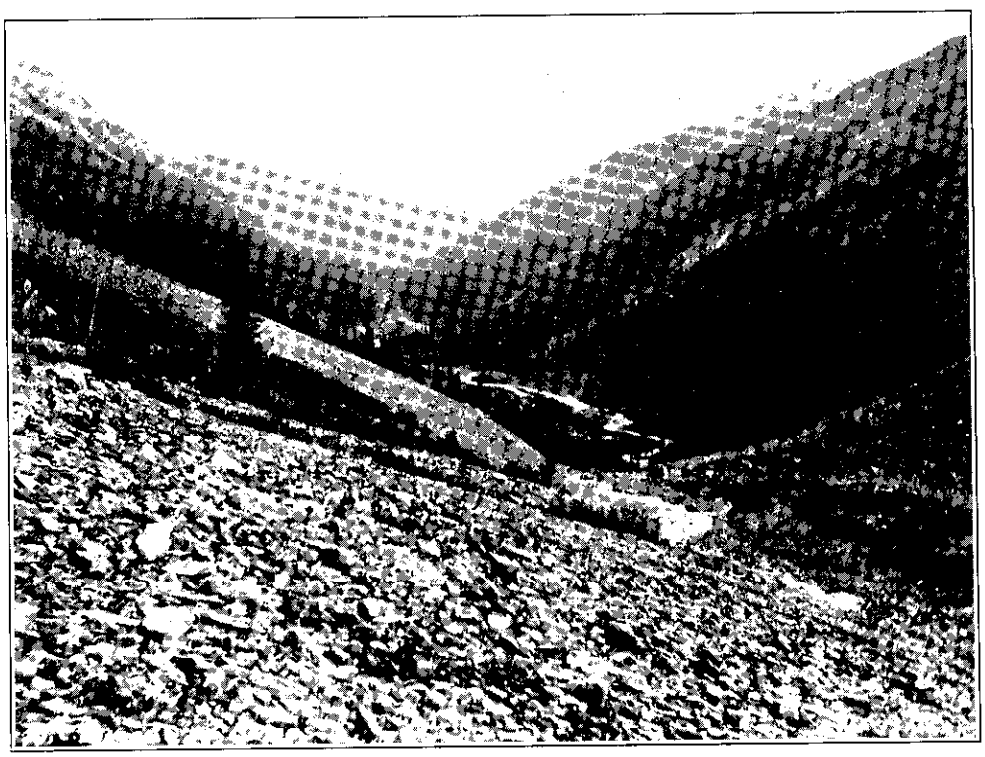
Mount Hammond—Windermere M.D.



Paradise Mine, No. 4 Tunnel—Windermere M.D.



Glacier, Head of Delphine Creek—Windermere M.D.



Looking down Law Creek—Windermere M.D.

The formation in which the ore-body occurs consists mainly of shales, slates, argillites, and occasional bands of limestone, all greatly twisted and contorted, and in places slightly faulted. The so-called "vein" is more probably a replacement of a limestone-band which is folded into an anticlinal structure. This vein, which is from 2 to 6 feet wide, is filled with lime, slate, siderite, calcite, quartz, iron oxide, pyrite, galena, and lead carbonates. The oxidation of the ore-body has been very complete and has proceeded beyond the lowest levels yet opened. This oxidation has been effected by surface waters following downwards on the vein. The precipitation here in winter, in the form of snow, is very great and would provide abundance of water to cause this oxidation. The iron and lead minerals were probably first formed in the sulphide form as pyrite and galena, but only comparatively small nodules and bunches of these sulphides are now found.

The ore-body and wall-rock for some distance on either side is characterized by being soft and crumbly, due to its oxidized condition and the freely circulating surface waters. The typical rich ore is what is called a "sand carbonate," which is like fine gritty sand and varying from grey to brown in colour. This softness of the material to be mined makes it necessary to timber up all drifts and stopes very thoroughly; everywhere all workings are lagged up tightly. The result is that in going through the old workings, some of which in spite of all precautions have caved in, very little can be determined as to the amount of ore still remaining in the mine. To the writer it seems probable that there is still a considerable quantity of ore available above the lowest drift, but this can only be taken as a guess. In many places the ore consists of a very completely oxidized mass of iron oxide, siderite, and lead carbonates, with small cores of galena, the whole being intermixed with clay-like material. It seems very probable that the ore is not confined to one single replaced limestone-band, but that there are several parallel bands in which the ore occurs in lenticular form. The general strike of the ore-body is north-west and south-east, with a dip of from 45 degrees to nearly flat. The hillside on which the workings are situated rises up from the basin at an angle of about 30 degrees, and on the surface consists of loose slaty rock with a few solid outcrops of slate.

The property is developed by three tunnels and a blind intermediate level, all connected by winzes and raises; these workings, with the various crosscuts, drifts, and stopes, total several thousand feet of work. No. 1 tunnel, which is not far from the top of the ridge forming the divide between Spring and Boulder creeks, is really an incline following down on the ore-body to No. 2 tunnel. It is very irregular and branches off at numerous places in different directions. From it many stopes and intermediate levels have been driven. A small tunnel starting on the surface just beside the No. 1 incline is now caved in. No. 2 tunnel, 125 feet vertically below No. 1, strikes the ore-body at a point 500 feet in from the portal. At a point 885 feet in from the portal a winze was sunk following down on the ore at about a 45-degree pitch for 180 feet, at which point the ore faded out. From this winze the blind intermediate level was run, and from it stopes were put up to the No. 2 level above.

Two hundred and fifty feet below No. 2 tunnel is the No. 3, which is 1,800 feet long. It turns and twists a lot and has numerous crosscuts radiating out from it. It would seem that this tunnel encountered the downward continuation of the ore-bearing band in the upper levels, but that in this working the vein-filling consists mainly of iron oxide, siderite, and calcite, and with only small amounts of lead carbonate. It is possible, however, that the pitch of the ore-shoot is such that this level is not in far enough to get properly into it, and in any case this may be a barren zone and another ore-shoot may exist farther down. The writer had no means of determining the character or quantity of the ore taken from this lower tunnel, as much good ore may have been extracted therefrom and shipped. But a grab sample of the dump from this tunnel was taken which only returned 4 oz. silver to the ton and 3.4 per cent. lead. As this is a good deal lower grade than is claimed for the dumps of the upper tunnels, it would seem as if the average value of the ore-body in the lower tunnel was much lower than in the higher levels.

It is claimed, when the mine was being operated, that as far as possible the ore was mined selectively, so as to only extract ore running about 50 per cent. lead; lower-grade ore than this could not be shipped at a profit. It is on this assumption that the claim is made that there still remains several thousand tons of low-grade ore in the stopes. Some low-grade ore was necessarily mined, and the most of this is now on the dumps. This second-class ore is, how-

ever, considerably mixed up with waste rock, so that it is doubtful if the material from the dumps could be shipped to a smelter at a profit without first concentrating it.

With the present high price of lead and the railway now running, conditions are more favourable for the operation of the property than in former years. The mine should not be lying idle, but the owners seem unwilling or unable to resume operations themselves, and it is understood that a very high figure is demanded of any prospective purchaser.

Mineral King. This claim is situated on the north-west side of Toby creek, at about the end of the wagon-road and some twenty-eight miles from Athalmer. The workings on the claims are about 1,000 feet above the creek, the hill rising at an angle of about 30 degrees. No information was obtained as to who were the owners or if there were several claims in the group.

The formation consists of quartzites and slate, which stand nearly vertical, but are badly twisted and contorted; the general strike is about north-west. The occurrence of ore here is quite peculiar and no satisfactory explanation for it could be obtained. All that can be told is that there is a large "blow-out" of quartz and barytes, carrying galena and zinc-blende, which is apparently elliptical in form, with its greatest diameter in a north-and-south direction and extending for 200 feet. The maximum width is about 60 feet. The streaks of barytes and quartz which occur in this "zone" have no definite strike, but the whole thing is a somewhat jumbled-up mass of quartzite, lime, schist, barytes, and quartz. Galena occurs speckled through the barytes, but in places there are streaks of solid galena up to 2 feet in width; these, however, are very irregular and are not continuous longitudinally. Some arsenical iron and zinc-blende occur, but are not of importance. A continuation in a longitudinal direction of the mineralized zone may exist, but no work has been done to find it.

Development-work consists of sundry open-cuts and an adit-tunnel 140 feet long. This tunnel crosscuts beds of the various materials mentioned above and shows some ore. The development so far done has not proved very much ore, but further work would seem to be worth while. The following assays were taken:—

Description.	Gold.	Silver.	Lead.
	Oz.	Oz.	Per Cent.
Across 8 feet of barytes carrying a little galena	Trace	2.8	7.5
Solid galena 6 inches wide	0.02	41.0	68.2
Average of dump containing 10 tons of ore taken from end of tunnel	0.02	6.2	11.8
Sample of arsenical iron	Trace	5.4	...

Black Diamond Group. This group of claims is owned by Pete Nicholson, Joe Lake, and another partner (name unknown). It is situated on the face of the mountain, lying in the bend where Jumbo creek joins Toby creek. The trail to the mine leaves the wagon-road before getting opposite it, so as to provide a reasonable grade, which it does by following along the mountain and steadily upward. The mine-workings are situated on the shoulder of the mountain, at an elevation of 7,600 feet, and in such a position as to give a view up Toby creek and also up the Jumbo fork.

The main workings are a series of tunnels on a small, true fissure-vein, which strikes N. 30° W. (mag.) and stands vertical. It cuts across the bedding-planes of quartzite and schist, which lie very flat and strike nearly east and west. An igneous dyke parallels the vein for some distance, with the same strike and dip and distant from 4 to 10 feet from the vein. This dyke consists mainly of hornblende largely altered to chlorite, and was probably diabase or diorite originally. The close relationship of this dyke with the vein suggests that it may have played some part in the formation of the vein. The dyke in places has a well-defined schistose structure and is from 10 to 15 feet wide, and is plainly intrusive into and across the quartzite country-rock. The vein is always to the west of the dyke, but in one place the hanging-wall of the vein is formed by the dyke.

No. 1 tunnel is at an elevation of 7,690 feet and is 125 feet long; in this working the vein varies from an inch to a foot in width. The vein-matter is usually quartz, but is sometimes schistose-rock matter, and the valuable mineral is galena, usually of the fine-grained or "steel"

variety. Some pyrite occurs, often entirely oxidized to limonite, and also traces of zinc-blende. The values are in silver and lead. A sample taken across 8 inches at the face of the tunnel assayed: Gold, 0.04 oz.; silver, 27.8 oz.; lead, 61.4 per cent. No. 2 tunnel is 65 feet below No. 1 and is 200 feet long; 175 feet from the portal a winze has been put down 10 feet. From a point 90 feet in the tunnel stoping has been done along 75 feet of the vein for some distance upward. A sample taken across 1 foot of the vein at the bottom of the winze assayed: Gold, 0.03 oz.; silver, 16.6 oz.; lead, 57 per cent.; while a selected sample of the galena carried 28.6 oz. of silver to the ton and 71.4 per cent. lead.

No. 3 tunnel is 200 feet below No. 2 and is 180 feet in length, and has a 15-foot crosscut to the east, near the face. No. 4 tunnel is 85 feet long and 65 feet below No. 3. The face shows 10 inches of vein-matter, but very little ore. These tunnels comprise the upper workings on the property, and from them, in past years, several car-loads of ore have been shipped. Not much ore is left in sight in these workings, but further development is needed. The hill where these tunnels are situated has a slope of about 45 degrees, and, as the vein runs up and down the mountain, development, therefore, is easy and cheap.

At some distance down the hill from the upper workings a good deal of development-work has been done. There is a big showing of white and rusty quartz, which, however, carries but little valuable mineral. On the west side of a small ridge a tunnel has been driven in 30 feet, which crosscuts a zone carrying several streaks of quartz up to 8 feet in width. The general strike of these quartz-bands is about the same as the vein farther up the mountain. On the east side of the small ridge a tunnel has been driven in 30 feet, with an upraise 20 feet high, and also several open-cuts dug, all of which are in quartz. The face of the tunnel is all quartz, rusty-coloured and crumbly; an average sample of this material assayed: Gold, trace; silver, 1.2 oz. Galena and sphalerite occur in small amount in this quartz, but only along seams and very irregularly. It would seem as if the quartz had been formed first, and that later a subsequent mineralization had taken place, depositing a little galena along slickensided seams in the quartz. About 10 tons of the best ore taken out of this working has been piled to one side at the portal of the tunnel. An average sample of this ore assayed: Gold, trace; silver, 6.6 oz.; lead, 9.9 per cent.; zinc, 6 per cent.

Two hundred feet below these workings a tunnel has been run in for 250 feet. For most of the distance this tunnel is driven through quartzite, but the direction of the tunnel having been altered for the last 50 feet, a quartz vein has been crosscut, which is probably the same as those just above. No mineral could be seen in this quartz, so no sample was taken.

Jumbo. This claim is situated on the south side of Jumbo creek, about four miles up that creek from its junction with Toby creek. The claim is situated on a steep, grassy, timbered hillside rising up from the creek, the showings being about 150 feet above the creek-level. The formation here is mainly quartzite, with a little schist. A large quartz vein striking N. 65° W. (mag.) and standing vertically has been slightly developed by two tunnels, the lower one of which is completely caved in. In places this vein is apparently 15 to 20 feet wide. The upper tunnel is 35 feet long and shows white, barren-looking quartz at the face. The only evidence of any valuable mineral was a few pieces of galena lying around the dump. A sample of this galena was assayed and found to contain 69.6 oz. silver to the ton and 73.2 per cent. lead. It is evident that quartz in this section of the country has no value in itself, as it never carries appreciable quantities of gold; so this property cannot be considered to have much value, as the amount of galena in evidence is very slight.

Charlemont. This claim is situated on the south-east side of Toby creek, at the head of an unnamed creek flowing into the former one, and nearly opposite the *Black Diamond*. The property was worked some years ago and a trail from the wagon-road runs up to it, which is now nearly impassable owing to the fallen trees, etc. The workings are just to one side of a small glacier at an elevation of 7,600 feet. A good cabin has been built at an elevation of 7,250 feet and in a good location to be clear of snowslides, the workings being on a shoulder north and east of the cabin.

The vein on this property is a small, quartz-filled fissure, striking N. 48° W. and dipping to the north, conforming in strike and dip with the schistose, quartzite formation in which it occurs. The width of the vein is from 3 inches up to 15 inches, and the ore-minerals are galena, grey-copper, and zinc-blende, and some iron oxide and azurite. An open-cut and short tunnel

show the vein in one place to be fairly well mineralized. A sample of carefully selected, high-grade ore assayed: Gold, 0.08 oz.; silver, 126 oz.; copper, 4.8 per cent.; lead, 47 per cent. There is, however, not much of this character of ore in evidence.

Twenty-five feet lower, another tunnel has been driven on the vein for 125 feet and a winze put down a few feet at a point half-way in the tunnel. In this working the vein does not look promising, as it consists mainly of barren, white quartz and is quite small. At the face the vein is 4 inches wide, and a sample of it returned a trace of gold and 1 oz. of silver to the ton.

Monroe's Claim.

On the trail to the *Charlemont* another cabin was seen at an elevation of 6,800 feet. A search was made and some workings were found, and it is believed the cabin and claim belong to a man named Monroe, but it is several years since anything was done on the property. The claim is situated on the same draw as the *Charlemont*, but lower down and on the opposite or easterly side.

A shaft was seen which was in bad condition and could not be descended, but, judging from the dump, the working was not in ore. Below this is a tunnel which bears to the south, and in 60 feet turns to the east for another 20 feet. The only thing to be seen in it is bands of quartzite and schist and an occasional streak of barren-looking quartz. Lower down the hill, at an elevation of 6,650 feet, another tunnel was discovered which is about 150 feet long in a north-easterly direction, and has a long crosscut to the south-east extending 150 feet, besides some shorter crosscuts. A few seams of white quartz can be seen in this tunnel, but no ore. It is believed this work was done to crosscut the formation in the hope of picking up an extension of the *Nettie M.* vein, but apparently without success.

Nettie M.

This claim is located down the hill below the last-described property and slightly to the east; it is Crown-granted and is owned by Charles Washburn. A considerable amount of work has been done on the property, consisting of open-cuts and adit-tunnels on the veins, from which several shipments of high-grade ore were made. The workings are at an elevation of from 5,525 to 5,800 feet.

The vein is a north-and-south fissure, following the bedding-planes of the quartzite and dipping slightly to the east. It runs up and down the hill, thereby enabling it to be worked by drift-tunnels. All the workings were in a bad state, many of them being caved in. There are six or seven tunnels, all driven on the vein, and stopes between some of them. The vein is generally filled with quartz, but, where it is valuable, it contains galena and grey-copper. Practically no ore could be seen in any of the old workings, the tunnels and stopes having stopped when the vein became barren. The vein is small, averaging perhaps 1 foot, but in one place on the surface it has swelled out to 5 or 6 feet of barren, white quartz.

At an elevation of 5,750 feet there are two tunnels about 50 feet apart, both of which are badly caved, but it is evident that a good deal of the ore shipped came out of them. The face of the lower one shows a few inches of quartz at the face. A few pieces of good ore have been left lying around the mouth of this tunnel, and a sample of this was taken to get an idea of the grade of the ore; it assayed: Gold, 0.2 oz.; silver, 69.6 oz.; lead, 71.8 per cent. This gives an idea of the galena ore, while it is said that the grey-copper carried very much higher values in silver.

At 5,650 feet elevation there is a short tunnel 80 feet long, and at 5,600 feet another one which goes in 300 feet, and has a 70-foot crosscut to the west from a point half-way in. This adit is driven on the vein and shows a small quartz vein all the way, but no ore. No samples of the quartz were taken, but the unmineralized quartz in this section never carries appreciable values.

At 5,525 feet there is a comfortable cabin erected, and near by is a short tunnel in 30 feet, which again shows some quartz. It would seem that on this property the vein had contained one shoot of good ore, but that all later development had failed to find another. Further work could hardly be advised, as it would be in the nature of a very "long shot."

There are many other claims on the main Toby creek on which some prospecting has been done, but those already described are the more important ones and no others were examined by the writer.

From here the outfit proceeded down Toby creek to where the North fork comes in, and then up to the head of that creek. Camp was made in the *Hot Punch* cabins and a number of claims in the vicinity were examined.

NORTH FORK OF TOBY CREEK.

The North fork of Toby creek rises in a glacial basin and flows easterly for about seven miles to where it joins Toby creek, twenty-two miles above Athalmer. The branch stream enters the main one through a canyon, but above that it widens out considerably. The principal claims are near the head of the creek and on Delphine creek, a tributary coming in near the head. A wagon-road runs up the creek and was completed two years ago to the *Hot Punch* group, situated right at the head of the creek.

Hot Punch Group.

This group of five Crown-granted claims is owned by Ed. Stoddart, Mrs. Stoddart, Evelyn Stoddart, H. F. Collet, Perry, Robeson, Ben Abel, and the Starbird Estate, and was staked many years ago. In 1914 the property was secured by a San Francisco company under lease and bond, and in August work was commenced under the superintendence of Dr. Schurz. He put up some excellent camp buildings, built two or three miles of wagon-road, and did some development-work on the property. By the spring of 1915 the company was in debt to the extent of several thousand dollars for supplies and wages. Work was discontinued, and about this time Dr. Schurz, who is a German, was taken to the internment camp for enemy aliens at Vernon.

The money was not judiciously spent by Dr. Schurz, and the company directors in San Francisco say that he was not authorized to do what he did; hence, they will not pay the bills. It is understood that the owners of the property have cancelled the company's option and may go ahead themselves with further work next year.

The workings on the group develop a small well-defined fissure-vein, one end of which is exposed at the foot of a small cliff and not far from the terminal moraine of an overhanging glacier. The vein is traced along through a patch of heavy timber and several openings have been made on it. It is somewhat irregular in strike, but the general direction is about N. 25° W. (mag.) and dips to the west at from 25 to 50 degrees. The formation in which it occurs is best described as a quartzose schist, as there is very little true quartzite in evidence. The vein varies in width from a few inches up to 2 feet and consists of quartz, calcite, siderite, galena, sphalerite, pyrite, arsenopyrite, and some grey-copper.

The most westerly opening on the vein is a shaft 78 feet deep, at an elevation of 6,940 feet. At the time of examination this was filled to within 20 feet of the top with water. The vein where seen is from 1 to 3 feet wide and is quite well mineralized. A sample of the best-looking ore assayed: Gold, 0.05 oz.; silver, 39.2 oz.; lead, 66.6 per cent. Some of the ore shipped from the property in previous years came from this shaft, and there is some still on the dump. A short distance to the north there is another shaft, evidently shallow, which is entirely caved in. One thousand feet north-easterly from the shaft a tunnel has been driven 96 feet on the vein. The width of the vein in this working is from 6 inches to 2 feet, and it is fairly well mineralized. A sample across 11 inches at the face, which gives a fair idea of the whole ore-shoot, returned 48 oz. silver and $1.20 in gold to the ton and 45.8 per cent. lead. Fifteen feet below, another tunnel has been run in 90 feet. At the face the vein has practically disappeared, but it is probable that the tunnel has followed a stringer to the right of the main vein. Both these tunnels have had some stoping done from them. A grab sample of a 50-ton ore-dump from the upper tunnel assayed: Gold, 0.1 oz.; silver, 49.3 oz.; lead, 38 per cent.; zinc, 7.9 per cent.

Continuing down the hill from the last working, the vein has been stripped in places, and at an elevation of 6,870 feet there is a tunnel driven in for 78 feet. From 1 to 8 inches is the width of the vein in this tunnel, and consists mainly of quartz and siderite, with but little galena.

Some distance below this another tunnel was run in for 150 feet or more by Dr. Schurz in the winter of 1914-15. This tunnel is practically waste work, as it is driven nearly parallel to the vein and at a considerable distance to one side of it.

In conclusion, it may be said that the property has a well-defined fissure-vein, well mineralized in places, which fully warrants further development. Wood and water are plentiful, right at hand, and the property is nicely situated for economical working.

Kootenay Queen.

This property is situated at the head of a small creek coming into the south side of Toby creek two miles below the *Hot Punch* cabin. It is at an elevation of 7,250 feet, and it is a rather steep climb, up an old trail from the wagon-road, to reach the property. A tunnel has been run in 140 feet on a small vein occurring

in quartzite and lime and striking N. 30° W. (mag.) with the formation. The greatest width of the vein is 1 foot, and for most of the length of the tunnel there is nothing but a good wall. The vein-filling is quartz, but there is very little mineralization to be seen, only a few small pieces of galena being visible. A sample of the galena was taken to see what silver values it carried, and was found to contain 31.8 oz. silver to the ton and 64.6 per cent. lead. This claim cannot be considered to have much prospective value.

Cody & McAndrew's Claims.

On the same mountain but nearer the *Hot Punch*, that is, higher up Toby creek, there are some claims the names of which could not be learned. They are owned by Cody & McAndrew and work has been done on them recently. A good trail has been constructed part way up, but not finished. The work consists of some tunnels and shallow cuts; the tunnels are apparently not driven on the vein and are of slight value. The open-cuts show a vein carrying in places 8 inches of solid galena and up to 30 inches of quartz and galena mixed. A sample of the solid galena returned 30 oz. of silver to the ton and 65.8 per cent. lead.

DELPHINE CREEK.

Delphine creek joins the North fork of Toby creek about a mile below the *Hot Punch* cabins, and on its easterly side a number of claims have been located. The more important of these are the *Delphine, Tilbury and B.C.*, and the *Beulah*, although practically no work has been done on the latter. A trail leaves the wagon-road below Delphine creek and climbs steadily up to the *Delphine*, and then on to the *Tilbury and B.C.;* beyond that, a rather rugged goat-track leads to the *Beulah*. From the higher points of this trail a beautiful panorama of alpine scenery can be viewed. At the head of Delphine creek a magnificent glacier cascades over an 800-foot fall to form the source of the creek, while beyond the glacier a massive peak looms up. Looking towards the head of the North fork, four or five glaciers and ice-fields can be seen, which are at the divide of the great Purcell range, and the waters from which finally find their way into the Columbia.

Delphine Group.

This group, situated on Delphine mountain about one mile and a half from the wagon-road on the North fork of Toby creek, is owned by R. R. Bruce and Mrs. Kimpton. It is now several years since any work was done on the property, and the cabins and workings generally are in bad repair. Several car-loads of high-grade ore was shipped in former years.

The vein is a small one of the usual type, striking nearly with the formation and being mineralized in irregular ore-shoots. There was a very nice ore-shoot where the vein was discovered and worked, and development has gone to the point of extracting the available ore and stopping work always where the vein became barren. Further work to prospect the vein in the hope of finding new shoots of ore must be considered as a speculation, but since the vein is known to have been mineralized in one section it is at least reasonable to suppose other pay-shoots could be found.

The main working is a shaft on the vein 30 feet deep, with a drift 146 feet to the east, where an incline raise goes up to the surface 60 feet above, and a drift 70 feet to the west, and a shallow winze which was full of water at the time of examination. It is believed that other drifts have been run from this winze at a lower level. From the bottom of the shaft and drifts therefrom most of the ground to the surface has been removed by stoping. On the surface the vein has been stripped in places, and where ore showed it was removed by underhand stoping. The vein strikes N. 60° W. (mag.) and dips at 65 to 80 degrees to the north-east. The formation in which it occurs is almost entirely limestone, with a little siliceous limestone and quartzite. The vein is very distinct between the walls and has an average width of between 10 and 18 inches. The vein-filling is quartz and the ore-minerals are galena, sphalerite, and grey-copper. Seven hundred feet south-east of the shaft some more surface underhand stoping has been done; these workings are more or less caved in and in bad repair. Farther to the south-east there is a tunnel 30 feet long showing a quartz vein 12 inches wide, which is probably the same vein, but carried no values.

It is understood that the ore that was shipped averaged about $100 a ton in silver and lead. The writer took no samples because there is really no ore left to be sampled, and it would only be misleading to sample the lean places in the vein where work has been stopped

in each drift and stope. The property was well equipped with cabins, ore-sorting sheds, blacksmith-shop, etc., but these are now in bad repair and have partly fallen in owing to the weight of snow in winter. The elevation at the cabins is about 6,900 feet.

Tilbury and B.C. Group.

Continuing along the trail on Delphine mountain beyond the *Delphine* claim to a height of 8,830 feet, the *Tilbury and B.C.* group of claims is reached. The number of claims in the group could not be learned, but there are at least two, which are Crown-granted; the owners are H. E. Forster and Mrs. R. Kimpton. Five or six cars of ore have been shipped during previous years, having been taken out by pack-train at considerable expense. The workings are situated on the steep, rocky mountain-side well above timber-line, and in such a position as to make it highly undesirable to try to work in winter, although it is said this was done. The vein runs along the mountain as a contour-line, thereby necessitating either shafts or crosscut tunnels to develop it. It strikes N. 70° W. (mag.) with the formation and dips slightly to the north-east.

The width of the vein is usually from 6 to 18 inches, and consists of quartz, often oxidized and rotten, galena, and grey-copper. The main working is a shaft 50 feet deep and drifting from the bottom in both directions. For a length of 250 feet and to the bottom of the shaft the vein has been practically all stoped out. Below this there is a short tunnel which probably taps the shaft, but it was caved and full of muck. About 1,000 feet to the north there is a short tunnel 30 feet long which shows a little ore.

The last work on the property was done by a lessee, and there is now on the dump about a car of ore taken out and sacked, but never shipped. It is said that an injunction was taken out at the time by the owners preventing the lessee from shipping this ore.

The following samples were taken by the writer:—

Description.	Gold.	Silver.	Lead.	Copper.
	Oz.	Oz.	Per Cent.	Per Cent.
Across 4 inches solid ore at face of stope	0.05	98.2	64.6	2.8
Across 18 inches mixed ore in a stope	0.05	38.2	11.8	1.7
Grab sample of sacked ore on the dump	0.03	61.4	49.4	1.7

It is doubtful if this grade of ore can be made to pay at this place, as the expense of packing it about four miles down a steep trail to the wagon-road, added to other charges, would leave very little profit.

Beulah.

This claim is situated some distance above the *Tilbury and B.C.*, at an elevation of about 9,500 feet. There may have been a trail up to it at one time, but this is now practically obliterated, and to get up to it is a somewhat difficult climb. There are two claims in the group—the *Beulah* and *Homestake*, owned by Al Palmer, G. A. Stark, Larabee, and Charles Fitzsimmons. Practically no work has been done on the property, although it has been staked for a number of years. It nearly constitutes an assessment to climb up to the property.

The vein has a strike of N. 50° W. and dips at 75 degrees to the north-east. It is from 1 to 3 feet wide, consisting of quartz, liberally mineralized with galena and grey-copper. Near the top of a steep hogsback running down from the peak of the mountain there is an open-cut on the vein with a 50-foot face and the commencement of a tunnel. A sample of selected ore containing a lot of grey-copper which was taken assayed: Gold, 0.1 oz.; silver, 471.2 oz.; lead, 13.8 per cent.; copper, 15.8 per cent. In conversation with one of the owners later on, the writer was told that there was another open-cut farther up the ridge in which the vein shows up well. This property is badly handicapped by its inaccessibility.

BOULDER CREEK.

Boulder creek is a tributary of Horse Thief creek lying to the north-west of Toby creek and having its headwaters near those of the North fork. From the wagon-road up Horse Thief creek a trail extends up Boulder creek, but this is not now in very good repair owing to fallen timber and slides. The most prominent feature on Boulder creek is Boulder mountain, which is on the north-west side between that creek and Law creek, and rises to a height of 10,556 feet. As usual, the country on both sides of the creek is very rugged, and on both sides the frequent

places devoid of timber show the favourite routes of snowslides. A number of claims have been staked along this creek, but none are of great importance. From the *Paradise* mine at the head of Spring creek it is only a short climb to the divide between that creek and Boulder, and the travelling from there down to Boulder creek is fairly good.

Black Prince. This claim is situated over the divide from the *Paradise* mine on the Boulder Creek slope at an elevation of 6,800 feet. On it there is a small quartz vein, in a slate formation, striking north-west (mag.) and dipping to the south-west at 60 degrees. There are three tunnels on the property, one 25 feet long driven on the vein, with a 15-foot winze; another is 90 feet long to the right of the vein and showing no ore; and one only in a few feet with nothing in it as yet. The quartz is slightly mineralized in places with copper pyrites, but no sample was taken as the whole showing is of but slight importance.

Delos. This claim is on the north side of Boulder creek and at an elevation of 6,200 feet, only a short distance up a steep bank from the creek itself. There are said to be four claims in the group, presumably all Crown-granted, as they were staked many years ago. The present owner is unknown, but in the 1898 Report of this Department Tom Jones, of Golden, was given as the owner.

The formation here is a schistose slate, with the line of schistosity dipping nearly vertically. The strike is very irregular, but is roughly N. 60° W. (mag.). Striking with the formation is an irregular quartz vein often split up into stringers, but in places attaining a width of 5 feet. The quartz is well mineralized with chalcopyrite, and in some places there are solid bunches of this material. The workings consist of a few open-cuts and a tunnel which is completely caved in. A sample across 3 feet taken from one of the cuts assayed: Gold, 0.02 oz.; silver, 0.8 oz.; copper, 9.6 per cent.; while a selected sample of the chalcopyrite gave 0.8 oz. silver to the ton and 27.6 per cent. copper. The vein is very bunchy and pinches quickly, but somewhere it might carry a nice lens of ore.

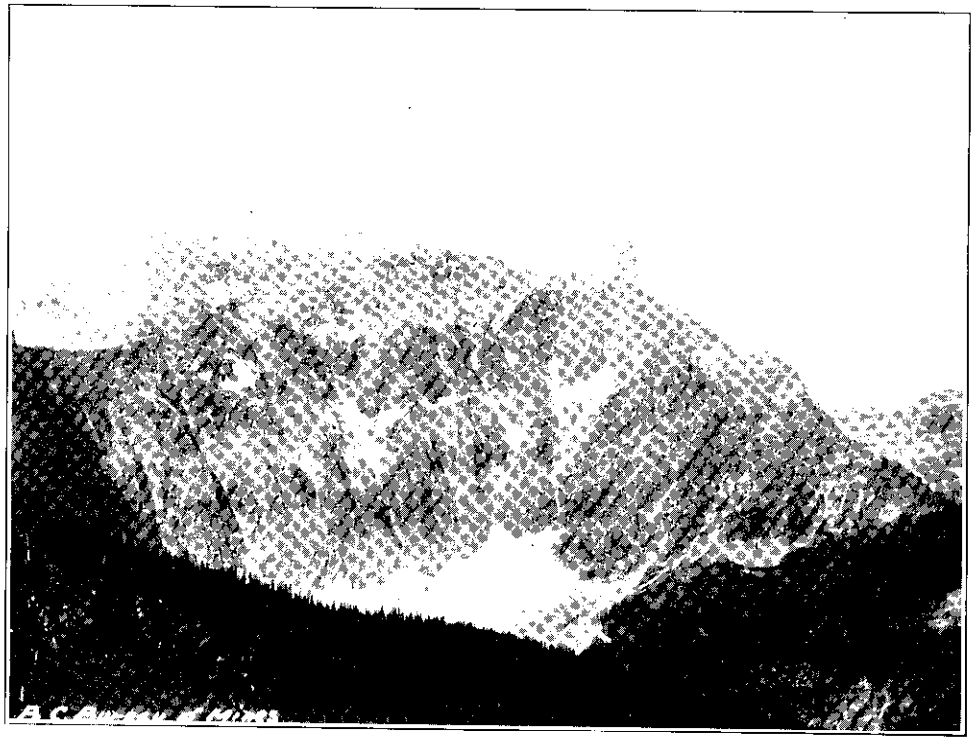
Sitting Bull Group. This group of claims is situated on the south side of Boulder mountain looking down into Boulder creek. These are also old claims on which no work has been done for years. Frank Stockdale, Invermere, is one of the owners and controls the group. The writer only saw some of the lower showings at an elevation of 8,050 feet, as he was assured that the upper tunnels would be full of ice. The lower workings consist of a shaft, tunnel, and some open-cuts. The cuts show a vein striking with the bedding-planes and carrying a pay-streak of stibnite and galena. This pay-streak is irregular and is generally not more than a few inches wide, but occasionally runs to a foot. The shaft is 80 feet deep, but could not go down to examine it. The surface shows a nice-looking vein, from 2 to 3 feet wide, well mineralized with streaks of galena and stibnite. A selected sample of the sulphides assayed: Gold, 0.05 oz.; silver, 43.6 oz.; lead, 38.8 per cent.

The tunnel is a crosscut 80 feet long and at the face shows a vein of quartz 3 feet in width carrying iron, but no ore. It is by no means certain that this is the same vein as is developed by the shaft, but is probably the same as one showing in an open-cut where it carries a little ore. It is understood that a small shipment of ore was packed out from the property some years ago.

LAW CREEK.

Law creek is a tributary of Horse Thief, which rises in a glacier north-west of Boulder mountain and flowing north-easterly for eight miles joins Boulder creek, and thence flows to the main stream, a further distance of three miles. From the Boulder Creek trail a branch trail goes off up Law creek right to its head. This trail is not in very good repair, but it is just possible to get horses over it. Most of the claims staked on this creek have never had much work done on them, and in some cases Crown-granted claims have been allowed to revert to the Crown owing to non-payment of taxes.

Pretty Girl. *This claim is now owned by Lionel J. Peake and Cornwall, and last* summer they staked some claims adjoining which had been staked before and allowed to lapse. The property, which was fully described by the *Provincial Mineralogist in the 1898 Report of this Department, is situated right on the ridge* between Boulder and Law creeks, at an elevation of 8,800 feet, and directly north-east of the peak of Boulder mountain. The shaft on the ridge was full, not of water, but of ice. The tunnel, *which starts from a short distance down the Boulder Creek side about 50 feet below*



Mt. Farnham—Windermere M.D.

Glacier at Head of Iron Cap Basin.

the shaft, was nearly altogether caved in. The writer managed to get in 60 feet, but could not get beyond that. The tunnel has evidently followed a vein, which varies from a seam up to 10 inches in width, consisting of quartz somewhat stained with malachite (copper carbonate). The ore in the shaft, some of which was shipped and some specimens of which are still to be seen on the dump, carried grey-copper with, it is said, high values in silver. The writer picked up a few pieces of the best-looking ore from the shaft dump which on assay returned 38 oz. of silver to the ton and 20.8 per cent. copper. This assay does not agree very well with statements regarding the ore, but does agree with one given by Mr. Robertson in his 1898 Report, where he says: "A fairly representative sample of this ore gave me, on assay, 26.68 per cent. copper, 55.5 oz. silver to the ton." The lower tunnel mentioned in the previous Report is now entirely obliterated by slides.

The property may have merit, but it seems unlikely that the original owners would have abandoned it if much encouragement had been found in the lower workings.

Iron King Group.

On the other side of Law creek and nearly directly opposite the peak of Boulder mountain is the *Iron King* group, owned by Frank Stockdale. There is a considerable exposure of siderite on this property, occurring as a wide band running up and down the mountain. A tunnel has been driven in 30 feet, following a schistose talcy seam a few inches wide lying between walls of lime and siderite. The writer did not see any ore, but it is claimed that in places the siderite, which weathers to a rusty brown, contains nodules of galena.

Another property which the writer should have examined is the *Mabel R.*, owned by R. R. Bruce and situated on the divide between Law and Horse Thief creeks, a short distance east of the *Iron King*. At the time it was thought that the *Iron King* was the *Mabel R.*, but the mistake was found out later. This latter property is said to have a good showing and to contain some very fine specimens of lead sulphate.

No other claims of much importance were heard of in this section.

McDONALD CREEK.

McDonald creek takes its source in a number of glaciers near the foot of Mount Farnham. It flows nearly northerly for seven miles to where it joins Horse Thief creek. It is a rapid stream flowing through a rugged piece of country, and goes through quite a canyon before joining Horse Thief creek, showing very clearly the hanging valley system developed by the glaciers along the main stream.

Ptarmigan Mines.

The Ptarmigan Mines property, on which considerable money was spent in former years, is situated at the head of the creek. A full description of this property will be found in the Minister of Mines' Report for the year 1903. Several thousand feet of tunnelling was done on the property, driving on veins which in places carried masses of iron pyrites. Associated with this pyrite in small quantities was tetrahedrite which contained high silver values. The total amount of this tetrahedrite was, however, small, and the bulk of the iron carries but little value. Even the pyrite is by no means continuous, but occurs in bunches, and for long distances the veins contain no metalliferous minerals. Assay plans of some of the workings seen by the writer show that the values on the average are much too low to constitute pay-ore. The rich ore near the surface was soon all extracted and shipped. Besides the underground workings, the company erected good mine buildings, a steam-driven compressor plant, and an aerial tramway from the mine-workings to the wagon-road. There is no doubt that the mine will never be reopened again, and there is also no doubt that a great deal more money was spent on the property than ever its showing of ore warranted.

Tecumseh Group.

This group of two claims is situated in the basin at the head of Iron Cap creek. It is owned by Tom Brown and Haupt. This property was also worked to some extent several years ago and some ore shipped, but now the workings are solid with ice; the elevation is close to 9,000 feet, and ice forming in the tunnels in winter never thaws out in summer. The lowest tunnel is 55 feet long, the next one is 30 feet above the first and 110 feet long, and 20 feet above there is another one in 20 feet. The owners had just started work on the property when it was visited by the writer, and were engaged in sorting over an old dump and blasting the ice and frozen muck out of one of the

tunnels in order to recommence mining. The vein could not be seen even on the surface, as it has been underhand-stoped, and these stopes are now caved in, so the writer cannot tell very much. The formation is lime, siderite, slate, etc., with quartz stringers running through. The vein is said to be from 1 to 2 feet wide and to have a fair-sized pay-stream of galena, lead carbonates, zinc-blende, and grey-copper in small amounts. One sample of the ore which was taken from the dump assayed: Gold, 0.06 oz.; silver, 116.2 oz.; lead, 60.6 per cent.; copper, 1.8 per cent.; and another one: Gold, 0.07 oz.; silver, 148.4 oz.; lead, 36.8 per cent. These values are sufficiently encouraging to warrant a further search for ore.

Silver King. This claim is situated on the south side of Iron Cap creek, a short glacial creek which is one of the branching feeders of McDonald creek at its source. The claim is now owned by Larabee & Sons, of Wilmer, who restaked it a few years ago. Practically all the development-work done on it was done by the Ptarmigan Mines, Limited, which at one time either owned or had an option on the claim.

The country-rock here consists of blue and grey lime, argillites, quartzites, and slates, striking roughly north-west. A small fissure conforming to the strike of the formation has been developed by a tunnel 250 feet long. Very little ore can be found in this fissure, as it consists for the most part of altered country-rock. In one place in the tunnel there is a little bunch of ore 6 feet long and 4 to 12 inches wide consisting of galena and zinc-blende. Sixty-five feet above this tunnel there is an open-cut showing from 2 to 6 inches of sulphides—mostly sphalerite—lying between decomposed red rusty rock-matter. In one other place a tunnel has been faced up on the vein and an inch streak of ore is showing.

A sample of selected galena assayed 45.4 oz. of silver to the ton and 56.0 per cent. lead, while another containing some zinc-blende assayed: Silver, 56.8 oz.; lead, 32.4 per cent.; zinc, 20.7 per cent.

The actual amount of ore taken out in development-work has been slight. An 11-ton shipment is reported to have been made during 1915, and this represented a clean-up of all the available ore already extracted.

FRANCES CREEK.

Frances creek (formerly called No. 3 creek) lies a short distance to the north of Horse Thief creek, and joins Forster creek (formerly No. 2 creek) some seven miles above the junction of the latter with the Columbia river, about eight miles below Windermere lake. For most of its distance Frances creek flows nearly parallel to the Columbia river, but in the opposite direction, from which it is separated by a detached low mountain-mass called Steamboat mountain. Along Frances creek there is a wide valley for some distance which contains a considerable acreage of good agricultural land; the production is, however, not very great as yet.

A wagon-road, which leaves the main road up and down the Columbia river at Forster's ranch, runs up Frances creek for some distance and goes through a low pass to the Salmon river, and joins the main road again near Spillimacheen. The claims on the upper part of Frances creek are reached by trail extending from the wagon-road up to the head of the creek. The lessees of the *Lead Queen* have just finished a road some fourteen miles long, following this trail to some extent, to the mine, which is only a few miles from the head of the creek. Ore taken out from the mine would be hauled out to the railway at some point near Spillimacheen or Galena.

Lead Queen Group. This group of five claims is situated near the head of Frances creek. A wagon-road extended to within about fourteen miles of the property at the time it was examined, but it is believed that a road has now been completed to a point a short distance below the mine-workings by the lessees. The claims are not Crown-granted and are owned by Tom Brown, of Wilmer, and C. Cartwright, of Vancouver. In August, 1915, the property was acquired under lease and bond at a price of $10,000 by Burgess & Barry, of Athalmer, who immediately commenced the building of the wagon-road and are now mining ore on the property. It is expected some ore will have been hauled out this winter to some point on the Kootenay Central Railway.

The vein on the *Lead Queen* is a clean-cut, well-defined fissure following the bedding-planes of a quartzite formation which at times changes to argillite. It varies from 2 to 4 feet in width and carries in places a nice pay-shoot of solid galena and lead carbonates. The vein-matter is

partly oxidized and often rusty-coloured from the oxidation of pyrite to limonite, and on either side of the vein there is generally a well-defined talc gouge. The strike of the lead is to the north-west (mag.), with a south-westerly dip.

Workings on the property consist of two tunnels and a large open-cut 125 feet above the upper tunnel. In the cut the vein is about 3 feet wide, of which 20 inches is galena, practically solid. Surface weathering has partially leached the ore at this point. A sample across 22 inches in this cut assayed: Silver, 37.8 oz.; lead, 65.5 per cent.

The upper tunnel is a crosscut; for 96 feet it goes through slide-rock, then for 51 feet through quartzite and argillite to where it strikes the vein, and then a further distance of 138 feet beyond the vein in the usual country-rock. The vein has then been drifted on for 20 feet to the north-west and 140 feet to the south-east. A sample across 8 inches half-way in this drift returned 40.8 oz. silver to the ton and 67.8 per cent. lead. At the face of the short drift there was 8 inches of galena and 10 inches of decomposed rusty material, mainly lead carbonate; a sample of this latter returned 33.4 oz. silver to the ton and 36.4 per cent. lead.

At the end of the long drift the vein has turned until it is striking nearly due west (mag.) and has pinched down, but it is probably only following a fold in the formation and may be expected to swell out again. From the tunnel there has been taken from 50 to 75 tons of ore which is piled on the dump; a grab sample of this assayed 29.4 oz. silver to the ton and 40.1 per cent. lead, and a representative sample of the ore as it would be sorted before shipping returned 39.4 oz. silver and 61.3 per cent. lead.

The lower tunnel is 400 feet below the upper one and about half a mile away. It has been run in 300 feet with some drifting, but no ore was encountered. It was run as a crosscut to strike a supposed extension of the previously described vein. The tunnel is of little value, as it neither proves nor disproves the continuity of the vein.

Steele Group.

Situated over the summit from the *Lead Queen* is the *Steele* group, consisting of the *Steele No. 1* and *Steele No. 2* claims, and owned by J. H. Scott, John Williamson, Frank Cottle, and Samuel Cobb. The workings are on the steep side of a rocky basin at the head of a small creek and are at an elevation of 7,630 feet.

The vein is supposed to be a continuation of the *Lead Queen* vein, but this is by no means certain. The formation is the same, the character of the vein similar, and the line of strike not far off that of the *Lead Queen* vein. A crosscut tunnel 60 feet long strikes the vein, but no drifting has been done on it. The vein is about 2 feet wide, largely filled with decomposed quartzose rock, but showing streaks of fine steel galena throughout, the largest one seen having a width of 8 inches; a sample of this streak returned: Gold, 0.02 oz.; silver, 34.6 oz.; lead, 56.9 per cent.

Above the tunnel the vein is exposed for 200 or 300 feet on the surface. Several shallow pits and cuts have been made, but these are mostly filled in again by loose slide-rock. These surface showings look promising, a width of ore up to 18 inches and 2 feet occurring often.

McLean Group.

McLean creek is a small tributary flowing into Frances creek a short distance above the *Lead Queen* cabin. A steep mountain rises up in the bend between these two creeks, and on it there is a steep hogsback near the summit and facing out on to the creeks, on which is located the *McLean* group of claims at an elevation of 7,000 feet; the present owners are unknown.

The vein is of the usual type of small fissure occurring in quartzite and greyish lime, and striking north-west (mag.), with a south-westerly dip of 70 degrees. Several open-cuts have been made along the vein, and others not on the strike of this vein, which show rusty decomposed places in the quartzite, which probably represent the oxidation of original iron and lead sulphide.

A tunnel 25 feet in length on the face of a very steep cliff shows the vein to be from 8 to 15 inches wide, largely consisting of iron oxide and sulphide and talcy material, but containing streaks and nodules of galena. A sample across 10 inches of rusty material, which was considered as containing lead carbonate, only returned 5.2 oz. silver and 2 per cent. lead. A sample of clean galena, however, gave: Gold, 0.04 oz.; silver, 114.2 oz.; lead, 68.6 per cent.

More or less mineralization is evident in all the cuts, and somewhere a fair-sized shoot of galena ore might be found. The property is, however, somewhat inaccessible, and the old trail to it is practically obliterated.

Isaac.

This is a Crown-granted claim owned by H. E. Forster, M.L.A., of Wilmer, and is situated near the head of Isaac creek, a short stream entering Frances creek a few miles below the *Lead Queen* cabin. The trail up the creek to this claim, and also to others, is nearly gone owing to slides and windfalls and the growth of young brush. The old camp was at the edge of a very small rock-bound lake, and the claim workings on a bluff rising up from the opposite shore of the lake. The vein apparently runs along a narrow ledge in this sheer precipitous bluff, and is only accessible from one end where a talus slope makes a possible approach. There are four openings along the strike of the vein. The first one shows some siderite and nothing else; the next had a little ore lying flat on the surface, apparently broken over, but on going down 15 or 20 feet there is nothing but a seam along a quartzite wall; the third open-cut shows nothing but schist and limestone. The last opening is a large shaft 15 feet deep with water in it, which prevented seeing the bottom. Here a nice vein 18 inches to 2 feet in width, of solid galena and pyrite, is exposed. From this shaft about 30 tons of good-looking ore has been taken out and precariously perched on the narrow ledge. A sample of this dump which would represent roughly sorted ore assayed: Silver, 34.8 oz.; lead, 70.1 per cent. The strike of the vein is west of north following the strike of the formation. Quartzite, limestone, and some schist make up the country-rock, but in the slide below the bluff there is a quantity of hornblendic chloritic rock evidently coming from a large dyke of this material higher up.

BUNYAN GROUP.

This group of five claims is situated on Bunyan mountain just north of Goldie creek and about six miles from Invermere in a south-westerly direction. The claims are the *Lucille*, *Bunyan*, *Pilgrim*, *Christian*, and *Dreadnaught*, owned by Richard Moreland, Dave Jackson, Rufe Kimpton, W. W. Taynton, and J. H. Taynton. The elevation of the claims is around 4,100 feet.

The ore-deposit here consists of parallel lenses or stringers of barytes and lime occurring between walls of slate. The chief valuable mineral is chalcopyrite and a small amount of malachite and azurite, which are oxidation products of the sulphide mineral. The lenses of barytes are somewhat irregular, but have a general strike of north-west and dip to the south-west at 45 degrees.

The main working is a tunnel 60 feet long, with a drift 30 feet from it along one lens of ore; near the end of this drift there is a winze 20 feet deep and a 10-foot crosscut going back out the hill. Besides this, there are a few open-cuts above the tunnel, and at some distance to the north along the hillside there are some more cuts showing barytes with copper-stain.

The mineralization with copper is very irregular, and although the barytes is often up to 15 or 20 feet in width, there is not usually more than a foot or two of good-grade ore; specks of copper sulphide can be found in most of the barytes. The following samples were taken:—

Description.	Gold.	Silver.	Copper.
	Oz.	Oz.	Per Cent.
Upper open-cut, across 2½ feet	Trace	0.6	0.75
Across 4 feet at face of short crosscut from tunnel	Trace	2.6	0.43
Across 2 feet at face of main tunnel	Trace	0.6	20.5
Sorted ore from dump	Trace	8.6	5.9
Grab sample of main dump	Trace	1.4	1.9

The silver content of the ore apparently bears no relation to the copper content, and it would therefore seem as if the silver did not occur in association with the copper sulphide. No other metallic mineral in appreciable quantities was noted by the writer, but it might be worth while to find out what the silver-bearing mineral is, as in rejecting all but copper-bearing material silver ore may be overlooked.

Further work might be advisable in stripping the vein on the surface in the chance of finding a pay-shoot of good size and length. One car of ore was shipped from the property containing somewhere about 6 to 8 per cent. copper. At the present time it would hardly be possible to handle at a profit any ore lower than this in grade. The property is nicely situated for easy working and plenty of timber is available.

FINDLAY CREEK.

Findlay creek rises in the main range of the Purcell mountains, and flowing easterly enters the Kootenay river just south of Canal Flats. A small amount of placer-mining has been carried on along this creek at different times in past years. It was reported that some work had been done on the creek during the summer of 1915, so the writer went to Canal Flats and then up the creek to see what had been done. It was found that the total amount of gold taken out was limited to a couple of hundred dollars taken out by one or two old-timers with rockers, and that a few others had spent a short time on the creek panning gravel more as prospecting than anything else. It is doubtful if there is much gravel on the creek that would pay to work in a modern way, as it has been tested many times and always later abandoned.

SOUTH-EAST KOOTENAY DISTRICT.

FORT STEELE MINING DIVISION.

REPORT BY N. A. WALLINGER, GOLD COMMISSIONER.

I have the honour to submit a report on the progress of mining in the Fort Steele Mining Division for the year 1915.

The following table shows approximately the number of mineral claims held during each year since 1899:—

Year.	Held under Crown Grant or Certificate of Improvement.	Certificate of Work.	New Locations.
1899	37	718	729
1900	71	704	470
1901	104	642	455
1902	117	451	253
1903	142	335	200
1904	167	260	169
1905	189	193	181
1906	241	235	160
1907	254	160	115
1908	264	150	100
1909	280	154	116
1910	294	161	179
1911	307	167	96
1912	316	143	145
1913	319	139	104
1914	345	189	179
1915	350	203	114

Although the public interest in mining has been maintained, the abstract mining possibilities of last year were not replaced by concrete development, and consequently, with the exception of the Consolidated Mining and Smelting Company of Canada, there is no other company doing permanent work in the district. In 1915 a good many mining engineers made examinations and reports, and in almost all cases the results seem to be satisfactory, as arrangements have been made for work to commence as soon as the snow is off, but, in spite of this, the year did not come up to expectation.

The *Sullivan* mine, the property of the Consolidated Mining and Smelting Company, shipped 44,084 tons last year, and the *St. Eugene*, belonging to the same company, 288 tons, all of which was shipped to Trail smelter.

The new adit tunnel for the more economical working of the *Sullivan* mine is now in over 1,600 feet, of which about 1,300 feet was in broken and loose country; when the tunnel is completed the ore-extraction can be much accelerated.

The Perry Creek section did not show any great development, although it received a great deal of inspection from outside mining engineers, with, as far as can be ascertained, favourable reports.

The St. Mary River section also received attention, and the large copper-deposits, which, unfortunately, are far from transportation, came in for favourable comment. It is only large companies who can work this section with advantage.

OFFICE STATISTICS—FORT STEELE MINING DIVISION.

Mineral claims recorded ("B")	101
Placer claims recorded or rerecorded ("B" placer)	13
Certificates of work ("E")	203
Certificates of improvements issued ("G")	6
Conveyances and other documents of title (bills of sale)	42
Partnership agreements	2
Gold Commissioner's permits	2
Documents filed	34
Affidavits filed	232
Mining leases issued	1
Mining leases in force	39
Free miners' certificates (ordinary)	261
Free miners' certificates (company)	1
Free miners' certificates (special)	1
Crown grants issued	5

Revenue.

Free miners' certificates	$1,306 25
Mining receipts	1,061 25

FORT STEELE MINING DIVISION.

NOTES BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

INTRODUCTORY.

From August 30th to September 13th, 1915, was spent by the writer in examining some of the claims in the Fort Steele Mining Division, including the *Sullivan* mine, the most important lead-zinc mine in British Columbia or Canada. Other sections visited were Perry and Wild Horse creeks and claims on Whitefish and other creeks tributary to St. Mary river. Only placer-mining is being done on Wild Horse creek, while on Perry creek, in addition to placer-mining, some very low-grade gold quartz veins, which have been known of for years, have recently again had attention turned to them.

Copper-deposits on the St. Mary river and tributaries have been known for some time, and on some of these a little development has been carried out. The most important are those on Whitefish creek, owned by the Evans Bros., and these were examined by the writer.

This district was one of the first prospected and best known in the Interior of British Columbia, and hence no extended description is needed here. It is interesting to note that Wild Horse creek was about the first important gold-placer creek worked by the California miners in their northern stampede away back in the early sixties.

Notes and reports on the Fort Steele Division will be found in many of the Annual Reports of this Department. An exhaustive detail report by the Provincial Mineralogist will be found in the Report for the year 1898. Dr. S. J. Schofield, of the Geological Survey of Canada, spent several seasons in working up the geology and physiographic history of the Cranbrook Map-area, the results of his work being published as Memoir No. 76 of the Geological Survey of Canada. This work includes a very thorough description of the silver-lead-zinc deposits of the Fort Steele Division, together with a full discussion of their probable origin and hints for future prospecting. For many years past this Division has produced a large percentage of the lead-output of the Province, but this has come from a very few mines. At first the *North Star* and *St. Eugene* mines made practically the whole production, but now these properties are apparently about worked out, the former having been closed down for some years, and the latter only now making an insignificant output. While these properties were declining, however, the *Sullivan* was being developed to such a point that it more than kept up the average annual output for the district.

The yearly value in lead and silver of the ore produced from this mine has, during each of the last three years, been over a million dollars, and, as in the near future the zinc value will

also be recovered, which has not been done in the past, the annual value of ore production will soon be materially increased.

The important coal-mines of the Crowsnest District are situated in the southern part of this Division, but none of these were visited by the writer. Descriptions of these mines and details of production and development are fully recorded in each Annual Report of this Department under the heading of "Coal." The Report previously mentioned, for the year 1898, contains a description of the coalfields, their geological features and early development. In the Report for this year, as in previous ones, the Mine Inspectors' reports on these coal-mines will be found near the end of the volume under the heading "Coal-mining in British Columbia." In a report on the coal resources of Canada, Vol. II. of the "Coal Resources of the World," prepared by D. B. Dowling for the Twelfth International Geological Congress, and issued by the Geological Survey of Canada, will be found an estimate of the coal potentialities, or probable reserves of coal, in this district. From this report the following is taken:—

District.	Actual Reserve.			Probable Reserve.		
	Area in Sq. M.	Class of Coal.	Metric Tons.	Area in Sq. M.	Class of Coal.	Metric Tons.
Southern Interior	230	B_2	22,586,342,000	216	B_2	33,491,000,000
					B_3	296,000,000
					C	1,800,000,000
					D	286,000,000

B_2 is good bituminous coking coal.
B_3 is bituminous coal with up to 35 per cent. volatile matter.
C is sub-bituminous coal.
D is lignite.

Memoir 69 of the Geological Survey of Canada, by D. B. Dowling, which is entitled "Coalfields of British Columbia," is a compilation of all known reports on British Columbia coal. From this report the following excerpt is taken:—

"*The Crowsnest Coalfield.*

"The Crowsnest coalfield contains the most important body of coal that is being mined in the Province. The coal-bearing horizon is the Kootenay formation, and it occurs in synclinal form covering an area of 230 square miles surrounded by tilted lower beds. As a result of erosion the Kootenay and overlying strata form an elevated plateau-like area bordered by depressions occupied by older beds.

"Most of the heavy coal-seams occur in the lower 2,000 feet of the Kootenay. On Sparwood ridge, near Michel, a further thickness of 2,000 feet in the upper parts of the measures contains a number of thin seams, mostly cannel or coal having a high percentage of volatile matter. The *Morrissey section at the south gives a thickness of 3,700 feet of coal-bearing beds. The covering* beds are mostly coarse sandstones and conglomerates and are of great thickness.

"The coal content, in natural sections at a number of places, including only seams over 1 foot in thickness, is as follows: At Morrissey twenty-three seams give 216 feet of coal in 3,675 feet of measures.

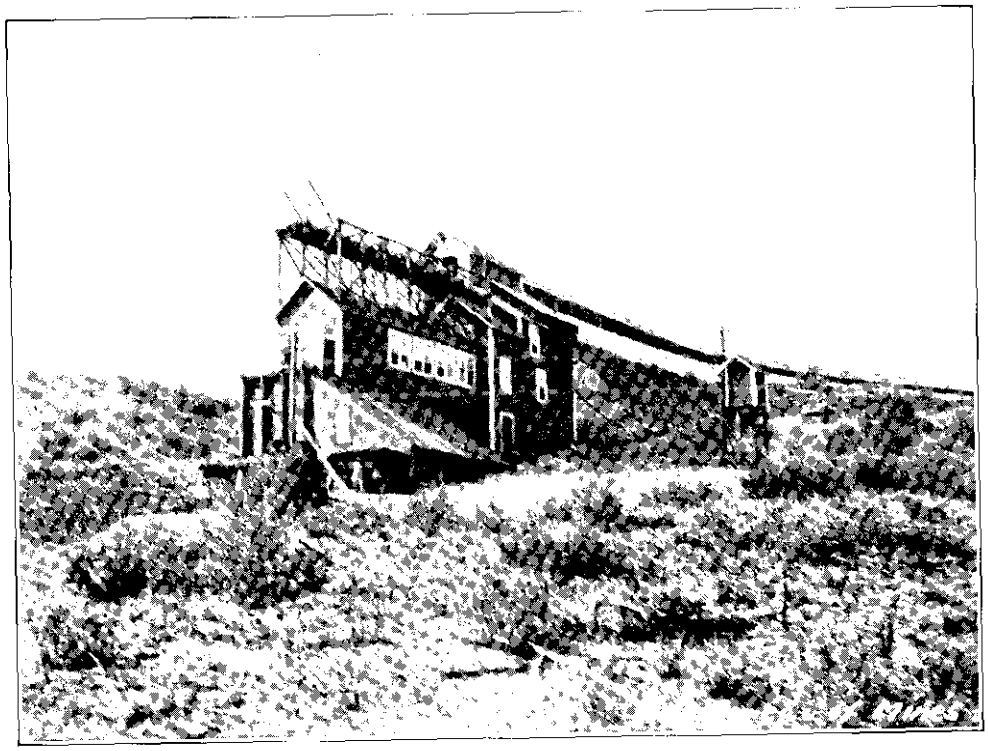
"At Fernie twenty-three seams give 172 feet of coal in 2,250 feet of measures.

"At Sparwood twenty-three seams give 173 feet of coal in 2,050 feet of lower measures.

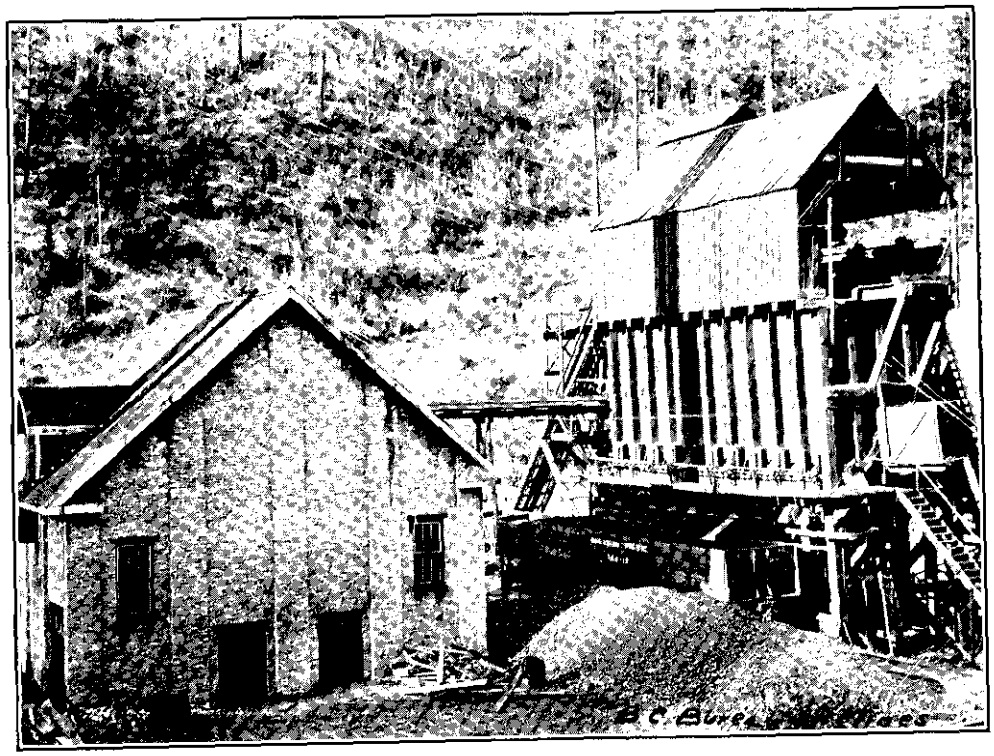
"At Sparwood twenty-four seams give 43 feet of coal in 2,015 feet of upper measures.

"The seams present in the upper measures in the Morrissey section probably thin out before reaching Fernie, but at Fernie there seems to be a possibility that there may be other, lower seams not included in the section, so that the basin appears to have a fairly constant coal content of nearly 172 feet in twenty-three seams, with, possibly, an additional 40 feet contained in the thin seams of the upper measures."

There are two important towns in the Division—Cranbrook, which is an important railway divisional point, the centre of a prosperous farming district, and near which logging camps and sawmills are operated on a fairly large scale; and Fernie, which is the centre of the coal-mining industry in the Crowsnest pass.



Ore-bins, Upper Terminal Tram, Sullivan Mine—Ft. Steele M.D.



Power-house and Bins at Lower Terminal of Tram, Sullivan Mine.

The Crowsnest branch of the Canadian Pacific Railway runs through the district and now is such an important line as to be regarded as a main trunk line instead of a branch. The Kootenay Central Railway from Golden, on the main line of the Canadian Pacific Railway, joins the Crowsnest line at Colvalli, twenty miles from Cranbrook, and links up this section with the main transcontinental line of the Canadian Pacific Railway.

The town of Steele (formerly called Fort Steele) is the oldest town in the district and one of the oldest in the Interior of the Province. It is not as important now as in former years, as it has been overshadowed and surpassed by its younger rival, Cranbrook, some twelve miles to the south and on the main Crowsnest branch of the Canadian Pacific Railway.

In 1915 the quantities and values of the mineral production of this Division were as follows:—

Tons of ore shipped	44,372
Ounces of silver	481,258
Pounds of lead	26,582,050
Tons of coal (net)	459,081
Tons of coke	240,421
Value of building materials	$7,000

SULLIVAN MINE.

This mine has been repeatedly described in the Reports of this Department, and the geological features of the ore-body have been thoroughly worked out and described in the report of Dr. Schofield as previously mentioned. The writer will therefore only summarize and enumerate special features regarding the recent development and operation of the mine.

The *Sullivan* mine, owned by the Consolidated Mining and Smelting Company of Canada, is situated about two miles and a half from the town of Kimberley. The present mine-workings and buildings are situated on the summit of a low rounded hill rising up from Mark creek. The mine was staked in 1895 and sold to a Spokane company in 1896, which operated it for a time, and later there was built the smelter at Marysville to treat the ore from it. This smelter was unsuccessful, primarily because the ore is not suitable to smelting by itself, but requires to be mixed with other ores and fluxes. In 1908 the smelter, after various remodellings and attempts to run, was finally closed, and in 1910 the mine and smelter sold to the Consolidated Mining and Smelting Company. This company has now practically dismantled the Marysville smelter and all the ore is sent to the company's smelting-works at Trail. Since that time the mine has been worked steadily and has made continuous ore shipments.

The production from the mine for the year 1915 was 44,084 tons, containing 474,253 oz. silver and 26,320,307 lb. lead. The average assay value is therefore about 30 per cent. lead and 10.75 oz. silver to the ton. And the gross value of the ore is about $33 a ton.

The oldest existing opening is a shaft with several levels, and from this, together with "glory-holes" and open stopes, the first ore was extracted. The present main working-level is a tunnel which taps the shaft at 100 feet below the collar. There is another level 100 feet lower than this on which there are also extensive drifts and stopes, and from which the ore is hoisted to the upper tunnel and out that way. The last report of the Consolidated Company for the fiscal year ended September 30th, 1915, gives the total footage of development-work done at the *Sullivan* mine as being 29,324 feet, or 5.55 miles. The following figures, from the same report, show the work done in that year: Drifting and crosscutting, 2,278.5 feet; raising, 286 feet; sinking, 26 feet; total, 2,590.5 feet. Diamond-drilling, 3,838 feet.

In June, 1915, a commencement was made to drive a long tunnel from a point on Mark creek about 700 feet below the upper workings. This tunnel will be 8,000 to 9,000 feet long and will eventually be the main working-level of the mine. This low-level tunnel was only decided on after extensive diamond-drilling, both from the upper workings and from various points on the surface, had disclosed the existence of enormous ore reserves. The ore taken from the upper workings is at present taken down to ore-bins by an aerial tramway; these ore-bins are situated on Mark creek and a railway spur connects directly with them. The new tunnel is situated a short distance from these ore-bins and will have railroad connections for handling the ore directly below it. This tunnel is therefore for the purpose of handling the ore more efficiently and reducing costs all round, and at the same time will make possible the handling of a larger daily tonnage.

An innovation in mining in the Province was the installation at this tunnel of a mucking-machine to do away with mucking by hand-shovelling. The machine is made by the Meyers-Whaley Company, of Knoxville, Tennessee, and is reported to be giving satisfactory service. It consists essentially of a shovel or dipper, very like that on a steam-shovel, but smaller, which is thrust forward into the muck, secures a load and throws it back on to a travelling belt, which elevates the muck and delivers it into a mine-car at the back of the machine. The shovel is very flexible and can be forced into the muck at different angles and from side to side of the tunnel. It consists really of two square box-like shells, the inner of which throws the muck back through the back end on to the belt after the shovel has been drawn out from the pile of muck. For convenience in operating two belts are used, one delivering the muck on to the other, and this latter one delivering into the mine-car which is run in under the discharging end of the belt. These belts run over the body of the machine, the operating mechanisms being placed underneath. The whole machine is 30 feet long, weighs 9½ tons, and is driven by a 12-horse-power direct-current motor situated within the machine. It is mounted on wheels and runs on the mine-track, and can be run in and out as desired by means of its own motor. One man operates the machine, and a sufficient supply of mine-cars to keep it going is ensured by having a double track in the tunnel. It is claimed that this machine will muck out in from half an hour to an hour what would take two men with shovels a shift of eight hours to do. The obvious advantage of such a machine is that, where it is desirable to rush work on a tunnel, the quicker handling of the broken rock enables drilling at the face to be resumed more quickly, with a resulting increased speed of tunnel-driving.

At the time of visiting the mine this lower tunnel was in 200 feet; at first it had gone through surface wash and sand, but was then in "hard-pan" that was very hard and studded with boulders, which proved troublesome material to drive through, as it was too hard to pick and had to be drilled, but would not break well. Up to that time the mucking-machine had, therefore, not been given a trial of what it could do working on straight broken rock.

This tunnel is 8 x 8 feet in the clear and will be laid with a double mine-track throughout. It is driven below the foot-wall of the ore-body and at intervals crosscuts and raises will be put through to reach the ore-body. With the flat pitch of the vein this tunnel will give about 1,800 feet of backs above it. When it is considered that the greatest depth attained on the vein as yet is not over 250 feet, it can be realized what an immense reserve of possible ore this tunnel will open up. It is not known to what depth ore has been proven by means of diamond-drilling, but from the guarded utterances of the mine officials the writer is convinced that the ore reserves in the mine are very great.

The ore-body, which is vein-like in form, pitches into the hill at an angle of 30 degrees. The average stope width is perhaps 20 feet, but runs up to 60 and 80 feet in many places. The ore is mined by the "big-stope method," in which the ore is broken down and left in the stope and the work advanced upwards, always leaving in enough ore to enable the men to reach and drill the overhead face. Some ore and waste has to be drawn off as the work proceeds, and the balance is taken off from below when the stope is finished. Pillars are left in places to support the hanging-wall, and in others a cribbing of timber is built up and filled in with waste rock, which thus makes an artificial pillar. Occasionally, square-setting is used, but not as a rule.

The ore is taken out of the main tunnel by an electric motor and cars and dumped into bins. From here it is fed through a jaw-crusher and on to a picking-belt. When first-class ore is going through, the pickers pick out waste and zincy ore and the galena is allowed to pass on to a bin. When second-class ore is going over the belt, galena and waste are picked out and the zinc passes on and to a bin, from which it is run out to a zinc-dump, which already contains many thousands of tons of zinc ore. The galena is in each case run into bins, from which it feeds into the buckets of the Riblet aerial tramway. This tramway is of the usual type, with automatic feed and dump and requiring one man to attend to it. It is 4,000 feet long, with a drop of 600 feet.

The power plant for the mine, which is situated beside the railway ore-bins on Mark creek, consists of a 30-drill air-compressor and alternating-current and direct-current generators. It is run by water-power for part of the year and by steam during the winter months when the water is frozen up.

"The "vein" in the *Sullivan* mine has been described as a replacement ore-body by Schofield; the following is a quotation from his report:—

"The deposit occurs in the Aldridge formation, which here strikes about north and south, with a dip of 10 to 60 degrees to the east. This formation consists of thin-bedded argillaceous quartzites and heavy-bedded, purer quartzites. The ore-body conforms in dip and strike with the quartzites and cannot be called a true fissure-vein, but a replacement deposit in which the sulphides replaced the fine-grained quartzites. The hanging-wall and foot-wall are not well defined and the ore grades gradually into the country-rock, except when the country-rock consists of thin-bedded slaty quartzites which are evidently difficult to replace. In the upper workings close folding later than the ore-deposition increases the real width of the ore. This was well shown in the glory-hole at the time of the writer's visit. On the 60-foot level the dip of the ore-body in places approximates 25 degrees and on the 100-foot level the dip increases to 70 degrees, which is also the dip of the surrounding quartzites. As far as exploited, the maximum stope width is 120 feet and the maximum stope length 325 feet. There are ten levels, the north level being 100 feet below the surface and forming the entrance to the mine.

"The ore-body is arranged in distinct zones which grade imperceptibly into each other. The centre of the lode is occupied by a fine-grained mixture of galena and zinc-blende in which masses of purer galena occur in large lenses. It is these lenses that constitute the valuable ore-shoots in the mine. They occur either singly or as two parallel shoots separated by one of poorer grade. The gangue in this inner zone is absent, except for a few idiomorphic crystals of a pink manganese-bearing garnet. This inner zone gradually passes exteriorly into a fine-grained mixture of pyrite, pyrrhotite, and zinc-blende, which contains as a gangue numerous crystals of an almost colourless garnet, with some grains of actinolite or possibly diopside. The sulphides gradually diminish in amount and finally give way, especially on the foot-wall, to a fine-grained chert which is present when the country-rock is a heavy-bedded purer quartzite, and is absent when a more argillaceous slaty member constitutes the wall-rock. No garnets or other gangue minerals were noted in this cherty zone. The chert gradually passes into the normal quartzite, in which, with one exception, all contact minerals, such as garnet, diopside, and actinolite, are absent.

"As mentioned, the ore-deposit as a whole is a conformable replacement of fine-grained argillaceous quartzites by fine-grained galena, zinc-blende, and iron sulphides. Replacement is very well shown in most parts of the deposit, since alternate banding of ore and quartzite is seen near the periphery of the ore-masses where the relative susceptibility to replacement of the laminæ of the quartzite is different. Joining these favourable bands are numerous interlacing veinlets of sulphides which, as shown in Plate XXIIIA, represent an intermediate stage in the complete replacement of the quartzite. Examined microscopically, the sulphides appear to have entered between the quartz grains of the quartzite and then to have attacked the quartz itself. The sulphides, entering along the favourable laminæ, replace the muscovite also, as shown in Plate XXIIIB. Evidently muscovite has been formed previous to the introduction of the sulphides."

It will be noted from this description that the galena occurs in the centre of the ore-body as large cores or lenses and containing a low percentage of zinc—5 to 10 per cent. Surrounding these galena-lenses are large bodies of zinc and pyrrhotite containing 15 to 30 per cent. of zinc and varying amounts of galena, from 20 per cent. down to none. This zinc-pyrrhotite zone either gradually fades away into unaltered wall-rock or in some cases stops at a well-defined wall. The tonnage of this somewhat low-grade zinc ore is considerably greater than that of the galena ore. A considerable tonnage of ore in the mine has a composition about as follows: Lead, 20 per cent.; zinc, 20 per cent.; iron, 20 per cent. It is evident that such an ore is unsuitable as feed for a lead blast-furnace owing to the high zinc content. Since the Consolidated Company acquired the mine numerous tests have been made to concentrate this ore in such a way as to separate the lead and zinc and produce a concentrate of each of these minerals that could be profitably handled. Water and magnetic concentration tests of various kinds were tried, but these all proved unsuccessful. The main reason for this difficulty is that the mixture of galena, sphalerite, and pyrrhotite is generally so intimate and fine-grained as to be a microscopic intergrowth of crystals, and it has been found impossible to grind the ore fine enough to separate it into its component minerals. And, further, the sphalerite and pyrrhotite are so nearly of the same specific gravity that it is impossible to so separate the pyrrhotite as to make a zinc concentrate of a marketable grade. After exhausting the possibilities of treating the ore by ordinary concentration treatments the company turned its attention to chemical and

electrochemical methods of extracting the zinc from the ore, which would leave the residue with only lead and iron contents, together with all the silver values; this residue would then be suitable for the lead blast-furnaces.

After some preliminary experimenting the Consolidated Company entered into an agreement with the French's Complex Ore Reduction Company, Limited, whereby a thorough testing of this latter company's zinc process on *Sullivan* ore was to be made. To this end an experimental plant was erected at the smelting-works of the Consolidated Company at Trail, and a series of tests made under the supervision of Thomas French, son of Andrew Gordon French, the originator of the French ideas and patents. Apparently some amount of success was obtained in these experiments, as, although the agreement with the French company was terminated, further experimental work was carried out along the same general principles, but with some modifications in details. This latter work was conducted by F. W. Guernsey, on the Consolidated staff, and under his direction the experimental plant made a production of ½ ton of electrolytic spelter a day for some time.

Having demonstrated that the process was satisfactory, the Consolidated Company in July commenced the erection at Trail of a zinc plant which is designed to produce 25 to 35 tons a day of spelter. This plant should be in operation early in 1916, and a contract for the entire output of this spelter has been made with the Imperial Munitions Board. This plant is designed solely to treat *Sullivan* ore, but may be extended later to treat customs zinc ore. The successful operation of this plant will mean a great deal to the *Sullivan* mine, as it will turn the vast reserves of zinciferous ores into actual instead of potential assets. By extracting the zinc from ore containing 20-per-cent. zinc and 20-per-cent. lead, not only the zinc is obtained, but the lead content is also made available, which opens up great possibilities for the future life of the *Sullivan* mine.

PERRY CREEK.

Perry creek joins the St. Mary river about four miles below Marysville. Placer-mining was carried on for many years on this creek, but latterly very little has been done.

Some enormous ledges of quartz and schist on the hills on either side of this creek attracted attention many years ago, and many attempts have been made to discover pay-shoots of gold-bearing quartz in them. The reader is referred to the Report of this Department for the year 1898 for details and extended description of these earlier workings.

As some more work has recently been done on the *Homestake* group and adjoining claims, the writer made a short trip of examination. The owners of this group have been aiming to show that, while it did not pay to mine and mill small parts of the veins, the whole of the veins, together with some wall-rock, carried sufficient gold to make it a paying proposition if tackled on a large scale. They hope to show that average values are in the neighbourhood of $4 a ton, and, as the veins are up to 50 feet in width, that by mining and milling several hundred tons a day a fair margin of profit would ensue. The writer regrets that he is unable to corroborate this statement, but would point out that his sampling was very meagre, and that perhaps the only satisfactory test of the gold-bearing tenure of the quartz would be by means of small-scale mill tests. However, bearing in mind the results of samples taken, which will be enumerated later on, it seems to the writer that certain portions of the vein will be found to carry no values, while certain selected portions may carry sufficient values to work on a small scale.

These deposits are true fissure-veins occurring in argillaceous quartzites and argillites. The veins are from 5 to 50 feet wide, and occasionally even wider. The vein-filling is partly quartz and partly the country-rock, or, in other words, the veins are really compound, there being streaks of quartz and streaks of interbedded schistose wall-rock. The actual walls, especially the foot wall, are generally well defined with a layer of talcose-gouge matter. The quartz is very often glassy and "hungry-looking," but appears better near a band of the schistose-rock matter. The only mineralization evident is with iron pyrites and some limonite, an oxidation product of the pyrite. Free gold occurs in a few places, but is of sparing occurrence. It is evident that the gold is associated with the pyrite and is sometimes released to the free state by the oxidation of this mineral. The total percentage of pyrite in the veins is, however, quite small.

The veins are all practically standing perpendicularly and striking with the strike of the sedimentary rocks in which they occur. This strike varies from north-west to north-east. Some

of the veins are very persistent in length, running through several claims, and there seems no reason to doubt that they extend to great depths. The only question therefore is one of values.

Homestake Group.

This group of claims is situated on the west side of Perry creek, near its head, between Manchester and Liverpool creeks, and is owned by George Carr, Gus Theiss, and others. The old workings, shafts and tunnels, are caved in, and so only the more recent work could be examined. A shaft 43 feet deep is part of the work recently done, and some was done there during the summer of 1915. The vein as exposed here consists of alternate streaks of quartz and somewhat decomposed and crumbly slate, of which the quartz forms from 10 to 15 per cent. At the bottom of the shaft there is a width of 8 to 10 feet of material that can be considered as vein-matter. A sample across 7½ feet of this returned 0.05 oz. of gold to the ton, or $1 in value. A specially selected specimen showing considerable iron assayed 0.11 oz. gold to the ton. A sample of pure quartz gave $1 to the ton, and 14 inches of talcose material yielded a similar result. From the material taken from this shaft about 3 tons of the best-looking ore has been selected and put to one side. An average sample of this gave 0.3 oz. to the ton, or $6 in value.

One hundred and seventy-five feet down the hill from this shaft another vein is developed by a tunnel which crosscuts the vein and has a short drift along it. This vein is over 30 feet wide, but two representative samples taken by the writer returned only traces of gold.

On a continuation of the No. 1 or shaft vein an open-cut discloses 8 feet of quartz and schistose material. The vein here is well stained with iron oxide and shows a little pyrite. A sample across 4 feet on the east side returned 0.05 oz. gold to the ton. Another across the adjacent 4 feet on the hanging-wall side, which is mostly decomposed argillite, returned only a trace of gold.

Another vein, called the No. 3 vein, is prospected by a crosscut 100 feet long and then drifts 50 and 180 feet on the vein. From 5 to 15 feet is the width of this vein, which occurs in a straight quartzite formation. A sample of what was considered to be possible ore returned only a trace of gold.

Yellow Metal Group.

A group of claims lying to the south-west of the *Homestake* and near the head of Perry creek is owned by W. van Arsdalen and Ed. McMahen, of Cranbrook. These claims are the *Yellow Metal*, *H.H.*, *Spondulix*, *Spondulix Ext.*, and *M.M.*, and some work has been done on them during the past summer by Van Arsdalen. The first two of the claims are at the head of Gold Run creek and the others on the north side of that creek. Gold Run is a small creek forming the commencement of Perry creek.

On the near-by flat ridge which forms the divide between Perry and Hell Roaring creeks is located one of the showings on the property. From this ridge a fine view can be had overlooking the two creeks mentioned, also the North fork of the Moyie river and the head of Whitefish creek, a tributary of the St. Mary river. Viewed from such a point the country presents an appearance of low, rounded, flat-topped hills dissected by many deep U-shaped valleys. The showing at this point consists of a slight mineralization along and between the seams of talcose material lying between very thin-bedded quartzites. This mineralization consists of scattered grains of pyrite and chalcopyrite, but in almost insignificant amounts. An open-cut 4 x 4 feet has been run for 40 feet, up and down the hill, which crosscuts the bedding-planes of the quartzite, which are here standing nearly vertical; there is no true quartz vein here as in other places on the hill. A sample across 3 feet of the best-looking material in this cut returned on assay 0.05 oz. gold to the ton. Farther along the ridge a similar slight mineralization is evident which has been prospected by a shallow shaft, now completely caved in, but a few pieces of ore evidently taken from the shaft show some chalcopyrite. An average sample of about a ton of this material, which represents all the good ore taken out of a 20-foot shaft, assayed 0.41 oz. gold to the ton. The rest of the dump does not assay anything, according to the statement of the owner; no sample was taken. A specimen of the best rock selected by the owner assayed 0.6 oz. gold to the ton and a trace of copper.

On the *Spondulix* claim, lower down the hill and on the Perry Creek slope, there is a ledge 40 feet wide of rather glassy-looking quartz. It is developed by a large cut and some work was done along the western wall during the past summer. The owner says that so far he has failed to find any appreciable values in this ledge by panning, and a general sample across 30 feet of quartz at the face of the cut returned only a trace of gold.

One thousand feet easterly and 200 feet lower down the hill there is another rather promising-looking vein, striking N. 10° W. (mag.) and dipping at 80 degrees to the east. It occurs in thin-bedded quartzites, along the bedding-planes of which sericitic material has formed, which dip at 75 degrees to the west. The vein thus cuts the formation as to pitch, but has a coincident strike. Next the foot-wall there is about 1 foot of talcose material, a sample of which returned on assay 0.05 oz. gold to the ton. The next 18 inches of the vein alongside this talc was sampled and assayed, giving also a return of 0.05 oz. gold to the ton. A few carefully selected pieces of ore assayed 0.71 oz. to the ton. The development consists of a small pit a few feet deep.

Annie. This claim lies to the south-west of the *Homestake* group; that is, farther up Perry creek and on the same side. It is owned by Dr. Rutledge, of Cranbrook, and Dan McIntosh. On this claim an open-cut exposes a quartz vein 25 feet wide, and at the face of the cut it is 12 feet high. This vein is supposed to be a continuation of the No. 1 vein on the *Homestake*. Very little mineralization is apparent other than some reddish-brown iron-stain, and a general sample across 20 feet of the quartz returned only a trace of gold.

WHITEFISH CREEK.

Whitefish creek is a small creek rising in the Purcell range and flowing into the St. Mary river about sixteen miles above Marysville and two miles above the upper end of St. Mary lake. On this creek some copper claims have been taken up by the Evans Bros. and considerable prospecting-work done on them.

The ore-bodies in this section are all found in an igneous eruptive rock which has been intruded into the quartzites in the form of sills. These sills are found in many parts of the Purcell range, and to them the name "Purcell sills" has been generally applied and adopted. These Purcell sills vary greatly in size, composition, and texture, but are all apparently contemporaneous and have been ascribed to the Pre-Cambrian age by Schofield, and hence are amongst the oldest-known rocks in the earth's crust. They were intruded into the quartzites when these rocks were lying in horizontal beds, and since have gone through all the folding and crumpling that has transformed these quartzites into the Purcell range. As these sills are formed of hard, tough rock, they often stand out prominently in bluffs and ridges and the tops of mountains.

The rock which constitutes the Purcell sills is primarily a basic rock—a gabbro. But in many of the sills magmatic differentiation has occurred during cooling, with the result that there are bands of rock more acid than the present gabbro. These more acid rocks range through diorite and granodiorite to a very acid granite or granophyre. These bands are generally transitional, one type passing gradually into the other. The thickness of the Purcell sills varies from 2 to 2,000 feet, but it is, of course, only in the larger ones that ore-bodies are found.

It may be well, before proceeding, to describe just what is meant by a sill, as it will assist in the understanding of these rather peculiar ore-bodies. Geikie's definition of a sill is: "A sill is a sheet of igneous material which has solidified there so as to appear more or less regularly intercalated between the strata." In other words, a sill is a flat tabular body of igneous rock intruded into other formations, in which the thickness or depth is the vertical dimension. In the case of the Purcell sills folding subsequent to their injection has tilted the strata enclosing the sills, and the direction of maximum thickness of the latter may be at any angle from the vertical to the horizontal.

There are two types of ore-bodies in the Purcell sills: (1) Irregular bodies which have been formed by differentiating out from the cooling magma; (2) veins which are perpendicular to the plane of the sills.

In regard to the first class, Schofield* says: "The differentiates occur usually in the interior of the sills and are of varied shape and size. No single body has as yet been outlined, but they are believed to be at least 200 to 300 feet in diameter. The boundaries of these bodies with the surrounding rocks are always gradational. The differentiates consist generally of a peculiar hornblende granite containing as a prominent feature opalescent quartz. The hornblende is usually fibrous and in some cases makes up 75 per cent. of the rock. The other constituent of the rock is an intergrowth of quartz and orthoclase. The ore-minerals charcopyrite, pyrite, and pyrrhotite occur sporadically throughout the differentiates."

* Memoir 76, Geological Survey of Canada.

The writer would emphasize the fact that these ore-bodies are mainly of geologic or scientific interest, as the present development has not as yet shown any of them to carry sufficient copper to constitute even low-grade ore. From the nature of these ore-bodies it is evident that they are confined to the sills and do not extend into the surrounding quartzites.

The veins give more promise than the other type of ore-body, as some of them contain a foot or two of good-grade copper ore. These veins are from 2 to 10 feet wide and have been formed in shear-zones within the sills, presumably after the sill magma had cooled. In many places the veins look as if they had formed in open fissures, and it is possible that some of the fissures were cracks formed by the cooling of the sill-rock. The vein-filling is quartz and calcite and the ore-minerals are chalcopyrite, pyrite, and pyrrhotite. The calcite is very coarsely crystalline and generally occurs in bands either in the centre of the vein or close to either wall; it was probably the last-formed mineral in the vein. Native copper and erythrite (cobalt bloom) are occasionally seen.

The veins are confined entirely to the sills and do not extend upward and into the overlying quartzites, and presumably do not go down into the underlying quartzites. In one place in Kelly basin a very pretty example of the top of a vein can be seen. Here the vein comes up through the sill to the contact with the quartzites, where it abruptly pinches out and is no more. From this it will be seen that the possible depth of the veins is limited to the thicknesses of the sills, while the length of the veins is only limited by the lateral extent of the sills, which may be very considerable.

The claims owned by the Evans Bros. on which there are showings of ore are the *Gigantic* and *S. J. Schofield*, in Kelly basin; the *Elizabeth* and *Kokanee*, in Pollen basin; and the *Curfew* and *Pacific*, down near the main camp on Fiddler creek. They have in all fifteen claims held by annual assessment. Fiddler creek is a little creeklet entering Whitefish, and Pollen and Kelly basins are the heads of small creeks flowing into St. Mary river. The claims then occupy the high ridges of a steep mountain lying in the angle between Whitefish creek and St. Mary river. Besides the main camp of two comfortable cabins near the head of Fiddler creek, there is another camp in Pollen basin, and a base camp down near the confluence of Fiddler and Whitefish creeks. The elevations are as follows: Base camp, 4,750 feet; Main camp, 6,200 feet; Pollen Basin camp, 7,000 feet; Kelly basin, 7,500 feet.

In Kelly basin there is a high bluff which it is not possible to get to, but in the slide-rock at the foot there is a considerable percentage of rock showing slight mineralization with chalcopyrite and larger amounts of pyrrhotite. Along the face of this bluff several large patches of copper-stain and iron oxide can be seen. It is evident that whatever ore there is in this bluff is irregular and of the differentiate type. A piece of the best-looking ore picked from the slide at the foot of the bluff yielded on assay: Gold, trace; silver, 0.2 oz.; copper, 1.4 per cent.

On the *Gigantic* claim, in Kelly basin, what is known as the No. 3 vein is developed by an open-cut 25 feet long with a 12-foot face. The vein is about 5 feet wide and strikes east and west (mag.), with a dip of 75 degrees to the north. The centre of the vein shows from 12 to 18 inches of good copper ore, and the rest of the vein, largely quartz, carries a little copper-stain. A sample across 15 inches of the best ore assayed: Gold, trace; silver, 4.4 oz.; copper, 16.3 per cent. An average sample of the ore-dump from this cut, which contains 7 or 8 tons of ore, assayed: Gold, trace; silver, 2.6 oz.; copper, 8.5 per cent.

On the *S. J. Schofield* claim, in Kelly basin, there are two veins, No. 1 and No. 2. The former has a 10-foot cut on it with a 5-foot face. From this cut about 2 tons of ore has been saved, an average sample of which assayed: Gold, trace; silver, 0.8 oz.; copper, 3.2 per cent. The vein is about 3 feet wide and consists largely of quartz carrying a little chalcopyrite. No. 2 vein is similar, but consists almost entirely of quartz and calcite.

On the *Kokanee* claim, at the head of Pollen basin, there is a good-sized quartz vein from 10 to 15 feet wide. This occurs in the diorite-gabbro, which at this place would appear to be one of the stalks connecting between two sills at different horizons. The strike is again east and west and a dip to the south at about 75 degrees. It is developed by an open-cut 15 feet long with a 10-foot face. The central part of the vein for a foot or two carries copper pyrites disseminated through the quartz, but the balance carries practically no sulphides. With the copper sulphide there are occasionally grains of galena (lead sulphide). From this working 10 tons of ore have been sorted out from the rock extracted; an average sample of which assayed: Gold, 0.12 oz.; silver, 3.5 oz.; copper, 1.9 per cent.

On the *Elizabeth* claim, also in Pollen basin, there is a vein from 4 to 8 feet in width. It is developed by several open-cuts and a shaft 15 feet deep from the end of one cut. In all a good deal of surface work has been done on this vein. Some of the cuts show bunches of galena in association with the chalcopyrite, but in others the galena is entirely missing. As a rule, in most of the cuts there is one or more bands which are more or less mineralized, and the balance of the vein is barren. These bands are from 1 to 3 feet wide. It is not of much use to sample one section of any particular band, as the mineralization is quite irregular. In any case, before shipping any ore it would have to be closely sorted, and the thing to determine is if there is enough high-grade ore in the vein to make it pay to mine it. In this way average samples across the whole vein are of no value and are quite misleading, as such would include a lot of waste rock. In the shallow shaft the main mineralization is confined to a streak about 1 foot wide which would contain perhaps 10-per-cent. copper. A sample of what might be considered roughly sorted ore from a 1-ton dump from the shaft assayed: Gold, trace; silver, 1.2 oz.; copper, 5 per cent. A few selected pieces of mixed galena, chalcopyrite, and pyrite assayed: Gold, 0.02 oz.; silver, 20.0 oz.; lead, 15.6 per cent.; copper, 1.7 per cent. The biggest cut on this vein is 20 x 8 x 15 feet; in it the vein is from 6 to 8 feet wide and carries a small amount of chalcopyrite disseminated throughout.

Another vein on this claim is of about the same size, consisting of quartz and calcite, but contains very little evidence of mineralization with sulphides. This vein is exposed right at the contact of the gabbro with the quartzites and might show more mineralization with greater depth. It does not penetrate into the quartzites. One cut on this vein is 20 x 8 x 10 feet, and another 15 feet deep by 10 feet square.

Main Camp.—More work has been done close to the main camp than on any of the other claims. The main working is a tunnel 300 feet long which prospects a quartz-calcite vein of the usual type. This vein is about 4 feet wide, consisting of quartz and calcite. It contains very little chalcopyrite or other sulphide, and at the face is half quartz and half calcite, with no sulphides present at all. It must be admitted that the development of this vein is disappointing and there is nothing about it to encourage further work.

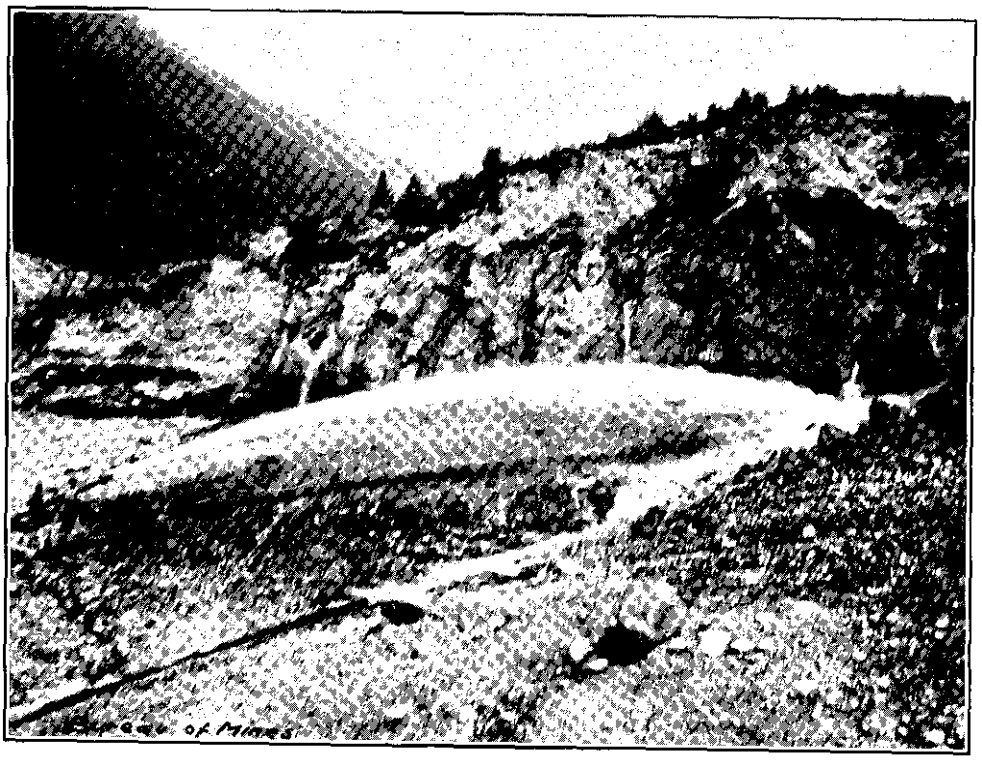
Near this vein there is a body of so-called low-grade ore which has been developed by some pits and cuts. This consists of the gabbroid rock impregnated with a little pyrrhotite and an occasional grain of chalcopyrite. A sample of the best of this ore only yielded traces of gold and silver and 0.2 per cent. copper. This, of course, cannot be considered as ore at all, and there seems little chance of any commercial ore-bodies being developed at this point.

Alliance Group. On the mountain on the other side, or north, of Whitefish creek from the claims previously described is the *Alliance* group of four claims, also owned by the Evans Bros. The diorite sill at this point is supposed to be a continuation across the valley of one exposed in Kelly basin. The ore-body here is one of the low-grade differentiate type, but here again it is so low grade that at present it can only be considered as slightly mineralized rock. The mineralized zone runs east and west, and crossing it there is at least one quartz vein and possibly others; these veins, however, carry practically no sulphides. In the neighbourhood of the vein the gabbroid rock is slightly more mineralized than elsewhere in the east-and-west zone. The sulphides noted are pyrrhotite and some chalcopyrite, but, to judge by the eye, there is not much rock that would carry 1 per cent. of copper. Development is by means of several large open-cuts. An average sample of the ore from the cut which shows the most mineralization assayed: Gold, trace; silver, 0.6 oz.; copper, 0.6 per cent.

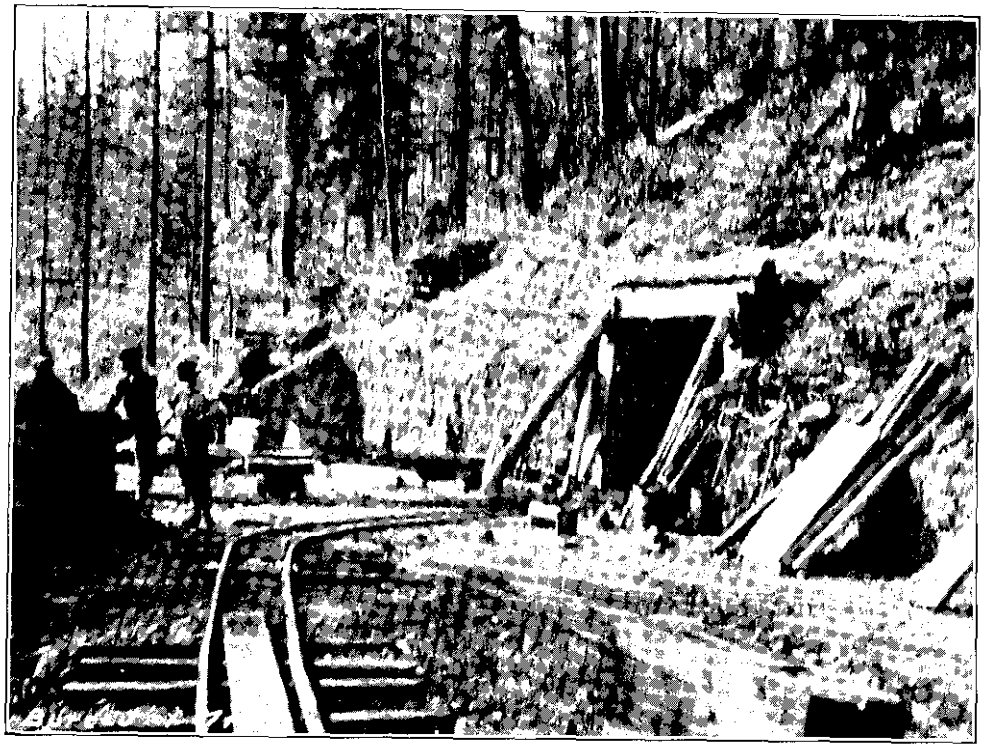
HELL ROARING CREEK.

Hell Roaring creek joins the St. Mary river just below St. Mary lake. The West fork of this creek comes into it about four miles above its junction with St. Mary river. About three miles up this West fork and on the east side there is a group of three claims owned by N. A. Wallinger and partners. These claims were staked about 1895 and the last work done on them was in 1909. They are situated 1,300 feet above the creek-level on a sloping mountain-side.

On this property there is a well-defined quartz vein striking and dipping with the formation which consists of quartzite. A belt of granitic rock lies a short distance from, and is apparently roughly parallel to, the vein. The strike is east and west (mag.), with a dip of 70 degrees to the south. The gangue of the vein is quartz and some quartzite, and on the foot-wall a talcose



Hydraulic Mining, Wild Horse Creek—Fort Steele M.D.



New Lower Tunnel, Sullivan Mine—Fort Steele M.D.

gouge is of frequent occurrence. Ore-minerals are pyrite, galena, and sphalerite and some oxidation products therefrom; silver values are quite low.

Development has been by means of two tunnels, the lower of which, on the *Iron Duke* claim, is completely caved in. The upper tunnel, which is 75 feet above the lower, is at an elevation of 5,300 feet. At the portal of this tunnel the vein is about 18 inches wide, mostly quartz and with but little galena. For most of the length of the tunnel the vein is chiefly mineralized with pyrite which carries little or no values. Towards the face the vein widens out and at the face is from 5 to 6 feet wide. On the hanging-wall there is 2 feet of ore carrying a fair percentage of galena, and the balance of the vein is quartz sparingly mineralized. A sample clear across the vein with a width of 5½ feet assayed: Gold, trace; silver, 1.6 oz.; lead, 5.8 per cent.; zinc, 6.2 per cent. On the foot-wall in one place there is 15 to 18 inches of lead carbonates and talcose matter, a sample of which assayed: Gold, 0.02 oz.; silver, 5.2 oz.; lead, 28.9 per cent.; zinc, 3.6 per cent. From the tunnel a few tons of the best ore taken out has been sorted and laid to one side; an average sample of this material returned on assay: Gold, 0.2 oz.; silver, 2.6 oz.; lead, 14.6 per cent.; zinc, 10.2 per cent.

Mascot Group. On the south branch of Hell Roaring creek, about eight miles from where the main stream joins St. Mary river, is situated the *Mascot* group. There are four claims in the group—*Mascot*, *Mascot No. 2*, *Eclipse*, and *Eclipse No. 2*—which is owned by James Angus, of Marysville, and William Tarrant. The four claims are staked in a north-and-south line along the hillside, in the direction of the strike of the vein. The vein is a strong, well-defined, and persistent quartz-filled fissure which has been exposed along a length of nearly 2,000 feet; in width it varies from a few inches up to 3 feet.

The vein occurs in quartzite and conforms in dip and strike with the bedding-planes of the quartzite; this strike is north and south, with an easterly dip of from 60 to 80 degrees. The gangue is quartz and the ore-minerals are galena, sphalerite, pyrite, and a little chalcopyrite. In places the vein consists of crumbly quartz stained green, blue, red, and yellow from the oxidation of the original sulphides.

Development consists of a shaft 55 feet deep and eight open-cuts to the south of the shaft and two to the north. The shaft has drifts from the bottom going 20 feet in both directions along the strike of the vein. It was not possible to examine the shaft, as the timbers and ladders were rotten and partly gone and no rope was available. In the open-cuts the vein maintains an average of perhaps 2 feet and is fairly well mineralized throughout. The following samples give an idea of the values:—

No.	Description.	Gold	Silver.	Lead.	Copper.
		Oz.	Oz.	Per Cent.	Per Cent.
1	Fifth open-cut south of shaft; sample across 18 inches	0.02	2.0	5.0	...
2	Same cut; selected galena	0.12	4.0	41.2	...
3	Third cut south of shaft; sample across 15 inches	0.186	3.0	...	...
4	First cut south of shaft; sample across 14 inches	0.2	2.0	14 6	1.4
5	Same cut; selected sample	0.46	23.2	36.6	10.0
6	Average of first-class ore-dump from shaft containing 10 tons of ore	0.34	3.1	8.9	...
7	Selected galena from shaft	0.02	10.6	69.6	...

There is a small cabin on the property and good mining timber is abundant. Access to the property is had by means of a trail leaving the St. Mary wagon-road and going up Hell Roaring creek and its south branch.

Park Group. This group of claims, owned by W. A. Chisholm, is located about one mile from Marysville. The vein on this property occurs in diorite, probably a portion of one of the numerous Purcell sills in the district. It is a fissure from 4 to 6 feet wide filled with quartz and calcite, and carrying some bunches of coarsely crystalline galena. The vein is developed by open-cuts and a shaft 60 feet deep, but, owing to bad timbers, it was not possible to get down this shaft. At the bottom the vein is said to be mainly calcite with very little galena. In one cut which is 100 feet long and 4 to 10 feet deep there are places that show a foot or two of galena, but, speaking generally, the mineralization

of the vein is very irregular and infrequent. At the time of visiting the property the owner was engaged in hand-sorting the ore already taken out and expected soon to be able to make a shipment. A grab sample of the hand-sorted ore assayed: Gold, 0.06 oz.; silver, 12.6 oz.; lead, 71.3 per cent. With the present development the property is of slight importance.

PLACER-MINING.

Placer-mining was at one time quite important in the Fort Steele Mining Division, but latterly it has dwindled away to a small annual output. As mentioned before, Wild Horse creek was the most important of the placer-gold creeks, several miles of the gravel bars and banks of this stream having been worked first by drifting methods and later by hydraulicking. Wild Horse creek rises in the Rocky mountains and joins the Kootenay river at Fort Steele.

During the last few years the creek has been mainly worked by Chinamen, who work in a primitive manner with rockers. They are for the most part working over old tailings, but occasionally find a small patch—a few cubic yards—of virgin ground overlooked in the previous workings. In the season of 1915 about 100 Chinamen were at work this way, working in groups of three to half a dozen. It is rather hard to find out how much gold these Chinamen recover, but it is certain that it does not amount to very much.

One small hydraulic concern was at work on the creek, also operated by Chinamen under some sort of an arrangement with the owner. The only information obtainable about this was that the gravel carried about 5 cents to the yard. The site is favourable for hydraulicking, with a bank 60 to 100 feet high and a 100-foot head of water. On the scale it is being worked it is doubtful if anything more than wages could be made.

On Perry creek no placer-mining was being carried on at the time of the writer's visit, but during the previous winter and spring some drifting operations had been done just above the "Falls" by Gus Theiss and partners. From time to time during the season a little work is done by "snipers."

Perry creek has the reputation of having had rich gold-placer ground, and the total production of all former years has been considerable. Hydraulicking operations have been tried in places along the creek, but without much success, and one company started to handle gravel by means of a steam-shovel and then running it through sluice-boxes. This outfit was not a success, due mainly to mechanical difficulties that developed in operation. The shovel is still on the ground.

Near the "Falls" the Perry Creek Hydraulic Mining Company in 1903 started operations on a large scale to hydraulic a high gravel-bank between the present channel and what is supposed to be an old channel of the stream. A full description of this placer deposit and the work done by the company is given by Wm. Fleet Robertson, Provincial Mineralogist, in the Minister of Mines' Report for 1903, to which the reader is referred. The company operated for a time, but apparently without any great success, and now has been idle for some years. There seems to be no doubt that the gravel-bank, which has hardly been touched as yet, contains a few cents to the yard, possibly enough to pay if worked on a large scale. Then once this bank is removed or a channel cut through it, access can be had to the old channel. From the configuration of the ground there is little doubt that this depression or valley is really an old channel of Perry creek, but the question of whether it carries pay-gold values has neither been proven nor disproven.

During the summer of 1915 an attempt was being made to again start up this hydraulic enterprise. The promoter had obtained some sort of an agreement or option from the original company, and he has now arranged with New York and Chicago capitalists to furnish the funds for a new attempt. Some changes are to be made in the methods of attack in the way of bringing the water from the flume in from a different point, and more adequate facilities for disposing of the tailings. It was hoped a start would be made in the fall of 1915 and that active work would commence in 1916, but it is not known how far these plans have materialized.

Placer-mining on other streams in the district has not been very active of late, being confined to small individual operators, mostly Chinamen.

FLATHEAD RIVER OILFIELD.

The Flathead River oilfield is situated in the south-eastern part of Fort Steele Division. In the 1914 Annual Report of this Department there is a report on the oil possibilities of this

district by Ralph Arnold, a well-known oil geologist of California. Further drilling was carried out in the summer of 1915 and encouraging results obtained. The following information, which relates to the holdings of the Flathead Oil Syndicate, is contained in a letter from the manager to Colonel Guy H. Kirkpatrick, a member of the syndicate, who kindly gives permission that it may be published:—

"I returned a week ago to-morrow from the oil camp. No. 3 well is down 970 feet, still in very badly broken bluish-grey limestone formation. The drilling is still in the overthrust formation, which is probably several hundred feet thicker.

"Fresh water was cased off at 715 feet, and at 735 feet a whitish limestone was encountered giving off a very strong petroleum odour, the limestone gradually turning somewhat grainy and darker in colour and yielding considerable oil. The drill was shut down to weld stem at about 800 feet deep, and on starting up considerable oil was observed, so the drillers set to to fill a 54-gallon gasolene-drum, and very few dippings of the bailer or sand-pump filled the barrel two-thirds full. No water was present in the hole at this time except a very small amount, which it was figured was struck with the oil. The well was continued on down to 970 feet, and considerably larger quantities of water, oil, and gas were struck in the lower layers of rocks. On arrival at camp I advised making a test of the upper strata producing oil, so we cemented off the water, gas, and oil below the 800-foot level, and have ordered a regular oil-pump and some storage-tanks from Pittsburgh. We will pump the well day and night for two weeks and see what it will yield. The drillers estimate 2 to 10 barrels per day, but only test will tell.

"Monday, October 11th, the casing arrived to shut off the water in No. 2 or Davenport well, so on Tuesday, October 19th, the crew started putting in the casing to shut off the last flow of artesian water.

"While trying to seat the casing the well took two spasms of flowing tremendous volumes of oil, gas, and water, driving the drillers from their work, and on subsiding some 10 gallons of oil was caught in some water-pails which were handy. The oil is the same colour and quality as No. 3, sample of which I have sent you by express. The casing was very light weight, best we could get without sending back to Pittsburgh, but we put it in, and had only drilled about 12 feet when another flow of water was encountered. The drillers pulled the casing and tried to reseat it to shut off last flow; bottom hole packer did not work, so they tried to pull it again and pulled it in two, so they shut No. 2 down again until we can get then 1,000 feet of extra heavy 6¼-inch casing and a bottom hole well-packer.

"The oil-pump, tanks, and casing have been ordered and will be at Belton ready to freight in on the first fall of snow. We have several months' provisions on hand, coke, horse-feed, etc., so we could keep working nicely during the six weeks of bad roads, which always occur about this time of the year, and again in the spring, as we did not expect any further delays on account of casing.

"Another standard drilling rig will be put in operation in the Flathead by Spokane capitalists on the first snow."

NORTH-WEST KOOTENAY DISTRICT.

REPORT OF ROBERT GORDON, GOLD COMMISSIONER.

I have the honour to submit herewith the annual reports on the progress of mining within the Revelstoke and Lardeau Mining Divisions for the year ending December 31st, 1915.

Although very little actual production has taken place, a most optimistic feeling has prevailed and steadily grown throughout the past year.

Development on, and the commencement of shipping from, the *Lanark* mine has proven that the abandonment of a number of mining properties a few years ago was a mistake, and the advance made of late years in the system of development and the mining and handling of ores will encourage the owners and investors in this district to recommence work on a more careful and economical basis than formerly.

Miners and prospectors who left this district some years ago for the newer, more northerly mining districts are now beginning to return.

With a continuance during the next year of the increasing interest already shown on the part of outside investors, we may look for a good year of development during 1916.

REVELSTOKE MINING DIVISION.

REPORT OF R. S. SQUAREBRIGGS, MINING RECORDER.

I have the honour to submit herewith the annual mining report and office statistics of the Revelstoke Mining Division for the year ending December 31st, 1915.

The mining operations in this Division, I am pleased to report, show quite an increase over the preceding year, and every confidence is expressed by the owners of mineral and placer claims.

French creek, in the Big Bend district, is again attracting quite a lot of attention. This well-known stream, whose placers have yielded in the past, principally through wing-damming the creek and shovelling in the shallow gravels near its mouth, continues to be the principal mecca for the "grub-stake" miner. The Pioneer Placer Mines, Limited, whose property is now in liquidation, was closed at the outbreak of the war. The Gold Hill Hydraulic claim, owned by Remillard, Fulmore, Williams, and Kitson, made a satisfactory clean-up for the season, notwithstanding shortage of water. Several individual miners and a number of Chinamen were engaged in "gophering" along the creek during the summer months.

At McCullough creek Marsaw, Shields, and Aiken have been working on the *Ophir* claim, and succeeded in sinking a shaft 110 feet deep on the lower end of the claim, but did not reach bed-rock on account of the excessive amount of water encountered below the 70-foot level. A drift was opened up at the 70-foot level to tap the lower gravels at the mouth of the creek, and is in approximately 300 feet. The owners now feel confident they will soon strike the old Ophir pay-streak.

Smith Creek.—During the year but little actual mining was done on this creek; several individual miners were engaged in "sniping" along the lower end of the creek, making fair wages.

At Raymond Allen's, across the river, where he has ground-sluiced a considerable yardage, the pay-streak has not been tapped, but gold in small quantities has been taken out each year.

Camp Creek.—No development of any consequence has ever been attempted on this creek. Although heavy gold has been found on the rim-rock, no one has succeeded in reaching the deep ground. Deep ground has been encountered on Goldstream, below the mouth of Camp creek, but the works were flooded by the high water. The prospects obtained from the preliminary shafts are said to be very encouraging.

Downie Creek.—This has been a very quiet year in this vicinity, nothing but assessment-work being done. On Boulder and Canyon creeks, tributaries of Downie creek, J. C. Montgomery has several promising claims, but has been unable to do more than the assessment-work.

Carnes Creek.—On the *98* group, consisting of four claims situated on the South fork of Carnes creek, about four miles from the Columbia river, and owned by Elijah McBean, of Revelstoke, considerable work has been done. A tunnel has been driven approximately 300 feet; the face is about 250 feet below the surface, and the ledge-matter, which is 10 feet in width, contains good values in gold. Two shafts 150 feet each have been sunk in the ledge at higher elevations; the vein-matter in both shafts carries arsenical iron with gold values; there is also considerable silver-lead ore near the surface. This property has been systematically developed for the past eighteen years, and will likely prove one of the principal producers of the district in the near future.

LaForme Creek.—The high prices being paid for metals has resulted in a number of new locations being made on the various silver-lead properties on this creek. Considerable development-work was done on some of these properties during the years 1898 and 1899, but owing to the lack of transportation facilities no shipments were made. During the past summer there have been a number of American capitalists looking over the locations on this creek, and the coming summer will see developments started and shipments made from these claims, which, from assays made during the past summer, show that they are rich in silver-lead.

From LaForme creek down the Columbia river to Revelstoke nothing of any importance has been ever done; although during the past few summers, principally during the low water in the spring, several miners have been engaged in rocking along the bars of the Columbia river, and some are said to have made good wages. At Eleven-mile creek, on the Columbia river north of here, work on the *Savona* placer claim has been kept up during the year.

South of Revelstoke, near Wigwam, several new mineral claims have been located on Akolkolex creek, and considerable development-work has been done on the old claims owned by Arthur Kittan and John Lewis. Several small shipments have been sent to the assay office, but we have not been able to procure the returns.

Albert Canyon, on the main line of the Canadian Pacific Railway, about twenty-two miles east of Revelstoke, is the headquarters of the old *Waverly-Tangier* silver-lead mines. This group, located at the head of Downie creek, and reached via the North fork of the Illecillewaet river, will resume operations the coming summer after lying idle since 1899. The new management, composed of Spokane and Seattle mining men, plans extensive developments. Several locations have been made contiguous to the group. Auto-trucks will be employed to make ore delivery to Albert Canyon and return supplies to the mines, greatly reducing the excessive wagon-haulage charges formerly charged.

Near Illecillewaet work on the *Lanark* mine, under the management of W. B. Dornberg, has been going on steadily since February, employing an average of ten men daily. A Riblet tramway was constructed late in the fall, worked in two sections. The total length of the two trams is 6,900 feet, the upper span being 3,600 feet and the lower span 3,300 feet. During the month of December 96 tons of ore was shipped from this group, 64 tons running 34 per cent. lead and 33 oz. silver to the ton, and 32 tons running 29 per cent. lead and 26 oz. silver. The severe cold and heavy snowfall during the latter part of December have been quite a handicap to the shipping, but that has now been overcome, and beginning some time in January of the New Year the management expects to be able to ship a 30-ton car every second day. Very little development-work has been done on new ore-bodies this year, the work being mostly confined to the prospected ground. A very profitable shoot of 175 feet has been driven on in the *Maple Leaf* claim, showing from 15 inches to 4½ feet of about $30 ore; this shoot has been developed for 200 feet perpendicular. It has been proven, by using a pump to sink with at their lowest point, that ore continues below the old *Lanark* workings. This was found by merely prospecting, and if it is found that the showing continues they intend to install another larger pump and sink to considerable depth. While the values have heretofore been confined to lead and silver, seemingly commercial bodies of zinc are now being encountered. Whether this will continue or not remains to be seen, but the owners, so far, are satisfied with their expenditure and have hopes ultimately of having a good producer.

OFFICE STATISTICS—REVELSTOKE MINING DIVISION.

Free miners' certificates	133
Claims recorded (mineral)	66
Claims recorded (placer)	11
Certificates of work recorded	19
Payments in lieu of work	2
Placer leases granted	2
Agreements and transfers recorded	9
Abandonments recorded	2

LARDEAU MINING DIVISION.

REPORT OF WM. A. STRUTT, MINING RECORDER.

I have the honour to submit herewith my report of the progress of the mining industry in the Lardeau Mining Division for the year 1915.

Mining operations in this district are not at all active; in fact, they show a falling-off from last year, aside from the assessment-work done.

No company operated in here this past year. The owners of the *Spider* and *Mabel* claims drifted some 80 feet with good results.

Two hundred and fifty feet of tunnel was driven on the *Excise* and *Duty* claims, but the ore-shoot was not encountered.

OFFICE STATISTICS—LARDEAU MINING DIVISION.

Free miners' certificates (ordinary)	33
Free miners' certificates (company)	1
Certificates of work	66
Payments in lieu of work	3
Locations recorded	19
Agreements and transfers recorded	10

SLOCAN DISTRICT.

AINSWORTH MINING DIVISION.

REPORT BY R. J. STENSON, GOLD COMMISSIONER.

I beg to submit the annual report for the Ainsworth Mining Division for the year 1915.

During the year an improvement has taken place in the mining industry; the high prices of lead and zinc have stimulated development and given speculative interest to several properties, as a result of which the *Revenue* and *Flint* properties, on the South fork of Kaslo creek, were bonded by East Kootenay capitalists. The latter property is under the management of J. Carter. It was found impossible, owing to the heavy snowfall, to get in supplies and arrange comfortable quarters for the men; therefore, work during the winter on the *Revenue* was abandoned. It is the intention to push the work on both properties as early as possible in the spring.

The principal shippers were the *Bluebell, No. 1, Cork, Utica, Whitewater,* and *Panama.*

Bluebell. This property, owing to the war, closed down for about a year, but resumed operations in August last; during the five months about 23,500 tons of ore was mined and milled, which produced 2,200 tons lead concentrates, all of which was taken from the third level, about 200 feet below the level of Kootenay lake; the water is being handled by an electrically operated centrifugal pump. An average of almost forty men was employed for the year.

No. 1. After a shut-down of six months operations were resumed on February 15th last. The shaft was sunk 100 feet and a crosscut driven to the vein on the lower level; 7,000 tons of silver-lead ore was shipped to Trail smelter; an average of thirty-eight men employed underground and twelve on surface work. The property is owned by the Consolidated Mining and Smelting Company.

Cork. Work was commenced on May 1st and continued until November 1st, when, owing to shortage of water, the mill was closed and the force reduced from thirty-five to fifteen men employed on development. Over 10,000 tons of ore was mined and 980 tons lead concentrates was shipped. Cook and bunk houses were erected and additional pipe-line was constructed, which is expected to furnish sufficient power for all purposes. It is understood operations will be resumed in the spring on a more extensive scale.

Utica.—Work done on this property consisted of 58 feet of drifting, 106 feet crosscutting, and 200 feet of raising; 476 tons silver-lead and 163 tons zinc was shipped, the latter to Blende, Colorado; both of these ores run high in silver. Twenty-five men were employed throughout the year.

Whitewater.—Twelve men were employed continuously; 175 tons silver-lead and 594 tons of zinc ore was shipped, the latter to Bartlesville, Oklahoma.

The *Panama* operated steadily all year, during which 120 feet of development was accomplished. This is a "dry ore"; the silver values are high. Three men employed and 35 tons shipped.

Florence.—This property has just entered the shipping-list; arrangements were made to mill this ore at the *Highland* mill, near Ainsworth, late last fall, but through lack of water it shut down. A new camp for forty men was erected and a hydro-electric plant on Woodbury creek was installed. Ten men were employed.

The *Highland* was operated by the Consolidated Mining and Smelting Company with five men on development. The lower level was connected with the upper workings, considerable ore being blocked out and 40 tons shipped.

Snelling.—Considerable development-work done, with favourable results, under the management of J. F. Carey.

Flint.—A large body of lead ore was developed on this property, and it was bonded by East Kootenay capitalists. It is expected to be further developed, extensively, in the spring.

The *Grant* and *General*, near Ainsworth, employed two men the greater part of the year, extending the tunnel 40 feet, two upraises 120 feet, and sacked 3 tons of ore, said to run 2,000 oz. silver.

The *St. Patrick*, on Hamill creek was developed with satisfactory results; the ore encountered assays 100 oz. silver and 79 per cent. lead.

Gallagher.—On this property six men were employed; the work done consisted of 472 feet of drifts, crosscuts, and raises. Thirteen tons of ore was shipped from the old workings. A gasolene-driven air-compressor and two machine-drills were added to the equipment.

Comfort.—Adjoins the *Bluebell*, and here buildings were erected and considerable stripping effected.

I may say increased activity is expected on the *Krao* and *Skyline*, in Ainsworth camp; the *Index* on the South fork of the Kaslo creek; the *Bell* and *U.S.*, in Jackson basin.

OFFICE STATISTICS—AINSWORTH MINING DIVISION.

Free miners' certificates	174
Locations recorded	103
Assessments	95
Transfers, etc.	40

SLOCAN MINING DIVISION.

REPORT BY ANGUS MCINNES, MINING RECORDER.

I have the honour to submit herewith the annual report on the mining operations in the Slocan Mining Division for the year ending December 31st, 1915.

It is pleasing to be able to state that the year 1915 was one of the most prosperous, in the way of ore shipments and development-work done, that the Slocan has ever seen. With the prices of our metal products on the move upwards, the prospects for the year 1916 are bright for the Slocan.

The Silverton camp has taken the lead in the last year, having four big producers in operation, of which the *Standard* made the greatest output. About October the Galena Farm Mining Company, owning the *Galena Farm*, operated by Patrick Clark, of Spokane, began shipping, which added greatly to the output from that camp. The shipments from Slocan Lake points will aggregate about 3,000 tons a month, including zinc shipments.

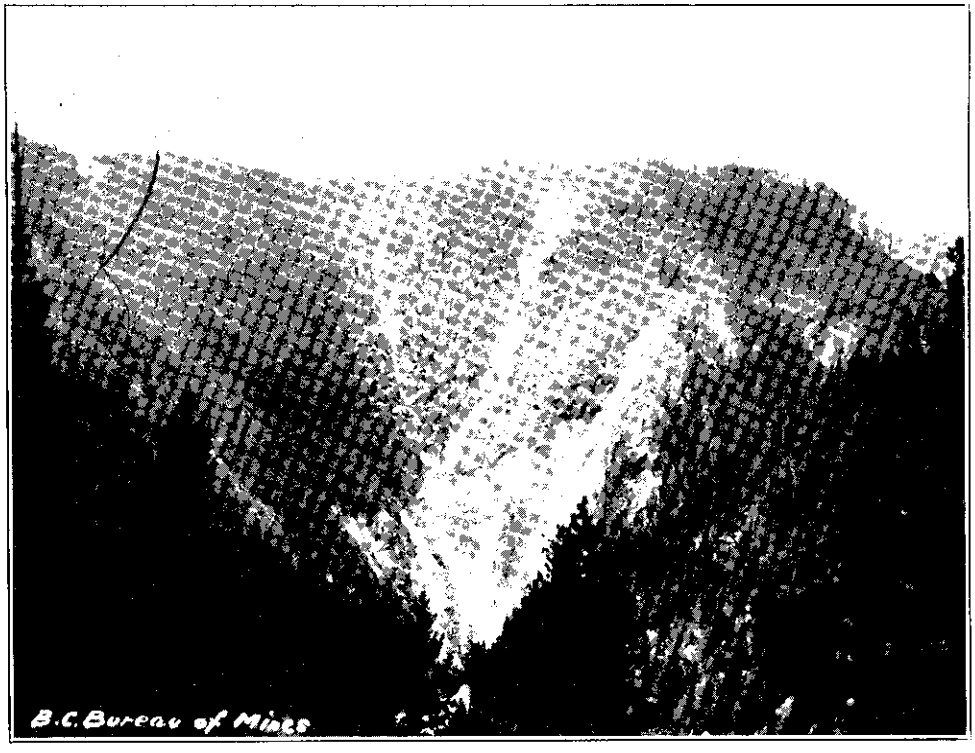
The *Standard* was the largest shipper, with an output of approximately 1,800 tons a month, working a crew of about 200 men. I am informed by the management that the mine never looked better than now. The company is paying regularly $50,000 in dividends, with an extra dividend when the accumulation warrants, which, at the present time, is over $300,000.

The Silverton Mines, Limited, situated on Four-mile creek, has had a good year; the mill has been grinding about 90 tons of feed daily; between concentrates and clean ore it has shipped on an average 400 tons a month. The ore is high in silver. About three-quarters of the tonnage is zinc ore with high values in silver. The mine-development is being kept well ahead, with big reserves of ore blocked out. I understand it is the intention of the management to increase the output considerably in the early spring.

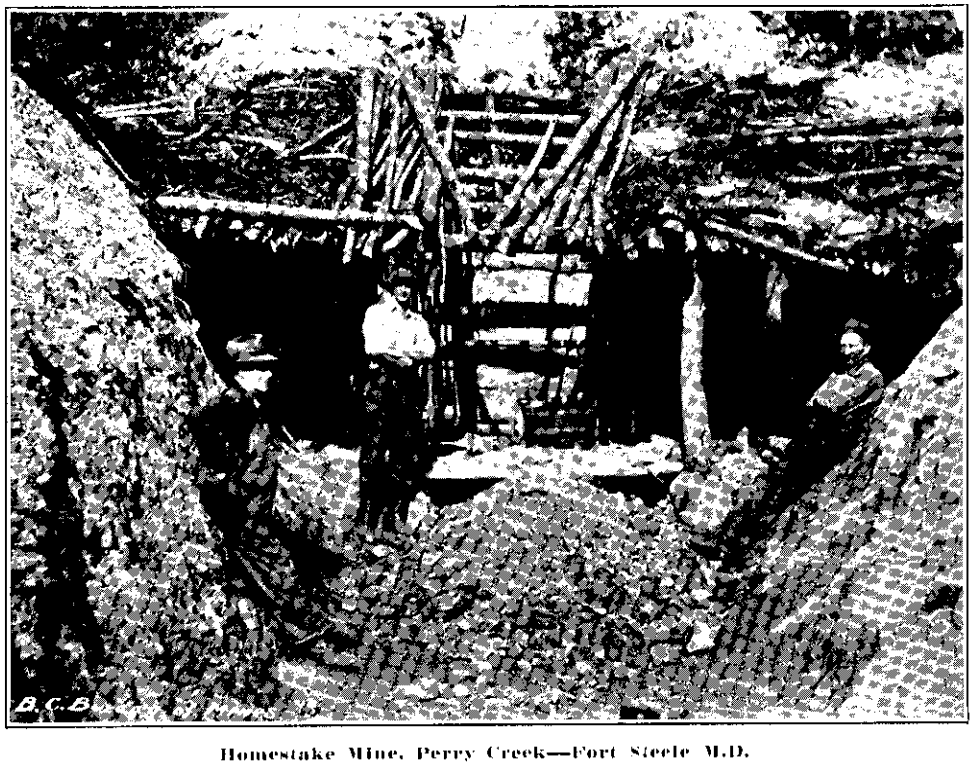
The Northland Mines, Limited, better known as the *Galena Farm*, was taken over shortly before the war started by the late Patrick Clark, of Spokane, and is now managed by the son, P. Clark, who last summer erected a fine concentrating-mill plant on the property capable of handling 100 tons of ore-feed a day. The mill is now turning out zinc and lead concentrates to about 700 tons a month. In the mine about a year's ore is blocked out, and it is expected, in the spring, to increase the output to 1,000 tons a month.

The *Lucky Thought* is owned and operated by the Consolidated Mining and Smelting Company of Canada, which acquired it about a year ago and has since been doing much development-work.

The *Echo* group, situated directly above the *Standard* and on the same vein, has also been doing a great deal of development-work in the shape of tunnels, drifts, and stopes. Some bodies of silver-lead and zinc ores are being opened up; the work is carried on under the management of J. Thompson, who is one of the owners.



Gravel Bank being hydraulicked, Perry Creek—Fort Steele M.D.



Homestake Mine, Perry Creek—Fort Steele M.D.

The *Apex* group, situated on Carpenter creek near New Denver, is operated by A. J. Becker, who has for the last two years been developing the property, and is now starting to ship the ore blocked out, the first car having been dispatched a few days ago to the Trail smelter; the ore carries from 100 to 600 oz. in silver.

The *Molly Hughes* is another property close to Slocan lake and was being developed for the last year; this is another dry-ore property and carries very high silver values. The owner expects to start shipping in the early spring.

The Sandon, Three Forks, and McGuigan camps have done much in the way of development and other preparations for a larger output of ore.

The *Black Grouse*, near Three Forks, is a dry-ore property, and recently large bodies of very high-grade silver ore were struck.

The *Alps*, near Three Forks, on the North fork of Carpenter creek, is an antimony property owned by W. A. McMillan, of Vancouver; the mine is very high up and difficult to work in winter-time. Mr. McMillan shipped two cars of this ore in the fall to England.

The *Ruth & Hope*, at Sandon, shipped high-grade silver-lead ore; this property has worked steadily for about fourteen years. Last fall the foundations of the mill were renewed, and concentrates as well as clean crude ore are now being turned out.

The *Slocan Star*, at Sandon, under the management of Oscar V. White, is shipping steadily and doing much development-work, and lately ran into bodies of clean ore; the concentrator is doing good work.

The *Mountain Con* is a property very high up the mountain, and, on account of lack of transportation and snow, can only work about four months in the year. It is worked under lease to Wm. Bennett, of Sandon; in the short time he worked with a small crew last summer he took out about $30,000 worth of ore of very high grade.

The *Noble Five* is owned and operated by the Hon. James Dunsmuir. A long crosscut tunnel started about a year ago is now about finished, which, it is expected, will tap the ledge about 1,200 feet below the other workings.

The *Payne* is also about finishing a long crosscut and has got the vein at a greater depth, with a good quantity of clean ore and much concentrating and zinc ore.

The *Surprise* has worked continuously for the last fourteen years and employs between thirty to forty men, and shipped during the last year about 1,800 tons of silver-lead concentrates averaging 120 oz. silver and 60 per cent. lead, and 2,800 tons of 40-per-cent. zinc concentrates having 24 oz. silver values.

The *Noonday*, in the Sandon camp, operated by a company, mostly Spokane people, and managed by Bruce White, has opened up a body of ore and is preparing to ship regularly from now on, having already started rawhiding.

The *Wonderful*, operated by Clarence Cunningham, has made several shipments of good ore during the year, and it is believed they now have the vein in-place. This property has been worked for years by different parties, who worked it for the float-ore found in the earth, but were never able to locate the vein.

The *Rambler-Cariboo*, in McGuigan basin, is owned and operated by a syndicate of people from Spokane, and has been working continuously for sixteen years. The superintendent (W. Cameron) informs me that they have much ore in sight now. They have a large reserve of ore blocked out and expect to ship more this coming year than ever. They shipped this last year 500 tons of crude ore (silver-lead), 2,000 tons of silver-lead concentrates, and 1,600 tons of zinc. They have paid $75,000 in dividends to the owners during the year.

The *Lucky Jim*, situated at Bear lake, under the management of A. Larson, of Spokane, has been put on the list of shippers last fall; this property is mostly zinc ore.

OFFICE STATISTICS—SLOCAN MINING DIVISION.

Free miners' certificates	151
Free miners' certificates (company)	2
Free miners' certificates (special)	2
Claims located	62
Assessments recorded	136
Agreements and transfers	13
Certificates of improvements	2

SLOCAN MINING DIVISION.

NOTES BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

At the close of the field season of 1915 the writer spent a week in the Silverton camp, noting mining conditions generally and examining some of the more important properties. This section of the Slocan district has experienced a very satisfactory mining development during the past few years and is now in a prosperous and healthy condition. The outstanding mine in this camp is the *Standard*, which has been and is a steady dividend-payer. This property was worked with indifferent success for many years, and its present condition is a testimonial to the hard work, ability, and progressive optimism of Geo. Aylard, the former owner, and now managing director of the Standard Silver Lead Company, which owns the property. Another important property in the district is the *Hewitt-Lorna Doone* group, owned by the Silverton Mines, Limited, M. S. Davys, managing director, and Geo. Stillwell, superintendent. The ore from this mine has always been difficult to mill, and it is only lately that complete success has been obtained. The introduction of oil-flotation in the mill has successfully solved the problem of treating the ore, but it took considerable time and experimentation to so adjust the oil-flotation process as to handle the ore. Mr. Davys and Mr. Stillwell are to be congratulated on their success after flotation experts of the Minerals Separation Company had failed. This mine now has a promising future.

The Van Roi Mining Company, which formerly was a large producer, has been closed down since war broke out. It is believed that the known developed ore reserves are practically worked out and further development will be required. This ore is also difficult to treat, and the present mill, designed only to use water-concentration, does not make a very high percentage extraction.

The *Galena Farm*, an old property previously worked twenty years ago, was bonded last year, work commenced, and a 100-ton a day concentrator erected. This property is now being operated by the Patsey Clark Estate.

Development-work was carried out during 1915 on the *Alpha* and *Echo* claims, above the *Standard;* on the *Lucky Thought*, near the Silverton Mines mill on Four-mile creek, by the Consolidated Company; and on the *L.H.*, south of Silverton. Small ore shipments were made from the *Buffalo*, *Comstock*, and *Wakefield* by leasers, but work was not continued on these properties.

The future of the camp now looks promising, and it is more than probable that the present high prices of lead and zinc will encourage the reopening-up of others of the old properties worked in former years.

The general geological and physical features of the Silverton camp are well known; references to the camp, sometimes short, sometimes extended, will be found in all the past Annual Reports of this Department since the commencement of mining in the district thirty years ago.

In 1909-10, O. E. Leroy, of the Geological Survey, studied the geology of the Slocan Map-area and prepared a topographic and geologic map of this section. Interim reports on this work appear in the summary reports of the Geological Survey of Canada for those years, but the final memoir has not been issued yet. The following excerpt from his 1910 Summary Report is appended:—

"The rock series underlying this district are the Shuswap, Selkirk, and Slocan, of which the former is Pre-Cambrian. The relative ages of the Selkirk and Slocan series have not yet been fixed with any degree of definiteness, owing to the apparently entire absence of fossils. The present contact relations between the three above series is to be accounted for by intense folding, accompanied by overthrust faulting during the later epochs of mountain-building. The biotite-schists of the Shuswap are in sharp contact with the softer green schists of the Selkirk, and those of the latter are similarly related to the black slates of the Slocan series.

"Near the border of the Selkirk small infolds of the Slocan series are occasionally to be found, while along the Blue Ridge summit there is a marked syncline, passing southwards into a monoclinal fold, the central portion of which is composed of rocks lithologically identical with those of the Slocan series.

"In Jurassic or Post-Jurassic time the above series were intruded by enormous batholiths of granitic rocks, and mountain-building processes continued long after this intrusion, as evidenced by the folded and faulted dykes and sills genetically connected with the batholith.

"The Tertiary period is not represented in this district, and the Quaternary only by limited areas of glacial drift and alluvium.

"*Shuswap Series.*—The Shuswap series is developed as a comparatively narrow band along the west shore of Kootenay lake, broadening somewhat in its northern extension beyond Shroeder creek. The series consists of interbedded acid and basic gneisses, hornblende, and biotite-schists, quartzites, and crystalline limestones, with intercalated sills of granite, quartz porphyry, diorite, etc. The general strike makes a slight angle with the trend of the shore-line, and varies from N. 15° W. to N. 25° W., with south-west dips ranging from 45 to 85 degrees. The series also occurs along the east shore of Kootenay lake and the west shore of Slocan lake in isolated exposures.

"*Selkirk Series.*—The Selkirk series occupies a roughly triangular area in the north and north-east part of the sheet, and is composed, in the main, of rocks of igneous origin, with but a small development of sedimentaries. Hornblende, chlorite, and quartz schists predominate, with subordinate breccias, partially sheared eruptives both acid and basic, silicified ash rocks, cherts, quartzites, and limestones. Of the basic eruptives, dykes and masses of serpentine are of most frequent occurrence. The general strike of the series corresponds with that of the Shuswap, and in the northern extension of the series gradually swings to the west. With the exception of a portion of the Blue Ridge syncline, the dips are prevailing to the south-west and south.

"*Slocan Series.*—This series occupies the main area of the sheet south and west of the Selkirk. It is composed of interbedded sandstones (passing into quartzites), argillites, slates, and limestones, with all grades of transition between the main types. The slates are usually highly carbonaceous, and in a crushed form become graphitic. The quartzites and sandstones are usually impure from clayey and calcareous material, and the limestones are both carbonaceous and argillaceous.

"In the zone of contact metamorphism surrounding the granodiorite batholith, the above rock types have been altered to andalusite, biotite, and quartz schists, hornstone, crystalline limestone, and marble.

"The series lies in an irregular basin, the rocks overlying the Selkirk on the east margin, and apparently the Shuswap on the west, although the Selkirk may also be present but concealed by the waters of Slocan lake. No basal beds are exposed, but sandstones and quartzites are predominant in the west, while limestone is a more prominent member of the eastern portion of the series. In the west the strike of the rocks is northerly, in the main, but gradually swings to the east and south of east, roughly corresponding to the trend of the contact between the Slocan and Selkirk series. The dips are usually high, and are rarely under 40 degrees.

"*Igneous Rocks.*—With the exception of those rocks peculiarly associated with the Shuswap and Selkirk series, the igneous rocks are later than the Slocan series. The oldest group occurs chiefly as sills in the slates and quartzites; they are completely altered and now consist of secondary quartz, carbonates, mica, and chlorite.

"To Jurassic or Post-Jurassic time is referred the enormous batholithic intrusions of granodiorite and other closely related plutonic rocks which occupy so large an area in the West Kootenay district. The northern part of the Nelson batholith occupies the greater portion of the southern border of the Slocan sheet. The rock varies from mica and hornblende granites to granodiorites, and even more basic types. They range from medium to coarsely porphyritic in texture, and in colour from light grey to almost white. Genetically connected with this batholith is the great series of sills, dykes, bosses, and stocks of finer-grained porphyritic varieties of the above plutonics, which are widespread throughout the area, with the greatest development in the rocks of the Slocan series.

"At a somewhat later period all the older rocks, both sedimentary and igneous, were cut by basic, mica lamprophyre dykes, and these represent the last evidences of igneous activity in the district.

"*Economic Geology.*—Silver-lead and zinc deposits occur in the granitic rocks of the Nelson batholith, and in the Selkirk and Slocan series, the most important and numerous ore-bodies being found in the Slocan slates.

"In the Selkirk the ore-bodies occur in the greenstones and schists, and have been found hitherto to be too small and of too pockety a character to render them important products. In the granitic rocks the ore-bodies occupy fissures or zones of fissuring which may correspond

to the local master-jointing in the rock. The fissure may be several hundred feet long, with a width varying from that of a knife-blade to 5 or 6 feet. Both wet and dry ores occur in the granite; examples of the former are the *Fisher-Maiden*, *Mountain Con*, and *Flint* mines, and of the latter the *Molly Hughes*, *McAllister*, *Sweetgrass*, etc. In the rocks of the Slocan series the fissure system is best developed and contains the largest veins and ore-bodies. The veins vary in length from a few hundred to about 4,000 feet, and in width from a few inches to 50 feet. They almost invariably cut across the strike or dip of the formation, bedded veins being quite rare. In such a wide area the strike varies greatly, and the dips range from 30 to 80 degrees. The veins either end by swinging in on the bedding-plane of the slates and quartzites, or feather out in the broad bands of softer slates. Faulting is difficult to detect on account of the similarity of the rocks; it is only where sills of porphyry occur that the small displacements may be seen.

"Where the vein is wide the filling is largely crushed and broken country-rock. Siderite, quartz, and calcite are the most common of the gangue minerals, and the deposits are characterized by having one of the above either as the predominant or as the almost exclusive gangue mineral.

"The ore-shoots are usually composite in character, and consist of irregular bands, lenses, and masses of clean galena or zinc-blende, and intimate mixtures of the two.

"The shoots vary from a few feet to 400 feet or more in length, and from a few inches to 40 feet in width. As a rule, the pay-streaks of high-grade ore favour the hanging-wall, and vary from a fraction of an inch to over 5 feet in width.

"The ore-bodies favour the softer slates and sandstones which are more carbonaceous, rather than the quartzites and porphyries, but there are some exceptions in which the reverse is true.

"The ores are classified under wet and dry; the former having calcite or siderite as gangue with the galena, while the latter have quartz. Galena and blende, with tetrahedrite (freibergite, grey-copper), are the chief metallic minerals. Ruby and native silver and argentite are found in a few deposits. Chalcopyrite and pyrite are almost invariably present, the former in small amount and the latter in increasing quantity as the lead content decreases.

"At present the values of the ores mined range from about 7 per cent. lead and 20 oz. silver to the ton—which is low-grade concentrating ore—to the high-grade ore which ranges from 50 to 75 per cent. lead and from 80 to 175 oz. silver per ton. The dry ores run high in silver, with low lead content. Gold occurs in many of the ores, with assay values from $1 to $7 per ton."

In the 1911 Report of the Minister of Mines will be found a report by W. Fleet Robertson, Provincial Mineralogist, on the Slocan district, in which there are extended descriptions of the *Standard*, *Van-Roi*, and *Hewitt-Lorna Doone* mines. The writer will therefore try to avoid undue repetition, but simply note new work and developments.

Standard Silver-Lead Mining Co.

This company owns a group of claims on the north side of Four-mile creek about two miles from the town of Silverton. The claims include the *Emily Edith*, *Standard*, and *Alpha*, and the principal mining-work is on the *Standard*. The *Standard* was the nucleus of the present company and was first acquired by Geo. Aylard from the original owners; later Mr. Aylard interested Finch & Campbell, of Spokane, and the company was formed, and the *Emily Edith* and other claims were secured by purchase. The *Alpha* is being operated at present by the company under some sort of an option with the owners, the estate of N. F. McNaught.

In 1911 the water-concentrating mill was erected on the shore of Slocan lake, at the north end of the town of Silverton, and connected to the mine by an aerial bucket tramway. A flow-sheet of this mill is given in the 1911 Report, and only slight modifications of the mill design have been made since that time. The capacity of the mill is about 150 tons a day. The products of the mill are lead concentrates carrying good silver values which is shipped to the Trail smelter, and zinc concentrates containing some silver which are sold to smelters in the United States. No figures as to extraction are available, but it is known that both lead and zinc losses in tailings are considerable. It is probable that the average all-round extraction on silver, lead, and zinc values is not more than 70 per cent. Such losses are usual in any mill using jigs and tables operating on lead-zinc ores. Also when any of the ore contains grey-copper and ruby-silver (as is often the case), these minerals are almost entirely lost in the tailings, thereby causing a heavy loss in silver values. The reason that a lead-zinc concentrator generally has

high tailings losses is owing to the habit of this class of ore to slime readily, and such slimes of metallic minerals cannot be saved in ordinary concentrators. Of late years a great deal of work has been done in adapting flotation processes to the treatment of these slimes, and great success has been attained in many places, notably at Broken Hill, Australia, where flotation had its inception, and later in many sections of the United States. The pioneers in the use of oil-flotation to treat silver-lead zinc ores in British Columbia were the Silverton Mines, Limited, and later the Standard Company. The process is working successfully at the mill of the former company in combination with a preliminary water-concentration, and a very satisfactory recovery of the values in the ores is being obtained. The process at the Standard Company's mill is in the final stages of experimentation and a plant to treat the tailings is about to be installed. One of the chief difficulties in adapting flotation to the treatment of tailings containing lead and zinc sulphides is the selective separation of these minerals by oil-flotation. It is comparatively easy to float the lead and zinc sulphides together and separate them from the associated gangue rock, but it is much harder to float either sulphide by itself. One way of dealing with it is to make a combined lead-zinc concentrate and then separate these by later treatment on a shaking table. Or, again, by a proper selection of oils and modifications of the process a partial separation can be made by oil-flotation. A description of the process in use at the Silverton Mines, Limited, is given in the notes on that company's mill.

The *Standard* mine is developed by eight tunnels, all of which are adits driven in on the vein. The vein is a large one, up to 100 feet in width, and the vein-filling consists for the most part of crushed slate, together with some quartz, calcite, and siderite. The main ore-shoot in the mine is developed between No. 3 and No. 6 levels. This ore-shoot was undoubtedly the largest shoot of high-grade galena ore ever uncovered in British Columbia. On the No. 5 level it was 400 feet long and showed up to 20 feet in width of clean galena, besides an equal thickness of concentrating-ore. All ore above No. 4 has been stoped out, and most of that above No. 6. At the present time No. 8 tunnel is being driven in, and exploration is being carried out between Nos. 6 and 7 to find the downward continuation of the main ore-shoot. The vertical distances between the tunnels are: No. 3 to 4, 100 feet; No. 4 to 5, 125 feet; No. 5 to 6, 180 feet; No. 6 to 7, 280 feet; No. 7 to 8, 400 feet. No. 7 is in over a mile and should have struck the main ore-shoot, but in such a large vein it quite possibly could have been missed. By working down from No. 6 in intermediate levels the ore-body will either be followed or it will be definitely known that it has ceased. No. 8 is in about 1,500 feet and has shown small amounts of ore. There is a long section of the vein that this tunnel will prospect before entering ground where a possible extension of the upper ore-shoot would be found, and it is quite possible that other shoots may be discovered. The general practice is to run crosscuts to foot and hanging walls every 100 feet. In this way any ore-shoot 90 feet or greater in length would be discovered, and shorter ones would stand a fair chance of being located. Work is being prosecuted steadily on this level, which has its portal on *Emily Edith* ground.

The main level entry of the mine is the No. 6 level, and from ore-bins at its mouth the tramway starts. Some crude ore is taken out of No. 5 and brought down to these ore-bins by a baby gravity-tram, but all mill-feed goes through to No. 6. There are also bins at the portal of No. 7 and the main tramway can be loaded there if desired. All the levels down to No. 7 are connected by raises, but there is no connection between Nos. 7 and 8. The system of mining is to stope the ore upwards in 5-foot sections, timber by means of square-setting, and fill in the timbers with waste rock.

When war broke out in August, 1914, the *Standard* had to stop mining and milling ore, as the Trail smelter refused to take any shipments at that time. Development-work was kept up, though, and in June, 1915, mining and milling was resumed. The mill is run in three 8-hour shifts and the mine in two shifts.

In 1915 the production, which is for the half-year operated, was as follows: Tonnage milled, 35,176 tons; lead concentrates, 7,910 tons, containing 747,313 oz. silver and 8,480,945 lb. lead; zinc concentrates, 4,406 tons, containing 101,330 oz. silver and 3,778,857 lb. zinc.

In the last four years this mine has paid the following dividends: 1912, $425,000; 1913, $650,000; 1914, $475,000, operating seven months; 1915, $250,000, operating seven months.

Like all Slocan mines, a great deal of dead development has to be done to find the ore-shoots, and, at certain times, the total tonnage of ore in sight in the mine is small.

Echo. The *Echo* group is situated above the *Alpha* and near the top of the mountain. It is owned by Grady, Briggs, *et al.*, and has been under lease and bond for some time to H. Thompson and Martin Welch. The group consists of two claims and a fraction above the *Alpha* and two below the *Standard*.

The lead on which the work is being done is supposed to be a continuation of the *Standard* vein on, through, and beyond the *Alpha* ground. The vein is, as usual, quite large, up to 100 feet in width, being largely filled with broken, crushed slate. The main tunnel, which is in about 500 feet, starts on *Alpha* ground. There are also some shorter tunnels and a few open-cuts. Some small pockets of ore have been encountered, and Mr. Thompson is quite hopeful that further development will reveal some good-sized shoots of ore. Six men were at work at the time the property was visited, with Mr. Thompson in charge of the work, and it was intended to continue development all winter. The work being done was to drive ahead the drift-tunnels which follow the vein, and crosscuts to both walls are put in every 100 feet.

Lucky Thought. This mine is on the south side of Four-mile creek about four miles from Silverton. It is owned or controlled by T. J. Floyd, of New Denver, but has been under lease and bond to the Consolidated Mining and Smelting Company for the past three years. The property is developed by three tunnels and raises between. The Consolidated Company spent considerable money in development, having done 2,000 or 3,000 feet of working.

The vein is the usual type of large vein, filled for the most part with crushed slate. Very heavy flows of water were encountered in some of the drifts and caused considerable trouble. As yet the development has failed to show any large shoots of ore, only small streaks of ore having been found, consisting of galena, zinc-blende, grey-copper, and a little ruby-silver. During 1915, 100 tons of ore was shipped which contained 6,589 oz. silver and 32,074 lb. lead, corresponding to an assay value of 65.89 oz. silver to the ton and 16 per cent. lead.

Practically no ore could be seen in the mine at the time of examination, and it is not known whether or not further development-work will be carried out.

Galena Farm Group. This group of five Crown-granted claims is situated on the hill back of Silverton on a flat bench and distant about one mile and a half from the town. This property was operated some twenty years ago, when a shaft was sunk and a water-driven compressor and hoist were installed. Since then the property, which is owned by A. W. McCune, of Salt Lake City, has been idle until the beginning of 1915, when an option on it was acquired by the late Patsey Clark. Work was at once commenced and vigorously prosecuted, and is now being continued by the Clark Estate.

The vein is mainly in granite, but is very close to the contact, with an inclusion of slates in the granite. Apparently the granite here is intrusive with the slates in an irregular manner, and erosion has laid bare the granite in places, while in others there is still a capping of slate rock. The vein strikes north and south (mag.) and dips to the west at 45 to 65 degrees. It is from 6 to 12 feet wide and consists of quartz, siderite, and fragments of crushed granite and slate, carrying varying amounts of zinc-blende and galena. The old shaft is vertical and cuts the vein at about 100 feet, and from that level drifts were run on the vein. The shaft was sunk to 200 feet and a crosscut made to pick up the vein, but unsuccessfully. The main showing of ore is in the north drift on the 100-foot level, which shows a shoot 200 feet long, with an average width of 6 feet, well mineralized with zinc-blende and some galena. It is also claimed that the quartz carries low gold values.

The present company ran in a tunnel 850 feet, raised 50 feet to the 100-foot level of the old shaft, and is continuing a raise from this level to come out exactly under the old ore-dump, which is supposed to contain 2,500 tons of good milling-ore. This is the only development-work so far done by the company. As the vein dips out of the hill, it should have been encountered by this crosscut tunnel, but the only indication of a vein was a zone of somewhat crushed slate at a point 500 feet in, which at the time was not considered to be the main vein. This may, however, be the vein or it may be faulted some distance up the hill. There seems little doubt that intelligent prospecting will reveal the downward continuation of the vein, and perhaps the most direct way would be to start on the 100-foot level and follow the ore down. In the meantime the company intends to mine and mill the available ore, said to amount to some 15,000 tons, to recoup some of the outlay in erecting the mill and other work. A comprehensive development plan will probably be started and may now be under way. The vein is exposed for several

hundred feet on the surface and shows ore in many places. The property lay idle for many years owing to the fact that the ore was very zincky, but zinc is much more popular in the Slocan now than it used to be. Another old shaft on the vein, 50 feet deep and now caved in, is said to have disclosed a good shoot of ore.

The 100-ton concentrating-mill is built just below the portal of the crosscut tunnel, and ore is trammed out the tunnel along a trestle a few hundred feet long and into ore-bins at the upper end of the mill. The mine, mill, etc., are all on a comparatively flat bench, as can be seen by the fact that the tunnel in going 850 feet only gained 150 feet in depth. The mill building is on nearly level ground and the ore has to be elevated several times in its passage through the mill. At the time of visiting the property the mill was finished but not operating. Tuning up the machinery and bedding-down of the jigs was in progress. The actual flow-sheet of the ore through the mill could not be definitely stated, as certain changes in handling the ore might be made after finding out the eccentricities which are peculiar to every ore. The general scheme of milling was to be as follows: From the ore-bins the ore goes to a jaw-crusher and then to a conveyor-belt, where waste rock or crude ore could be picked out; then to ore-bins and fed to rolls; then to three trommels making five sizes; the coarse sizes go to four sets of 3-compartment jigs, and the fines to a classifier and thence to Wilfley tables. The jig tailings go to waste and the middlings are reground in rolls or two Huntingdon mills. There are ten Wilfley tables which will take pulp from classifiers and dewatering-tanks fed from regrinding-machines.

The mill is the ordinary type of lead-zinc concentrator, with no particular devices to ensure a high extraction; the recovery would probably be from 60 to 80 per cent. Provision has been made in the mill building for the erection of an oil-flotation plant to treat the tailings if later on this is found to be desirable.

Speaking generally, the Slocan district is some years behind in milling practice. Most of the mills are modelled after the Coeur d'Alene style of fifteen to twenty years ago, and more attention has been paid to putting through a large tonnage with a small number of men than to scientific milling. The result is that the percentage extraction is low, and zinc concentrates, if saved at all, are generally much lower grade than they should be. The introduction of oil-flotation processes in the Slocan mills should result in higher recoveries being made.

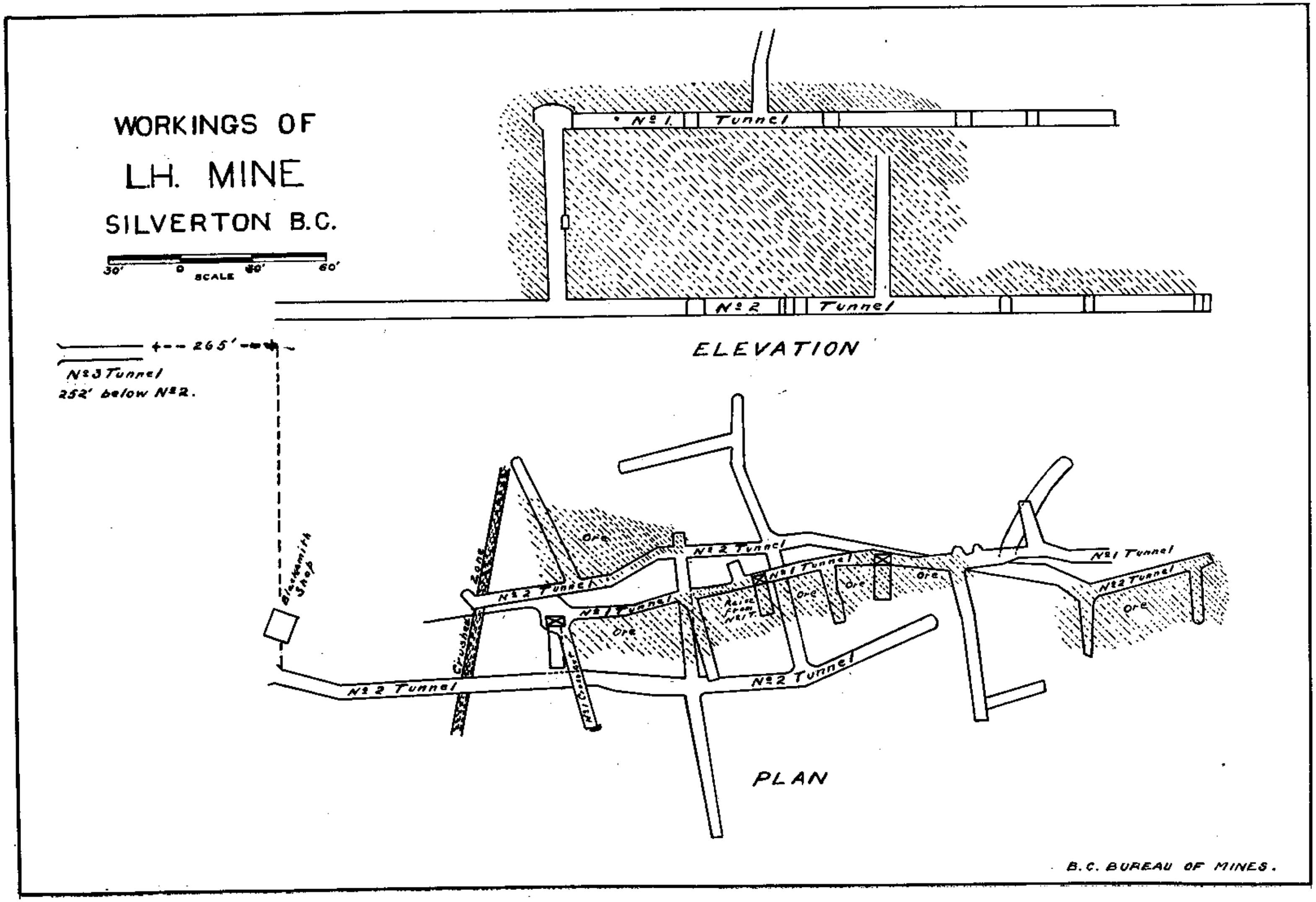
L.H. Group.

This group of seven Crown-granted mineral claims is situated about five miles and a half from Silverton in an easterly direction and at an elevation of about 5,250 feet. The workings are on a rather steep bluff, being near the head of a small branch of Eight-mile creek. There is plenty of timber available for mining purposes, and a good water-power could be developed at the mouth of Eight-mile creek. A. R. Fingland and Charles Brand, of Silverton, are the owners. The British Columbia Copper Company held a lease and bond on the property for three years, during which time development-work was carried on, but in 1914 allowed the bond to lapse. Since then some work has been done by the owners working themselves. The wagon-road to the *Galena Farm* mine is used for two miles, and beyond that a trail extends to the property.

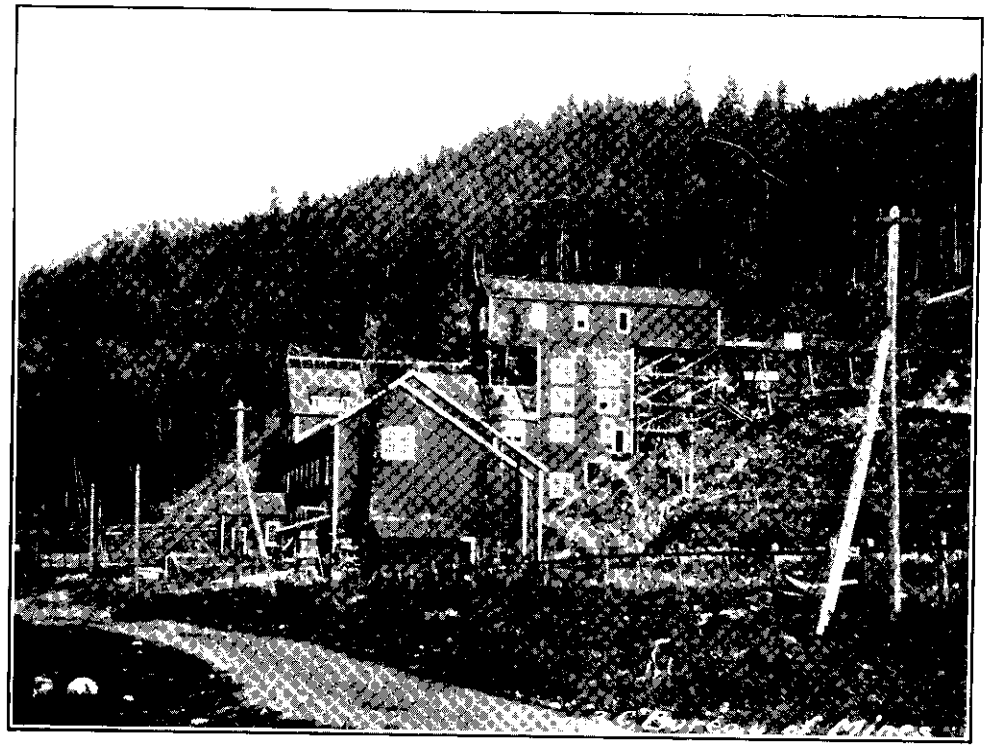
The formation here consists of an inclusion of slate entirely surrounded by granite. This slate is a mile wide and two or three miles long, and is considerably altered and silicified by the contact action of the granite. In the neighbourhood of the ore-body the slate is a hard, siliceous, very dark-coloured, dense, fine-grained rock. The ore is apparently developed along fractures in the slate which have an east-and-west strike and a variable dip. At first it was supposed that the ore-body dipped to the south, but certain work on the lower level would appear to show that it dips to the north at about 65 degrees.

In the upper tunnel there is a 2-foot porphyry dyke, soft and decomposed, which parallels the ore-body on the north side, and in the lower tunnel there is a granite (or pegmatite) dyke paralleling the ore-body to the south. In one place this dyke is mineralized with iron pyrites.

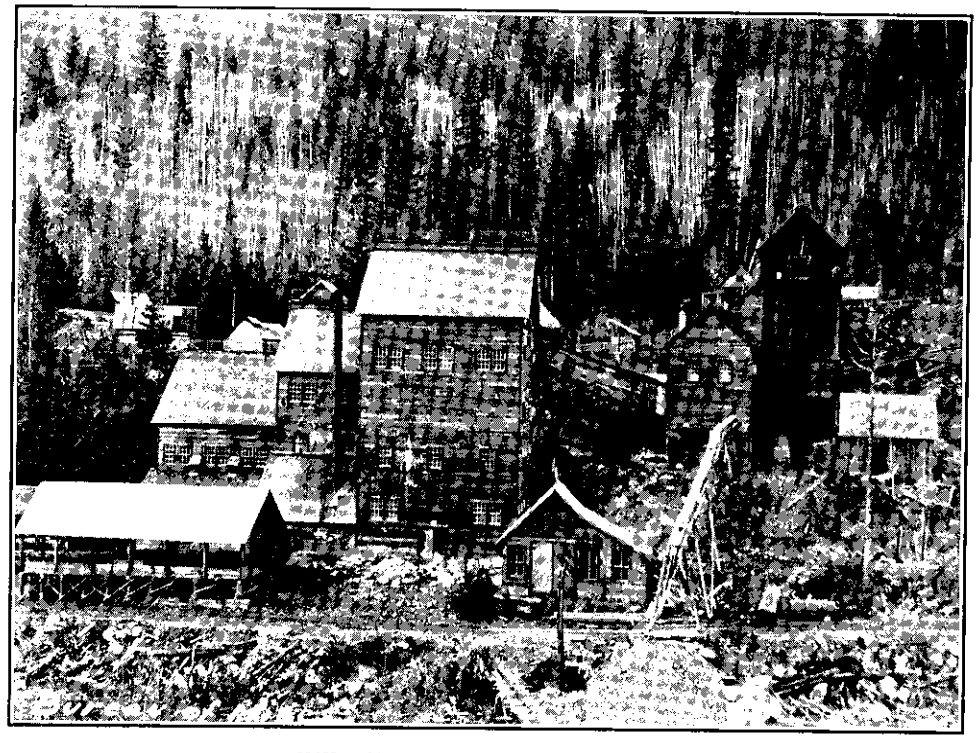
The ore-body is developed by two tunnels, together with crosscuts and raises. No. 1 tunnel (upper one) is 250 feet long and is 80 feet vertically above No. 2, to which it is connected by a raise coming through near the portal of No. 1. This tunnel has several crosscuts, as is shown on appended plan of the workings. The first 200 feet is all in ore, but beyond that the ore gradually fades away. A crosscut to the south picks up a little ore, however. There is no definiteness or regularity to the ore; it is developed along a crushed, sheared zone in the slate and has been formed by replacement. The slates have been altered, silicified, and pyritized, and all transitional stages, from pure quartz carrying pyrite to unaltered slate, can be seen.



WORKINGS OF L.H. MINE SILVERTON B.C.



Mill, Standard Mine, Silverton—Slocan M.D.



Mill, Silverton Mines—Slocan M.D.

The maximum width of ore is 40 feet and the most pronounced ore-shoot is 200 feet long in the No. 1 tunnel. The ore consists of arsenopyrite, pyrite, and pyrrhotite, and occasionally some native arsenic is found. The values are in gold, and, considered as a whole, the ore-body is admittedly low grade. The British Columbia Copper Company's engineers estimated that the development had proved some 30,000 tons of ore with an average gold value of $6 a ton. In places bands of well-mineralized quartz will give high gold assays; the quartz, as a rule, assaying better than the pyritized slate.

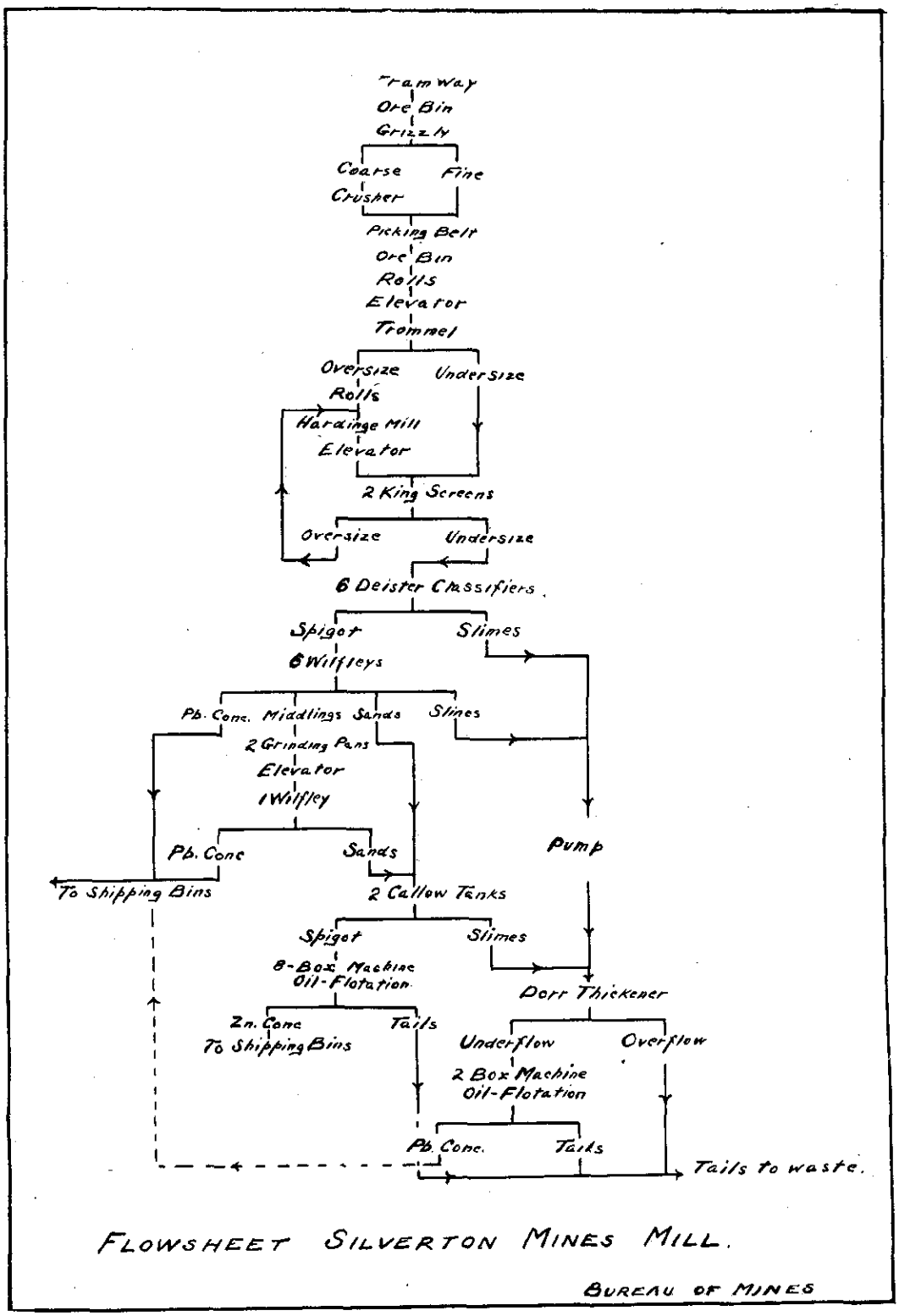
No. 2 tunnel is 400 feet long and gives a depth at the face of nearly as much. This tunnel has been driven in on a porphyry dyke for some distance, and at 80 feet cuts a crushed zone or fault-plane. A crosscut from a point 210 feet in picks up a band of quartz, which has been drifted on and shows some ore. There are several drifts and crosscuts and a raise that goes up to within 12 feet of No. 1 tunnel. The assumption that the ore-body dipped to the south, which it appears to do, was not proven by the work in the lower tunnel, which failed to find the ore where it should be, but where ore was found in one place it would show that the general dip or trend was north. This point is more important than might appear, as a lot of work done in the lower tunnel was valueless if the dip is really to the north. It would seem probable, though, that there is a considerable fractured zone here with a general slight dip to the south, and that in it lenticular ore-bodies have been developed, parallel and possibly overlapping. Therefore, in going down, one ore-body may fade away and another one be found either to the north or south.

With low-grade ore of this nature it is, of course, essential that it should be treated on the ground. The ore would probably be amenable to cyanidation, but in any case some suitable mill treatment could be devised for it. But to handle such ore at a profit it would be necessary to mine and mill on a fairly large scale. The first thing the property needs is, therefore, further development to prove up a much larger tonnage of ore, when milling plans could be considered. This the owners have realized, and they are now at work on a No. 3 tunnel which starts at a point 252 feet vertically below No. 2, and which will take 360 feet to be under the portal of No. 2. It would seem as if this ore-body could be prospected more cheaply by diamond-drilling than any other way; but this is, of course, beyond the scope of the present owners.

The failure of the British Columbia Copper Company to take up its bond on the property should not give it a "black eye," but it probably has had that effect. At the time this company was in a somewhat shaky financial condition and was not in a position to go ahead with the deal. About the time the company took the option on this property it also secured options on many others, all with the idea of developing a tonnage for treatment at its smelter at Greenwood. This smelter is a copper-smelter, and primarily the company's business is to handle copper ore. Before long it became apparent that the *L.H.* was not a likely source of ore for a copper-smelter, and the company therefore did not prosecute development very vigorously. After holding it for a time it became apparent that the purchase, development of the property, and erection of a suitable mill would involve a very considerable outlay of money which was not in line with a copper mining and smelting policy, and therefore the bond was allowed to lapse.

Silverton Mines, Ltd.

The Silverton Mines, Limited, owning and operating the *Hewitt-Lorna Doone* group and a 150-ton concentrator, had a successful year in 1915 and prospects for the future are good. The *Hewitt* and *Lorna Doone* mines are amongst the old properties of the Slocan; they have been worked more or less continuously for sixteen years, and as they have been repeatedly described in Reports of this Department, no description of them will be given by the writer. It has been known that there were considerable ore reserves in these mines, but the difficulty has been to successfully mill this ore so as to save a reasonable percentage of the values. The presence of ruby-silver, grey-copper, argentite, and zinc-blende carrying high silver values makes the treatment of this ore by the ordinary type of lead-concentrator practically impossible. When the properties were first worked, the ore was hand-sorted or milled as well as possible in some mill leased for the purpose. Later, when M. S. Davys acquired control of both properties and joined them together in one company, a commencement was made to devise a suitable mill process. The old *Wakefield* mill on Four-mile creek was leased, and, after having exhausted the possibilities in ordinary water-concentration, the Elmore vacuum oil process was tested, with, however, indifferent success. This mill having been burned down in 1912, a new mill was erected by the Silverton


Tramway
Ore Bin
Grizzly
Coarse
Fine
Crusher
Picking Belt
Ore Bin
Rolls
Elevator
Trommel
Oversize
Undersize
Rolls
Hardinge Mill
Elevator
2 King Screens
Oversize
Undersize
6 Deister Classifiers
Spigot
Slimes
6 Wilfleys
Pb. Conc.
Middlings
Sands
Slimes
2 Grinding Pans
Elevator
1 Wilfley
Pb. Conc
Sands
Pump
To Shipping Bins
2 Callow Tanks
Spiget
Slimes
8-Box Machine
Oil-Flotation
Dorr Thickener
Zn. Conc
To Shipping Bins
Tails
Underflow
Overflow
2 Box Machine
Oil-Flotation
Pb. Conc.
Tails
Tails to waste.
FLOWSHEET SILVERTON MINES MILL.
BUREAU OF MINES

Mines alongside the old mill-site. Experiments were soon commenced with the oil-flotation process of the Minerals Separation Company, and, after a lot of disappointing work, a system has been devised suited to these ores which is giving good results.

The Minerals Separation Company process as installed by that company's experts proved a failure, and after repeated changes the Silverton Mines Company officials discarded the Minerals Separation ideas in detail (although the principle of the process remains the same) and worked out the problem themselves.

A diagrammatic flow-sheet of the mill is appended to this report which shows the general method of milling. It must be remembered that this diagram is only an approximation, as the actual course of the ore through the mill changes from time to time as conditions make advisable. The ore varies greatly from day to day, and the varying percentages of sphalerite, galena, and silver minerals require that no hard-and-fast mill plan be laid down.

No figures in regard to extraction of total metals in the mill are available for publication, but it is safe to say that the additional recovery, made by reason of the oil process, makes all the difference between operating at a profit or a loss. The recovery by ordinary water-concentration would not exceed 50 to 60 per cent., while the present recovery is very likely between 85 to 90 per cent.

To describe the mill process roughly, it may be said that the ore is crushed fine and then classified into sands and slimes. The sands are treated on Wilfley tables and the slimes go to a Dorr thickener; the thickened product then goes to a two-box oil-flotation unit, where a lead concentrate and a tailings product are made. The Wilfleys make lead concentrate, middlings, sands, and slimes. The middlings are reground, joining the table sands and going to an eight-box oil-flotation unit which makes zinc concentrates and tailings. The slimes in each process mentioned above go to the two-box machines after being dewatered in a Dorr thickener. The tailings that go to waste are the overflow from the Dorr thickener and the tailings from the two flotation units. Rolls, Hardinge mills, and grinding-pans are used for crushing and grinding the ore.

The oil-flotation machines were built at the mill and are practically similar to the standard machine of the Minerals Separation Company. Essentially they are wooden boxes, square on three sides, and having a front sloping outwards and a baffle-board extending down to the bottom which would form the fourth side of the box. A simple diagrammatic cross-section of an oil-flotation cell is shown here which illustrates the way the machine works.

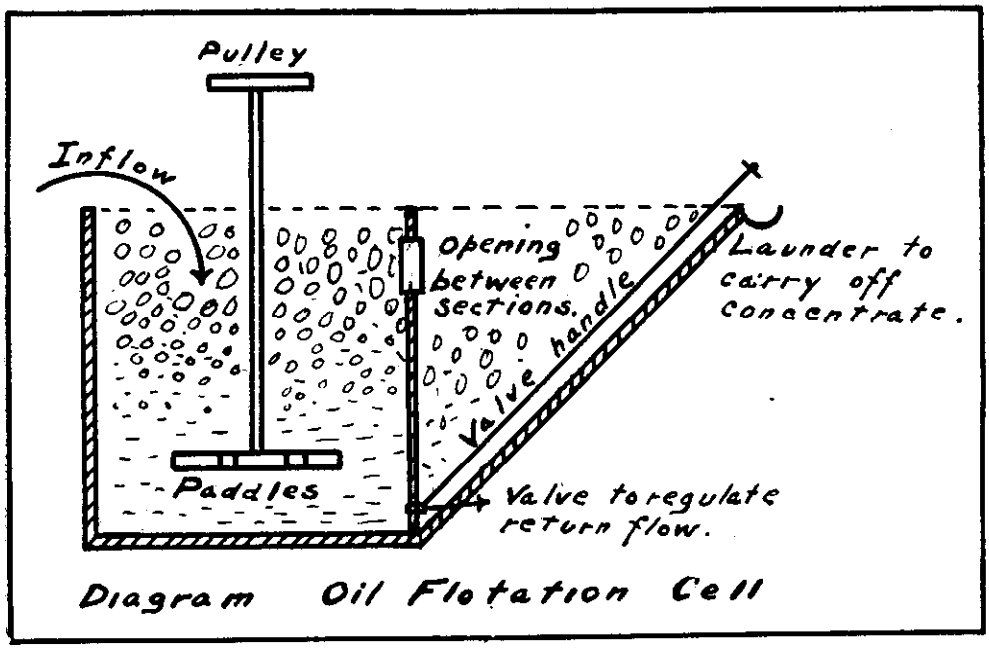


Diagram Oil Flotation Cell

The agitation and frothing takes place in the first section; the froth concentrate passes through the opening into the second section and over into the launder at the lip of the second section. The pulp of water and ore is fed into the top of the first section. Oil is added drop by drop from a tap above the cell as required, or may be previously fed into the pulp if desirable; in this latter way some mixing would be obtained in pumping the pulp up to the oil-flotation machine. The pulp and oil in the first section is agitated by means of the paddles driven by the pulley, and this agitation sucks air into the mixture. Not to enter into the theories of oil-flotation here, it will suffice to say that the oil and air-bubbles select particles of sulphide from the pulp and rise to the surface, and thus we have at the surface a mineral-laden froth which finally passes out into the launder. By means of the valve at the foot of the baffle-board a return flow to the first section can be regulated. The whole thing seems marvellously simple, but, while the general scheme is simple, the actual working has to be closely watched in its minutest details, as any slight change in conditions is sufficient to prevent the floating of the sulphides.

An oil-flotation machine generally consists of a number of such cells in which successive treatment of the pulp is given. In the eight-box machine at the Silverton Mines mill there are eight cells in which pulp flows steadily through, a circulation being maintained by the suction action of the paddles, and one cell feeds the next one by a pipe underneath; it is only in the first cell that the pulp is fed in at the top. The last cell discharges the tailings which go to waste. The eight cells are all built together in one frame and are quite compact. The paddles are driven by pulleys run from belts from a counter-shaft. The whole eight-box machine takes about 45 horse-power to run it. The concentrates made in the last four cells are pumped back again and into the first cell. The first four cells are run so as to produce a clean concentrate without much regard to the tailings, while the last four cells are required to produce a clean tailing at the expense of a lower-grade concentrate, which is returned for retreatment to the first four cells.

Many different kinds of oil have been used, and now different oils are used in the cells. Fuel-oil seems to give good satisfaction, also cresylic acid (a coal-tar product). The use of sulphuric acid to make an acid pulp, which is in use in many oil-flotation plants, was tried, but was discontinued as it was found to prevent the proper frothing. A "hot circuit" was also tried, in which the pulp is kept heated to a certain temperature, but was soon abandoned as not assisting the flotation in any way.

The two-box machine treats the fine slimes of the mill which contain the greater percentage of the ruby-silver and grey-copper in the ore. The concentrate from this unit has an average assay of 27 per cent. lead, 17 per cent. zinc, and 300 oz. silver to the ton. This, although high in zinc, is, of course, a lead concentrate and is shipped to Trail for treatment.

The eight-box machine makes a zinc concentrate and a tailings product which goes to waste. The Wilfley tables make lead concentrates, and, if desirable, can also save some zinc concentrates.

SLOCAN CITY MINING DIVISION.

REPORT OF T. MCNEISH, MINING RECORDER.

I have the honour to submit my report for the Slocan City Mining Division for the year ending December 31st, 1915.

During the past year the mining industry has recovered considerably, several new properties having been opened up.

The *Black Prince*, which is under lease to J. T. Tipping, had a force of eight men doing development-work and taking out ore. They have already shipped one car of ore and have another ready for shipment; the assay averaging about 200 oz. silver to the ton.

The *Alice S.* mineral claim, which is being worked by C. M. Hardie, of Hackensack, N.J., shipped one car of ore and is now driving a 250-foot tunnel to tap the lead at a lower level.

The *Inco* had a small force of men at work doing development-work for the past year, and now things are in shape to take out ore.

The *Meteor* is under lease and bond to Barber & Taylor, who have been doing extensive development-work, and have just shipped a car of very high-grade silver ore which assays on an average of 350 oz. silver to the ton.

The *Ottawa* mine has been worked by the Consolidated Mining and Smelting Company. Extensive development-work has been done during the past year by a force of seven men continuously at work.

The *Enterprise* is under lease to E. Shannon, who shipped several cars of ore and did considerable development-work.

OFFICE STATISTICS—SLOCAN CITY MINING DIVISION.

Free miners' certificates issued (ordinary)	69
Free miners' certificates issued (special)	1
Certificates of work recorded	130
Locations recorded	29
Certificates of improvements	1
Bills of sale and agreements	11
Notices to group	24

TROUT LAKE MINING DIVISION.

REPORT OF A. N. VARS, MINING RECORDER.

I have the honour to submit herewith my report of the progress of the mining industry in the Trout Lake Division for the year 1915.

Work on the *Silver Cup* mine, on Nettie L. mountain, has been continuous throughout the year (under lease to S. Cavanagh and associates), and from which 44 tons of ore has been shipped; this property, as also the *Ajax* mine adjoining, are owned by the Ferguson Mines, Limited.

During the early months of the year work was also done on the *Ajax* mine, from which 21 tons of ore was shipped.

On the *Yuill* group considerable development-work was done under the supervision of C. T. Porter (owner), of Spokane, Wash., with a view to larger operations during the coming spring.

The *Noble Five* group was also developed by Mr. Porter until weather conditions made further work too difficult.

Work was resumed on the *Ethel* group during the latter months of the year, and from which 4 tons of high-grade ore has been shipped; this group is in the South Belt, situated on the Ethel mountain.

A number of the more promising prospects in the vicinity are at present under bond, and there is a feeling generally that mining activity will be resumed during the coming summer.

OFFICE STATISTICS—TROUT LAKE MINING DIVISION.

Free miners' certificates	61
Mineral claims recorded	42
Placer claims recorded	1
Assessments recorded	135
Agreements and transfers	17
Notices	24

NELSON DISTRICT.

NELSON MINING DIVISION.

REPORT OF J. CARTMEL, GOLD COMMISSIONER.

I have the honour to submit the annual report on the Nelson Mining Division for the year ending December 31st, 1915.

The ore production during 1915 was considerably less than that of the previous year, owing principally to the fact that the *Silver King* and *Queen Victoria*, which between them shipped over 22,000 tons in 1914, were practically dormant this year, but this was to some extent offset by increased activity in the Sheep Creek section of the district, particularly at the *H.B.* mine, from which in the neighbourhood of 4,000 tons of zinc ore was shipped to the United States.

The district was fortunate in receiving a visit, in the fall, from J. D. Galloway, Assistant Provincial Mineralogist, whose report will doubtless prove of interest and value, and will render superfluous anything other than a more or less cursory report from me.

Molly Gibson. This mine was closed down during the first half of the year, since when twelve men have been employed on development-work and drove 643 feet of tunnel (drifts and crosscuts). No ore was taken out nor was the mill operated; work was discontinued on December 20th on account of the snow, which was exceptionally deep this year.

Silver King. Two men have been employed continuously all the year by the Consolidated Mining and Smelting Company keeping the mine in shape and attending to the electric pump by which the workings are kept free from water. Apart from this, nothing has been done.

California. This mine is owned by Wm. A. Moore, of Nelson, and was worked under lease from the beginning of the year up to about October 1st, an average of eight men being employed. The lease was terminated consequent upon negotiations for sale of the property.

No. 2 tunnel, which about two years ago was driven 130 feet, was extended a further 180 feet this year, making its total length 310 feet, all on the vein. From this a 60-foot raise was put up, all in ore, to connect with an 80-foot winze from No. 1 tunnel; a new cabin also was built. Eighty-five tons of ore, averaging about $30 a ton in gold and 3 oz. in silver, was shipped to the Trail smelter.

Venus. Operations on the *Venus* were discontinued about the end of June owing to financial conditions due to the war. No new development was undertaken during the year, work having been confined to stoping the remainder of the ore left above No. 5 tunnel and to milling the same.

Eureka. This mine is under bond to the Pingree Mines, Limited, a Victoria company, owners of the *Pingree* group. Considerable development-work has been done during the year on a new tunnel about 200 feet below the old incline, which will afford better drainage and open up a large section of new ground.

The company plans the installation of an aerial tramway and an electrically driven compressor, and in the meantime it is not intended to attempt to ship any ore, some hundreds of tons of which is already on the dump, owing to the expense of hauling by wagon over an indifferent road.

Queen Victoria. Several men have been working this property on a lease, and during the year shipped 775 tons of ore, 745 tons of which went to Greenwood and 30 to Trail.

Perrier. Three men have been working steadily at the *Perrier* all year, and considerable surface work was done, including completion of the pipe-line, installation of a Pelton wheel (which runs a 3-drill compressor and two vanners), and an hydraulic jet-pump to take care of the seepage. Fifty feet of drifting and

20 feet of shaft-sinking were done and between 50 and 60 tons of ore milled. A new mill building and assay office, 36 x 14 feet, was completed late in the year.

Granite-Poorman. During the past year the *Granite-Poorman* has been the scene of considerable activity. Dr. W. H. Willson and Barney Crilly, of Nelson, have leased this well-known property and employed an average of thirty men at the mine and mill. On the *Hardscrabble* vein a shaft has been sunk 110 feet on 3 feet of high-grade ore and a tunnel started on the new 100-foot level, this work opening up a large tonnage of ore, sufficient, it is stated, to keep the 20-stamp mill (which has been thoroughly overhauled) in operation for a lengthy period.

Some work has also been done on the *Beelzebub* and *Granite* veins and considerable on the *Greenhorn*, on which a sublease has been given.

Fern-Gold King. W. S. Hawley and associates, of Spokane, last summer took a lease and bond on these properties, which are situated near Hall Siding, ten miles south of Nelson. Work was first started on the *Fern*, which some years back was a fairly heavy producer. A better showing having been discovered on the *Gold King* group adjoining, however, their activities have been transferred to the latter property, on which bodies of ore of good grade have been revealed by open-cuts, shafts, and tunnels. An average of seven men are working on the *Gold King* and two on the *Fern*.

YMIR CAMP.

Ymir-Wilcox. No ore has been shipped from this property during the year, only two men being employed watching the mine and keeping things in shape.

Yankee Girl. On this mine, which is owned by the Hobson Silver-Lead Company, Limited, the new tunnel was run in a distance of 900 feet and encountered the vein at a depth of 500 feet beneath the previous lowest workings, the ore-body running to 8 feet in width and being found equal to or better than those previously encountered, both in extent and value. A tramway-line was built from the lowest level to the railway, over which the high-grade ore will be shipped, this level being about 1,300 feet beneath the highest point of outcrop of the vein. The mill, however, has not been completed as yet.

Dundee. This mine has been closed down all year, the owners awaiting an improvement in financial conditions.

SALMO-SHEEP CREEK DISTRICT.

Emerald. From this mine, which is owned by Iron Mountain, Limited, and of which John Waldbeser is the manager, 1,109 tons of ore was shipped to the Trail smelter, the production being slightly in excess of that of the previous year.

H.B. This is the most important mine in this section, and, owing to the large deposits of zinc-carbonate ore therein, will doubtless continue to hold this position for some time to come. W. R. Salisbury, of Salmo, and associates had a lease on the property, which expired at the end of August, and during the term of such mined and shipped all the ore that could be handled by the teams available, over 2,000 tons it is believed.

The property was then taken over under lease and bond by a syndicate of Spokane mining men, and work actively continued under the management of R. K. Neill, a member of the syndicate. During the last quarter of the year over 1,000 tons of ore was shipped to Pennsylvania and nearly 600 to the Kusa Spelter Company. Work was started with a force of fifteen men, which was increased as rapidly as they could be effectively handled, and at present fifty-two are being employed.

The 200-foot level has been driven over 1,000 feet from breast to breast in ore which runs from 20 per cent. up and a shaft sunk to 300 feet. A tunnel has been started also at the 800-foot level, which is now in 180 feet, and it is expected that the vein will be struck at 1,737 feet, which will take about four months to accomplish. A Sullivan air-compressor is being installed, to be run by water-power from Deer creek under a 280-foot head.

The management expects to handle from 12,000 to 15,000 tons of ore during 1916 by means of wagons and sleighs, and has in contemplation the construction of a short line of railway from the mine to connect with the Great Northern Railway near Salmo, which will immensely facilitate the shipment of the ore.

Some work was done on the *Zincton*, from which a few tons of ore was shipped, and also on the *Leadville*, 140 tons being shipped from the latter to the Trail smelter, the gross value of which was $2,570.

Queen. This property still continues to be a steady and consistent producer. About 10,000 tons of ore was milled during the year, and 853 tons of concentrates from same shipped to Trail, the bullion recovered amounting to 5,090 oz. gold and 1,819 oz. silver. Nine hundred feet of drifting was done, and the ore-bodies encountered in No. 6 level found to continue on the No. 7; 935 feet of drifts was also run on the *Alexandra* claim, adjoining, in which good ore was struck. An average of thirty-eight men was employed in the mine and mill.

Motherlode. Work on the *Motherlode* was discontinued early in the fall, but about 3,000 tons of ore was mined and about $42,000 in bullion recovered therefrom. Some work was done on the *Ore Hill*, *Summit*, *Golden Fawn*, *Reno*, and several other properties in this vicinity, but the ore production was not of any great consequence.

Molybdenite. In May last the *Molly* mine, as it is locally called, was bonded to a Vancouver syndicate, of which Merton A. Merrill is the head, and work was actively commenced on the construction of a small mill, tram-line, flume, etc., the intention being to effect concentration on the spot by the latest improved flotation process.

Some development-work was done by means of open-cuts and stripping of the overlying capping, but this was early discontinued in order that the work might all be concentrated on the mill-construction and the necessary building of about three miles and a half of road connecting the camp with the Salmo-Lost Creek road.

W. L. Mack, who was in charge of the operations, having learned of an entirely new process of concentration which was said to be a great deal more efficient than any heretofore known, decided to suspend work on the mill pending investigation of the new method, and after arranging for completion of the road left for the States with the intention of endeavouring to interest the inventor or discoverer of the new process in the *Molly* mine, but with what success I am unable to state. I understand, however, that some work is being done on the mill this winter, and doubtless with the disappearance of the snow in the spring work will be actively resumed.

ERIE CAMP.

Relief. The ore production from the *Relief* did not come up to that of the previous year, for the reason that ore-extraction was discontinued in the latter part of October while changes were being made in the plant. This new plant is now quite efficient and up-to-date, about $45,000 having been expended on its construction, exclusive of the cost of new machinery consisting of a tube-mill, classifier, cyanide plant, stamp-mill, etc.

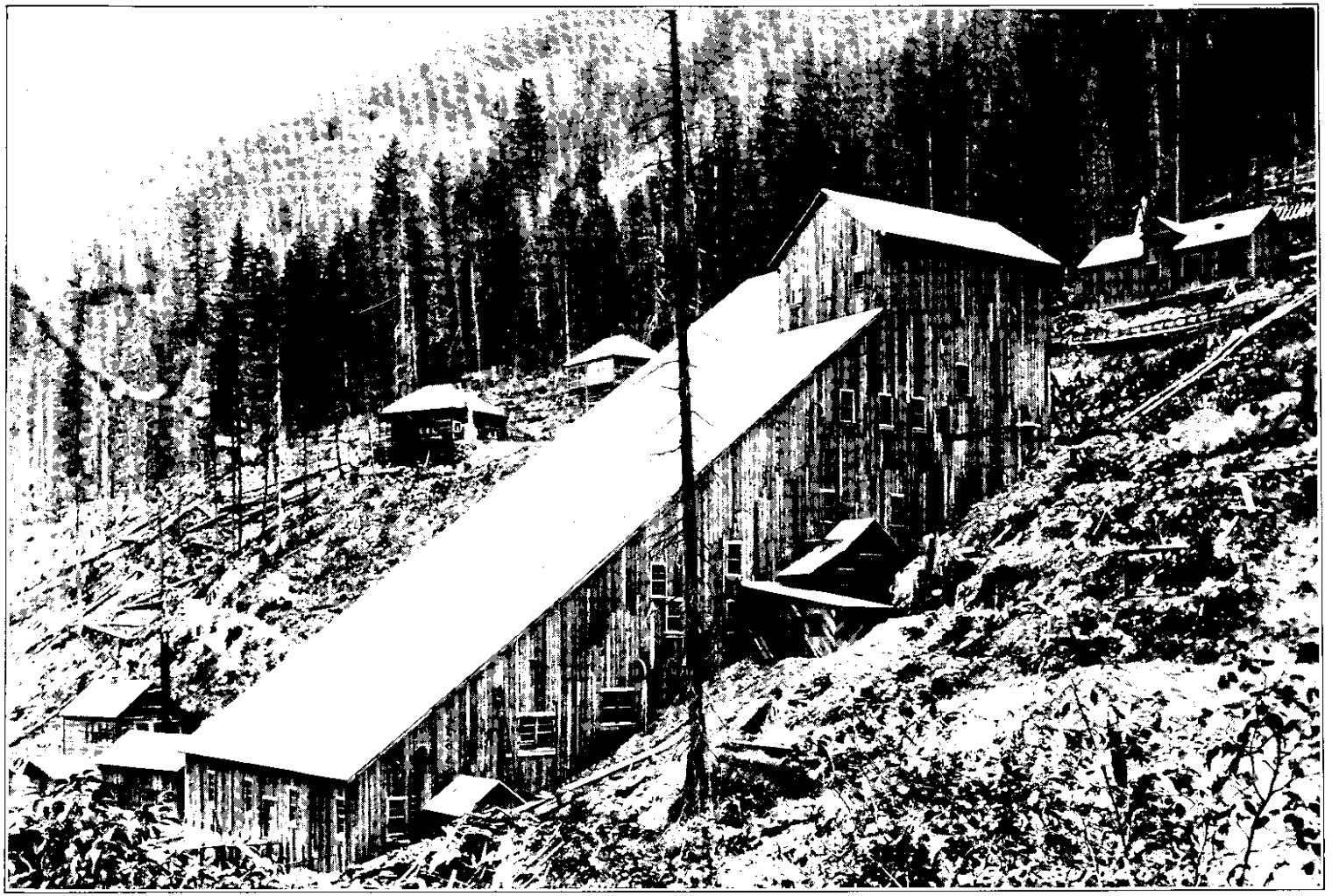
Whereas the loss of values in tailings formerly ran from $6 to $7 with the old plant, it is said to now be only 50 cents a ton. It is expected that with the new cyanide plant it will be possible to recover practically all the gold previously lost with the tailings, which have been conserved with that idea in view for years back, and this should constitute a source of considerable profit to the present owners. An average of eighteen men was employed in the mine and mill and forty on the reconstruction of the plant.

Development-work consisted of over 400 feet of drifting on the fourth level and several stopes and raises. About 2,000 tons of ore was extracted, the yield of which is reported to have been $16,141.80.

There has been no production from any other mines in this vicinity.

THE FRENCH PROCESS.

French's Complex Ore Reduction Company, which has had its "demonstration" works at Nelson for the past five years, conducted a further demonstration of the process for the extraction and electrolytic deposition of zinc at the Standard Silver Lead Mining Company's mill at Silverton. As a result of this demonstration a considerable amount of interest was created in this district, and an effort was made to obtain Government assistance for the establishment of a larger plant at Nelson.



Motherlode Mill, Sheep Creek Camp—Nelson M.D.

After a very thorough inquiry by the Provincial Government, the following statement, evidently inspired, was published in the *Daily Colonist* of Victoria on September 12th:—

"The Provincial Government has decided to extend a measure of financial assistance to a mining project which promises to exert an important influence upon the problem of zinc production in British Columbia, and which will as an immediate development have the effect of placing in operation at Nelson a demonstration plant.

"This announcement is made by Sir Richard McBride, who explained that for some time the Government has had under consideration representations made by the French Complex Ore Reduction Company, Limited, of Victoria, the chairman of which is Albert E. Griffiths. The company, which has obtained the patent rights of the French process for the electrolytic deposition of zinc, has made successful experiments with small plants for the past five years, and believes the time has arrived when steps should be taken to demonstrate the commercial possibilities.

"Evidence placed before the Government, said Sir Richard, tended to show that the process can be successfully employed on a large scale in the treatment of zinc-bearing ores, and after the fullest investigation by officers of the Mines Department it has been decided to assist the company in completing its financial arrangements, so that a demonstration plant of some practical usefulness may be established at Nelson. Besides this measure of assistance, the Government will lease to the company on favourable terms the old Fairview plant at Nelson, which reverted to the Province some time ago, after it had been abandoned by those who were operating it.

"Sir Richard McBride said that the Government was moved to extend a measure of aid to the company at this time in view of the possibility of encouraging the greater production of zinc in British Columbia, a matter of vital concern just now to the Imperial Government in view of the use of zinc in the manufacture of munitions of war."

The plant at Silverton was designed on the same lines as that erected at Trail during the previous year, but on a considerably smaller scale. The *Sullivan* mine ore which was used while the French process was being operated at Trail is much purer as regards those particular constituents which tend to prevent the deposition of the purest zinc than the *Standard* mine ore, and as the manganese, a constituent on whose presence the success of the process depends, amounts in the latter ore to less than 1 per cent., it furnished a particularly severe test.

The various tests were made on ores ranging from mill-feed containing 10 per cent. zinc up to zinc concentrates with 43 per cent. zinc. The principal test was made on a concentrate containing 32.2 per cent. zinc, 3.5 per cent. lead, and 31.6 oz. silver to the ton. After the zinc was extracted the remaining residue weighed less than 45 per cent. of the original ore used, and its lead and silver content increased to 8.7 per cent. and 76 oz. a ton respectively. The extraction of zinc amounted to 91.5 per cent. of that in the ore, and the electric-current consumption measured at the electrolytic vats was less than 3,000 kw. hours per ton of zinc deposited.

PLACER.

Some work was done on several claims located on the North fork of the Salmo river near the mouth of Whiskey creek, a few miles from Erie, and I have heard that fairly good returns were secured therefrom for a short time during the summer.

On the Forty-nine Creek leases, which are under bond to F. Keffer and Harry Johns, prospecting-work was prosecuted continuously from March until well into the winter, three men being employed driving a tunnel into an old channel on the No. 3 Lease.

Progress was greatly hampered by the presence of quicksand, which necessitated the use of face-boards and great care in lagging, but, when work was suspended at a point 226 feet distant from the mouth of the tunnel, the indications were that this impediment would soon be passed, as the top laggings were then being driven in a stratum of fairly tight wash-gravel which was rapidly replacing the quicksand with the advancing of the face. Once the quicksand is left behind, good progress will doubtless be made, and when bed-rock is reached the width and richness of the channel will be thoroughly explored.

During low water some work was done in last year's pit in the stream-bed, and, while no signs of bed-rock were apparent, some nice coarse gold to the amount of several ounces was secured. Chris. Jensen, an experienced placer-miner, has been in charge of the work.

OFFICE STATISTICS—NELSON MINING DIVISION.

Free miners' certificates (individual)	527
Free miners' certificates (company)	3
Claims recorded (mineral)	258
Claims recorded (placer)	9
Certificates of work recorded	527
Agreements, transfers, etc.	84

Revenue.

Free miners' certificates	$2,503 75
Mining receipts, general	2,741 40
Total	$5,245 15

NELSON MINING DIVISION.

REPORT BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

INTRODUCTORY STATEMENT.

During the field season of 1915 the writer spent a month—from September 15th to October 15th—in the Nelson Mining Division, and examined a number of the more important producing mines, as well as many properties only partially or slightly developed. The sections visited were the Bayonne camp, Sheep Creek district, Lost Creek district, Ymir camp, and territory contiguous to the city of Nelson. The information gathered in the course of this work is contained in this report, but in the preparation thereof use has been made of much literature descriptive of the properties in the Nelson Mining Division, as well as some private reports loaned to the writer by different people.

Wherever the results are given of assays of samples taken by the writer, it is to be understood that, unless otherwise stated, the sample is an average of the section sampled, and that the sections were chosen to give an idea of the average of the ore-body. It is evident that one or two samples taken from a property, while giving an idea of the values at those points, may or may not represent the average grade of the whole ore-body.

LOCATION.

The Nelson Mining Division, which is one of the smaller Divisions of British Columbia—containing only about 2,000 square miles—is situated in West Kootenay District, the other Divisions of which are Ainsworth, Slocan, Slocan City, Trail Creek, Revelstoke, Trout Lake, and Lardeau. Its position is in the south-eastern part of the Province and nearer to the Alberta boundary-line than the Pacific Coast. In form it is almost a half-circle, with its southern boundary, which is formed by the International Boundary-line, as the diameter and the most northerly point near Procter on Kootenay arm. The westerly and north-westerly part of the Division is bounded by the Columbia and Kootenay rivers, and its eastern boundary is the divide of the Moyie range.

Nelson is the chief town of the Division and is also one of the most important commercial centres in the interior of the Province; it is situated in the northern part of the Division on Kootenay arm, a branch of, and outlet for, Kootenay lake. The city, including suburbs, has a population of 5,000 to 6,000 and is quite a modern and progressive place; it has a street-railway, power plant, and electric- and gas-lighting plants, all owned and operated by the city. The first growth of the place was due to mining and business connected therewith, but of late years lumbering, agriculture, and other industries have become important; and, owing to its position in relation to the transportation systems of the country, Nelson has become an important distributing centre for the West Kootenay and Boundary districts.

Nelson is reached from the east by the Crowsnest branch of the Canadian Pacific Railway, which comes by rail to Kootenay Landing and then by boat down Kootenay lake to the West

arm. From the main line of the Canadian Pacific Railway a boat service via Arrow lakes to Castlegar and train from there provides communication with Nelson. A line runs from Nelson to Slocan and then by boat up Slocan lake to Rosebery, and railway connections can be made to the Arrow lakes at Nakusp or to Kaslo on Kootenay lake. The Columbia and Western Railway (Canadian Pacific Railway) runs from Nelson to Midway, in the Boundary country, and from this latter point the new Kettle Valley line is now running to Vancouver, thus giving a new direct line from Nelson to the Coast via the Boundary and Similkameen districts. The Nelson and Fort Sheppard Railway (Great Northern) connects Nelson with Spokane, Grand Forks, and thence by the Vancouver, Victoria & Eastern Railway to the Coast.

The Nelson Mining Division may be divided into several subdivisions according to the grouping of the mines. The vicinity of Nelson (town) contains a number of mines and prospects. Along the Nelson to Fort Sheppard Railway there are Ymir and Sheep Creek camps and the Lost Creek district. Over the divide from Sheep creek, on the Kootenay Lake slope, is Bayonne camp, and there are claims held on nearly all the creeks flowing into Kootenay lake.

HISTORY.

As in most of the older mining sections of the Province, placering was the first form of mining to be carried on in the Nelson Mining Division. But placer-mining has never been very important, and there was probably as much going on during the last year as in former ones. Wild Horse creek at Ymir and Forty-nine creek near Nelson might be called the most important placer creeks of the district, but many others have yielded small amounts of gold. Chinamen are now about the only ones doing much, and their operations are generally conducted in a small way. The annual placer output is now about 50 to 100 oz.

Prospecting for lode minerals in the Nelson Division commenced about 1886, when the *Silver King* group was located on Toad mountain, a few miles from the present town of Nelson, which at that time was not in existence. In the next few years many claims were located in this vicinity, including the *Granite-Poorman* and other gold properties. The first ore shipped from the Division was from the *Silver King* in 1888, and the gold-mill on the *Poorman* group commenced operations in 1890. Communication with the outside world was soon made possible by boat connections up the Arrow lakes to connect with the Canadian Pacific Railway at Revelstoke, and in 1893 the construction of the Nelson and Fort Sheppard Railway gave easy access to the district from Spokane.

The mines in the vicinity of Nelson have experienced many vicissitudes, but to-day a fair number are operating and the outlook for the future is promising. The *Silver King*, which went through many changes of ownership, is now owned by the Consolidated Mining and Smelting Company, but has not been operated during the past year.

Claims were staked in Ymir camp in 1885 by the Hall Bros., who the following year staked the *Silver King* near Nelson. But nothing was done in this camp until the railway came in 1893, and only a little then; the real activity in this district came in 1896, when many claims were located, including the *Ymir*, *Dundee*, *Wilcox*, *Yankee Girl*, and many others. The *Ymir* mine soon developed into a steadily producing property and was worked continuously until 1908, since when it has been closed down. With the closing of this important mine the camp and town of Ymir became very quiet, but in the last two years considerable development has been carried out, and it seems probable the camp will soon again become productive.

Sheep Creek camp first attracted attention about 1900; the *Yellowstone* was one of the first locations, and on this property a small stamp-mill was erected. In 1900 the *Queen* commenced producing and has been operated nearly continuously ever since. In later years a very modern and up-to-date mill was erected on the *Motherlode* mine, and the output of gold from this property materially offset the decrease due to the shutting-down of the *Ymir* mine.

The Sheep Creek camp is a gold camp, but on Deer creek, a tributary of Sheep creek, a promising zinc-lead group—the *H.B.* and *Zincton*—has lately been opened up, while the *Emerald* lead-mine is also in that section.

On Lost creek a molybdenite deposit has attracted considerable attention, as this mineral is at present in great demand due to war conditions. This property is still in the prospect stage.

Bayonne camp is situated at the headwaters of Summit and Canyon creeks, which flow into Kootenay lake, and is just across the divide from Sheep creek. Claims were staked here in

1901, but after being developed for a year or two they were allowed to remain dormant. During the last year interest has been revived in this camp, and it is hoped that in a short time some of the properties will again be worked. The growth of the camp has been retarded by lack of transportation, but this can be remedied by the construction of a wagon-road in from Kootenay lake.

On all the creeks flowing into Kootenay lake and arm, on both sides, claims have been located, but very few of these have been developed to any great extent. The *Molly Gibson*, a silver-lead property on Kokanee creek, is the most important of these. It is owned by the Consolidated Company and has been a fairly steady producer.

The *La France* group on the creek of the same name has had a considerable amount of development-work done, but has not yet shipped any ore; it also is a silver-lead-zinc property.

The Nelson Mining Division, while being comparatively small, nevertheless embraces a sufficient area to allow of wide differences in types of mineral deposits. In fact, in no other Division of the Province is there such a variety of metals produced. Minerals containing gold, silver, lead, zinc, copper, and molybdenum are all found in sufficient quantities to form commercially valuable ore-deposits. Rocks suitable for building-stones are abundant and ordinary brick-clays are of common occurrence. Until lately comparatively little zinc ore has been produced from this Division, but conditions are promising for the present output to be maintained, and probably largely increased in the near future. Molybdenum ore is a recent addition to the list of minerals, but so far only two cars have been shipped.

Gold is produced chiefly in the Sheep Creek and Ymir camps and in the vicinity of Nelson. Copper ore is confined mainly to Toad mountain, and silver also comes from there, together with the small amount associated with the gold in the milling-ores in other sections. Lead and zinc ores are obtained in the Sheep Creek and Lost Creek districts.

The total value of metalliferous minerals produced in the Nelson Mining Division from 1895 to the end of 1915 amounted to $13,671,933. Exact records for the years preceding 1895 are not available, but it is safe to say that it was not greater than $100,000, which is therefore not a very important item in the total production. The largest production in any single year was in 1901, when minerals to the value of $1,244,568 were mined and sold. This large output was mainly accounted for by a heavy gold production from the *Ymir* mine and a large tonnage of copper-silver ore from the *Silver King*.

The mineral output of the Division for 1915 was $608,277, made up as follows: Placer gold, $1,000; lode gold, $190,846; silver, $4,439; lead, $40,356; copper, $5,225; zinc, $351,811; building materials, $14,600.

General Physical Features.

The Nelson Mining Division embraces a small section of the Selkirk system of mountains and a smaller part of the Purcell system. The eastern part of the Division is in the Moyie range, a part of the Purcells, while the western part includes practically all of the Nelson and Bonnington ranges and a fringe of the Slocan mountains, all included in the Selkirk system of mountains. The dividing line between the Moyie and Nelson ranges is the Selkirk Trench, here occupied by the southern part of Kootenay lake.

The dominant water feature of the Division is the Kootenay river and lake; the river re-enters from the United States and, flowing north for fifteen miles, expands into Kootenay lake. This lake, which is a long narrow body of water lying in a north-and-south direction and draining at its northern end Trout lake and the Duncan river, discharges by means of the West arm, which is a narrow stretch of water commencing about the central point of Kootenay lake and extending westerly for twenty miles to Nelson. At this point the lake expansion, which there becomes narrow, is again called the Kootenay river, and the water flows for twenty-seven miles farther to where it joins the Columbia river at Robson. The point where the West arm narrows into the river is the site of the city of Nelson. It is this central position in relation to a number of the large waterways of the southern interior of the Province that has made Nelson an important commercial centre. The Columbia river from Robson southerly to the International Boundary-line forms part of the western boundary of the Nelson Division.

The main drainage of the central part of the Division is by the Salmo river, which rises a few miles north of Halls and flows in a southerly direction to Waneta, where it joins the Pend d'Oreille at a point four miles north of the International Boundary-line. This latter river

in turn joins the Columbia about six miles below Trail. The Salmo river occupies a secondary north-and-south trench which forms a break or dividing line between the Bonnington range on the west and the Nelson range on the east. The northern end of this trench is occupied by Cottonwood creek, which, rising near Halls, flows northerly into Kootenay arm at Nelson. The main tributaries of the Salmo river are, on the east, Wild Horse, Hidden, and Sheep creeks and the South fork, and on the west Hall creek and the North fork. The eastern tributaries of the Salmo river drain the western slope of the Nelson range, while the water from the eastern slope of these mountains is taken to Kootenay lake by means of Boundary, Summit, Cultus, Canyon, Midge, and other smaller creeks. The western branches of the Salmo drain the eastern slope of the Bonnington range, and the drainage of the western slope of these mountains is to the Columbia river via small creeks.

The western slope of the Moyie range sheds its waters to the Kootenay river by Goat river and a number of small creeks, amongst the more important of which are LaFrance, Granite, Duck, and King creeks. The boundary-line between the Nelson and Fort Steele Mining Divisions is the divide of the Moyie range.

The watershed of the Slocan mountains forms the boundary-line between the Nelson and Slocan City Mining Divisions, and on the Nelson side a number of creeks flow into the West arm of Kootenay lake. The north-western part of the Division not drained by the Salmo river has its outflow to the West arm and Kootenay river.

The whole district is decidedly mountainous, but not of the extreme rugged alpine type found in the Rockies and Selkirks. The topography in places approaches more nearly to that of the Interior plateaus, with, however, greater relief and more thoroughly distinct mountain ranges. The Division is divided by two main north-and-south trenches, the easterly one being occupied by the Kootenay river and lake, and the other by the Salmo river and Cottonwood creek. Elevations up to 7,000 feet are common in all parts of the Division, while a few peaks go up to 8,000 feet. The main valleys are at elevations of 1,800 to 2,000 feet, which thus gives a considerable relief nearly everywhere. As the timber-line is at about 8,000 feet elevation, there is very little of the district which is not covered with vegetation, while in the valleys there is a large acreage of valuable timber.

The territory embraced by the Nelson Mining Division may be said to consist of a mountain region maturely dissected. In a general way the rocks are hard and resist erosion to a considerable degree, but soft schists and argillites occur in many places and play an important part in the local topography. The summit-levels are generally in accordance and prominent outstanding peaks are not of common occurrence.

GEOLOGY.

The geology of the Nelson District has been partially worked out by different officers of the Geological Survey of Canada, but detail work has not yet been done. In 1901 the West Kootenay Sheet of British Columbia by McConnel and Brock was issued, which covers a considerable portion of the Nelson Division, as well as parts of Ainsworth, Slocan, and Grand Forks Divisions. This sheet has 500-foot contour-lines on it and is geologically coloured to show the different rock formations and their approximate boundaries. This map is reconnaissance-work.

The geological report entitled "North American Cordillera Forty-ninth Parallel,"* by R. A. Daly, includes that part of the Nelson Division which is on the International Boundary-line. Sheets Nos. 6, 7, and 8 of this report show this part of the district. In 1911 O. E. Le Roy made a geological examination of the Nelson Map-area, an area of 106 square miles around the city of Nelson. The 1911 Summary Report, Geological Survey of Canada, contains a preliminary report of this work. In 1914 Chas. W. Drysdale commenced the geologic and topographic mapping of the Ymir mining camp; this report has not yet been issued. The Annual Reports of this Department contain various notes and reports on the Nelson Division, each year containing a report by the Gold Commissioner for the district. Special reports by Wm. Fleet Robertson, Provincial Mineralogist, were made in the years 1900, 1904, and 1909.

The Nelson Mining Division contains a large variety of rock formations, and representatives occur of nearly every geological age from Archæan to the modern. Sedimentary, igneous, and metamorphic rocks are all found, and in many places the geologic relations of the different formations are quite complicated.

* Memoir No. 38, Geological Survey of Canada.

In a general way the geological history may be summed up as consisting of extensive sedimentation extending from Pre-Cambrian through to the end of Palæozoic times, with also great volcanic activity in the Carboniferous period; vast granitic intrusions in the Mesozoic age; and further volcanism in the Cretaceous and Tertiary. The orogenic forces which formed the mountain ranges in many instances mashed, crumpled, and faulted the rocks to a very great extent, while the granitic intrusions caused widespread metamorphism of the older rocks.

In Brock's Sheet a small area of Archæan rocks called the Shuswap series is placed along the shores of Kootenay lake and the West arm. These rocks consist of a highly metamorphosed complex of gneisses, mica-schists, crystalline limestones, and dolomites, with intercalated, crushed, and altered granites and diorites. Along the International Boundary-line and extending upwards along the Salmo river on the eastern side there is a large development of quartzites, schists, dolomites, limestones, phyllites, argillites, etc., which are in part referable to the Archæan (Daly) and partly Cambrian to Carboniferous. These rocks have been partially classified by Brock and Daly and mapped under several names. The quartz veins and replacement ore-bodies of the Sheep Creek and Ymir camps are as a rule in these formations, but as yet it is best not to say any more than that these ore-bodies are in rocks of Palæozoic age.

The dominant geological feature in the Nelson Division is the great body of intrusive granodiorite, which is called the Nelson batholith by Brock, and satellites and outposts of which are given other names by Daly. This batholithic mass is not continuous, nor is it constant in composition or physical features in the different exposures, but the different batholiths are more or less contemporaneous and can be referred with certainty to the Jurassic or Post-Jurassic age.

This granodiorite is well developed along Kootenay lake, in the vicinity of the city of Nelson, west of the Kootenay river, and along the western slope of the Nelson range. This same granite has a widespread occurrence in the Slocan, Slocan City, and Ainsworth Divisions and in the Boundary District. In composition this rock ranges from an acid granite to a diorite, but is generally a typical granodiorite containing orthoclase, plagioclase, quartz, hornblende, and mica. The colour is generally a mottled greenish-grey, although pink shades are often found. In texture it is generally coarse-grained, but wide variations from fine-grained to porphyritic facies occur frequently. A pronounced gneissic structure has been developed in many places, while in others the granodiorite is rich in inclusions of the older rocks through which it has been intruded.

Daly describes a belt of granite occurring on the International Boundary-line and west of the Kootenay river which occupies an area of about fifteen square miles and extending an unknown distance into Idaho and Washington. This granite is very coarse-grained with large phenocrysts of feldspar, and has an unusually perfect gneissic structure. This "Bayonne Batholith and its Satellites," described by Daly, is the southern extremity of the large Nelson batholith which extends along Kootenay lake.

The volcanic rocks are confined to the western part of the Division, extending, roughly, from the Pend d'Oreille river to the city of Nelson, and lying between the Salmo river and the Columbia and lower part of Kootenay river. This whole area is not covered by volcanic rocks, as in places the formation is Nelson granite. The greater part of these rocks belong to what is called the Rossland volcanic series, which are listed by Brock and Daly as being of Carboniferous to Cretaceous age. They consist of lava-flows, ash-beds, breccias, pyroclastic rocks, and a small amount of intercalated sediments which are mashed together and metamorphosed into a complex series. The lavas are largely altered into schistose greenstones. These extrusive rocks belong to at least two and possibly several distinct time periods, but, owing to inability to distinguish in the field, the whole series is mapped as one by Brock, and this procedure has been followed also by Daly. A small area of volcanics on Beaver mountain, however, has been recognized by Brock as distinctly younger than the main mass of the Rossland volcanics, and hence is mapped separately as the Beaver Mountain volcanics. These rocks also consist of flows of augite andesite and basalt, and pyroclastic beds.

Dykes of many different kinds of rock types are plentiful all through the district; many of these are apophysal phases, and contemporaneous with the various batholithic masses occurring so frequently. Amongst these might be mentioned pegmatites, aplites, felsites, syenite and other porphyries, diorite, and diabase dykes. The greatest number of the dykes are, however, of a basic nature, and many of these are the youngest igneous rocks in the district cutting through all the other formations. They consist mainly of lamprophyres, minettes, kersantites, etc.

ECONOMIC GEOLOGY.

The ore-deposits in the Nelson Mining Division are, as a rule, of the fissure type of deposit, and a great many of them are true-fissure quartz veins. Contact metamorphic deposits are somewhat rare, but a number of replacement deposits along sheared zones in limestone are found. The enormous intrusions of granitoid rocks, which, although separable into different batholiths, are collectively termed the Nelson batholith, have been the great mineralizing factors in this district, and, in fact, throughout the whole West Kootenay District. The ore-bodies are often developed near the contacts of the granitic bodies with the older rocks, but in many instances true quartz veins are found well within the granitic masses themselves. In the schists the veins are mineralized zones of alternating schist and quartz which are often lenticular in form. In the limestone-bands some very distinct replacement deposits following the bedding-planes are found; while, where the limestone contacts the granitic rocks, there are developments of contact metamorphic ore-bodies similar to the large low-grade deposits in the Boundary District, but of much less relative importance. Quartz veins cutting quartzites form an important type of deposit in the Sheep Creek camp and occur elsewhere as well.

In the metamorphosed schistose greenstones, belonging to the older part of the Rossland volcanic series, ore-bodies occur which are partly of the replacement type and partly open quartz-filled fissures. Many of these are found along the Nelson and Fort Sheppard Railway between Nelson and Ymir.

MINERALOGY.

As might be expected in a district having so many different types of ore-deposits, there are found all the common ore-minerals, and in addition some of the rarer forms. Native gold, silver, and copper are all found, but gold occurs in the greatest abundance. Pyrite, arsenopyrite, pyrrhotite, chalcopyrite, bornite, molybdenite, tetrahedrite, and pyrargyrite are the common sulphide minerals, while azurite, malachite, chrysocolla, limonite, molybdic oxide, and other oxides and carbonates are the oxidized forms of these sulphides.

Magnetite and scheelite are also found, and the gangue minerals are quartz, calcite, garnet, epidote, actinolite, siderite, barite, and wollastonite. A small vein of fluorite occurs at Five-mile point.

Oxidation of the sulphides has proceeded to a greater depth in this district than is found in most parts of British Columbia. At the *Motherlode* mine, on Sheep creek, the ore is oxidized to a depth of 500 feet below the surface, and in only a few places in that mine can unaltered sulphides be found. At the *Queen* mine, also on Sheep creek, but at an elevation about 1,700 feet lower than the *Motherlode*, the ore is only oxidized for a short distance down; all the present working-levels are in sulphide ore. At the *Eureka*, on Eagle creek near Nelson, the copper ore is mainly azurite, malachite, and chrysocolla, formed from the oxidation and carbonation of primary chalcopyrite; thin films of bornite on the outside of chalcopyrite are also common. Many of the ore-bodies, however, show no appreciable oxidation, the sulphides being found right at the surface.

CLIMATE AND AGRICULTURE.

The habitable portions of the Nelson Mining Division are along the main valleys of the Kootenay and Columbia rivers and the many smaller valleys of the tributary streams. The climate in these lower elevations is very pleasant and is as fine as can be found in Canada. The summers are moderately warm, but are characterized by long periods of good weather. The winters last about three months, and during this time there is a snowfall of from 1 to 4 feet, during which time the temperature rarely goes below zero. In the mountains, of course, the winter is longer and the snow accumulates to a considerable depth. Great extremes of heat and cold are not common, and of short duration when they do occur.

Agriculture in the last few years has assumed a considerable importance and is now a more important industry than mining. A considerable acreage of land was planted in fruit-trees in latter years, but it now appears that the country is better adapted for mixed farming than anything else. Creston, at the southern end of Kootenay lake, is an important centre of fruit-growing, while a good deal of farming is done contiguous to the city of Nelson.

Between Nelson and Castlegar thousands of acres of land have been acquired by the Doukhobors under the guidance of Peter Veregin, who might be called general manager of the

community system under which they work. These people, while not very skilful farmers, make up in industry and numbers what they lack in efficiency, and have succeeded to a considerable degree in this district. They have their own sawmill and canning-factory, and are to a considerable extent self-contained and self-sustaining. There is some good land along the Salmo and Pend d'Oreille rivers and the International Boundary-line, but so far comparatively little has been brought under cultivation.

Good timber is plentiful in many parts of the district. Along the Salmo river some very fine stands of cedar occur, and numerous sections of the country are held by timber licences. All the common types of trees are found, such as cedar, fir, balsam, hemlock, spruce, tamarack, pine, cottonwood, poplar, aspen, alder, larch, and birch. Timber suitable for mining purposes occurs in abundance, and most of the claims are well supplied in this respect. The rivers and lakes are well stocked with fish; rainbow and speckled trout are found in the greatest abundance, and the waters of Kootenay lake and river are world-famous for the excellent trout-fishing to be had there. The Canadian Pacific Railway has a first-class tourist hotel at Balfour, on Kootenay lake, and the fly-fishing is one of the chief attractions of the place.

NELSON CAMP.

There are many properties situated within a radius of ten miles of the city of Nelson, and several of these are now, or have been, important mines. These mines are mainly situated on Toad and Morning mountains, Eagle and Forty-nine creeks, to the south of the Kootenay river. North of the river the formation is mainly Nelson granite and no ore-bodies of importance have been found in it. South of the river the rock formations are considerably jumbled up, consisting of granite, members of the Rossland volcanic series, and limestone and Pend d'Oreille quartzites. The *Queen Victoria* mine does lie north of the river, but at some distance west of Nelson, and here an area of the Rossland volcanic series is found, in which the ore-body has been formed.

The writer did not visit all the properties in this section, but only those that were working. Nearly every mine in this district has been reported on in past years in either the Minister of Mines' Reports or in the Summary Reports of the Geological Survey, so that the writer confined himself to ascertaining facts about present or future work.

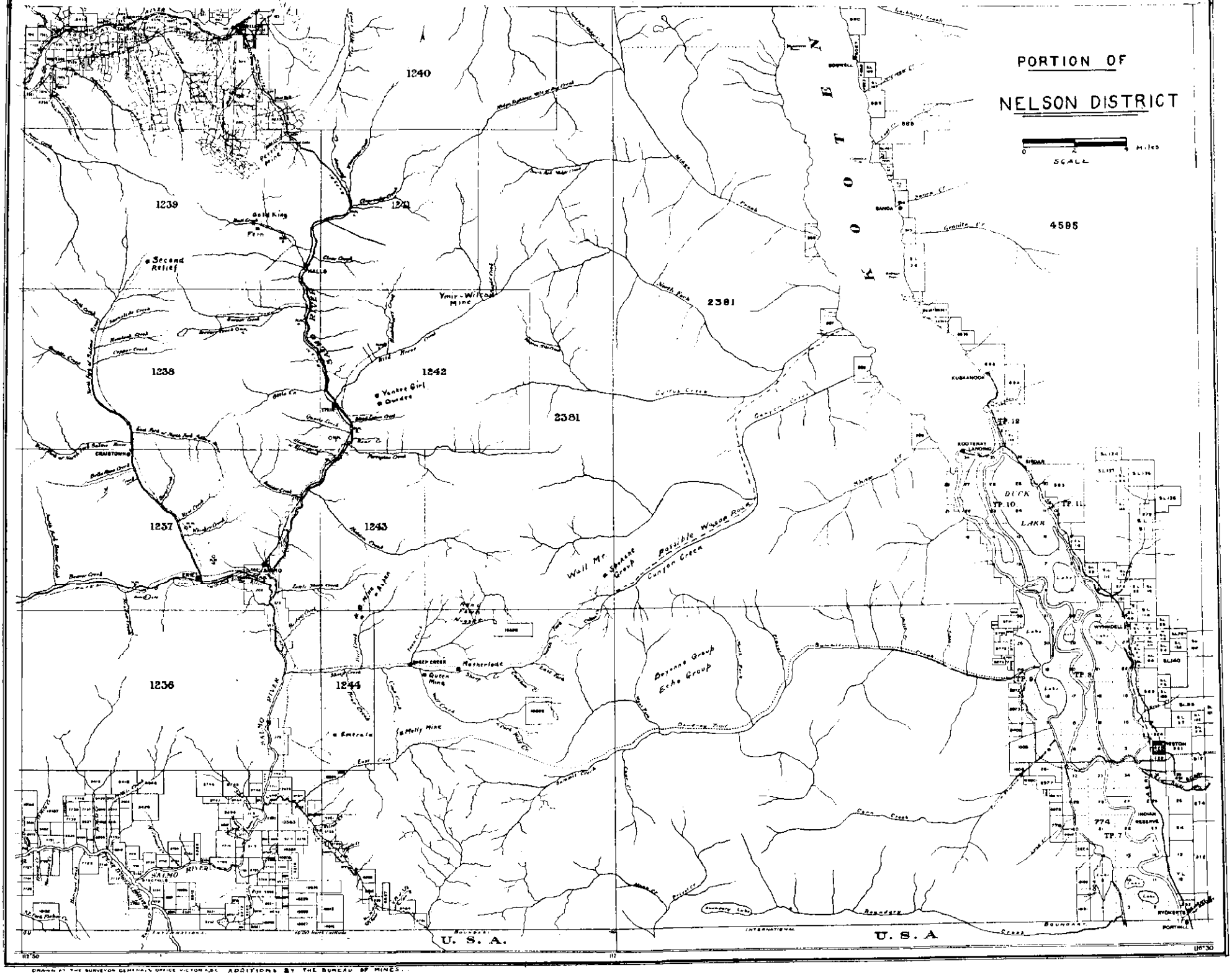
The *Silver King* group, now owned by the Consolidated Mining and Smelting Company, was not operated during 1915, having been closed down indefinitely about the time of the outbreak of war. The exact condition of the mine is not known, but it is believed that the last deep-level development-work—the *Dandy* tunnel—was disappointing, and that new work will have to be done before steady shipments can be resumed. It is believed, though, that considerable possible ore-bearing territory has not yet been explored.

On Eagle creek are situated the *Granite-Poorman* group, owned by the Kootenay Gold Mines, Limited, and the *Eureka* and *Pingree* groups, all of which were visited by the writer.

The *Queen Victoria*, situated near Beasley Siding and owned by the British Columbia Copper Company, was closed in August, 1914, and the compressor plant and other machinery taken away. In the latter part of 1915 a few cars of ore were taken out and shipped by leasers, but it is understood most of this came from old dumps which were resorted. This property was not examined by the writer.

Granite-Poorman Group. This group of claims is situated on the east side of Eagle creek about eight miles by wagon-road from the city of Nelson. The main road down the Kootenay River valley is followed for about six miles, and from there a steep switchback road goes up Eagle creek to the mine, which is at an elevation of about 2,200 feet above the river. The group comprises, in all, fifteen claims, some of which are fractional, and all are Crown-granted. Five separate and distinct veins have been uncovered and on which development-work has been done.

The mine is equipped with a stamp-mill—twenty stamps and four Wilfley tables—situated about one mile west of Granite Siding, on the Columbia & Western Railway, and at the foot of the hill on which the mine is situated. An aerial tramway connects the mine with the mill. This mine was about the first gold property to attract attention in the Nelson District, and was the first to have a mill erected. The mill started operations in 1890; since that time work has been carried on more or less continuously.



DRAWN AT THE SURVEYOR GENERAL'S OFFICE VICTORIA B.C. ADDITIONS BY THE BUREAU OF MINES.

The property has had a somewhat checkered career, having passed through many hands and been repeatedly worked by leasers. At the present time a syndicate composed of Wilson, Crilly, and T. Gough have a lease on the whole group. They have subleased the *Greenhorn* vein to a party of fifteen miners, who are working on a partnership basis under the superintendence of Andy Anderson. He was elected "boss" and also has a committee to advise him. Two men also have a sub-lease on the *Red Rock* vein and two more on the *Poorman*, while the leasing syndicate is at work on the *Hardscrabble* vein. The other veins on the property are the *Granite*, of which the *Red Rock* is supposedly a continuation, and the *Beelzebub*, on neither of which was work being done.

All the veins are quartz-filled fissures occurring in Nelson granite, which is more accurately defined as quartz hornblende diorite. The walls are usually well defined, but in many places pyritization of the wall-rock has proceeded to a small extent. Quartz is the predominating gangue mineral, but occasional inclusions of highly altered and silicified granitic rock are encountered. Throughout the quartz, pyrite is disseminated, and in places this is oxidized to iron oxide. Chalcopyrite, galena, and sometimes sphalerite are found in sparing quantities, and the occurrence of any of these sulphides, especially galena, is an indicator of high gold values. In the oxidized portions of the veins free gold is often seen, and also sometimes along with the sulphides.

The veins vary in thickness from a few inches up to 5 or 6 feet. Their general strike is a little west of north, but considerable variations and irregularities are noticeable in all of them; the dip is generally to the north-east at from 45 to 60 degrees. Faults are common, but generally have small displacements, although in the instance of the *Granite* vein there is one with a very large throw. The veins are also cut by the basic mica dykes common in the district.

The veins strike into the hill in such a way as to enable them to be worked by means of drift-tunnels; these tunnels go in as crosscuts for a short distance and then continue on the strike of the vein.

Greenhorn Vein.—This vein is developed by two adits, the lower one of which is being worked. This adit goes in as a crosscut for a distance and then branches, one branch going to the *Greenhorn* vein and continuing as a drift, and the other similarly as a drift on the *Granite* vein. Ore has been stoped from both these veins in past years. At present the sub-leasers are working on the *Greenhorn* vein developing by drifting ahead and stoping at the same time. The vein where stoping was in progress varied from 6 inches to 2½ feet in width. Quartz constitutes the vein-matter and iron pyrites is disseminated throughout. Gold occurs free and in association with the pyrite. Four air-drills were at work, and the ore was trammed to a station on the aerial tram and thence to the mill. The ore varies considerably in value and is very pockety, but the average assay value over a number of years is about $10 a ton.

Red Rock Vein.—The *Red Rock* vein lies up the hill from the *Granite* workings, and is probably a continuation of the latter. On this an adit-tunnel has been driven in on the vein for a distance of 350 feet. The two men who are sub-leasing on this vein were stoping at a point in 150 feet. At this place there was from 6 to 10 inches of fair-looking ore. Arrangements are made whereby the sub-leasers can run their ore through the mill after mining enough to make a few days' run possible.

Hardscrabble and Poorman Veins.—The *Poorman* and *Hardscrabble* veins lie considerably to the west of the others and are themselves close together. The *Poorman* vein is opened up by four adit-tunnels, and from the lowest—No. 4—an incline winze has been sunk and a fifth level run in; the greatest depth on the vein is nearly 700 feet. A large part of the tonnage produced by the whole property has come from this vein. From the lowest level up to the surface the major portion of the ore-shoot has been stoped out. The lower level to near the top of the winze was full of water, so it was impossible to examine it. The No. 4 tunnel cuts the vein at a distance of 475 feet from the portal, and then continues as a drift for about 1,000 feet more. Stoping has been carried out along nearly the entire length of this drift upwards to the surface. At the face the vein is pinched to a seam. One man was sub-leasing on this vein cleaning up old stopes and generally extracting a little ore wherever it could be got at easily.

The *Hardscrabble* vein is intersected by this No. 4 tunnel of the *Poorman* at a point about 60 feet from the entrance. From the point of crosscutting a drift has been run to the south for a distance of about 800 to 900 feet. There is one main ore-shoot in this vein which has a

length of about 300 to 400 feet. Near the end of the drift the vein has separated into two stringers and a drift has been run a short distance on each. At the faces the stringers are pinched down to seams. The general strike of the vein is from north and south to N. 15° W. and dipping at about 45 degrees to the east.

Most of the productive portion of the vein above this No. 4 crosscut-adit level has been stoped out, but good ore is exposed along the bottom of the drift for a distance of 400 feet. The lessees commenced work at a point 600 feet in the tunnel by starting a winze which it is intended to sink 100 feet, and which at the time of visiting the property was down 60 feet. The winze has been made big enough to operate two machine-drills on it, one large drill and the other a small hammer-drill. The vein has been followed down, keeping it on the hanging-wall. It looks very promising down the whole 60 feet; the quartz is well mineralized with iron pyrites, galena, and zinc-blende, and shows free gold in many places. The width of quartz averages about 2½ feet and all of it can be considered good ore. The gold in this vein is as a rule coarse and easily saved on the amalgam-plates, and the average grade of the ore in this vein is better than the others previously described.

It is the intention of the lessees to sink the winze to 100 feet and then drift both ways on the vein and then commence stoping. As the bottom of the No. 4 level shows a good ore-shoot, it seems very likely that this work should prove up a nice-sized block of good mill-ore. A small power-hoist serves for hoisting ore and rock from the winze.

In 1915 the whole group produced about 1,500 tons of ore containing approximately 750 oz. of gold; practically all of this came from the *Greenhorn* lease.

Eureka.

About two miles farther up Eagle creek above the *Granite-Poorman* group is situated the *Eureka* mine, owned by the Eureka Copper Mines, Limited, of Nelson. The property is reached by a continuation of the wagon-road beyond the former property, and is at an elevation of 2,700 feet above Kootenay lake. Seven claims and fractions, all Crown-granted, constitute the group. The country at this point is not so steep as at the *Granite-Poorman*, and it is therefore necessary to run long tunnels to get any considerable depth. The total footage of work on the property to date is about 4,500 feet, consisting of an incline shaft with three levels and a crosscut tunnel. In addition to this, some open-cutting and trenching has been done and a new lower level crosscut tunnel has recently been started.

The first mention of the *Eureka* mine in the Annual Reports of this Department was in 1904, when some development-work done on the property was noted. In 1905 the owner, J. P. Swedberg, continued development, and in July of that year bonded the property to Nelson men, who before the end of the year had shipped 250 tons of ore assaying 7 per cent. copper, $7 in gold, and 4 oz. silver.

In 1906 the mine was in the hands of the present company, and 940 tons of ore was shipped, assaying about $14 a ton. Shipments in 1907 totalled 620 tons of about the same average grade. In 1908 no ore was shipped, work being confined to the driving of a long crosscut tunnel. Further development-work was carried out in 1909, but no ore was shipped. Shipments were resumed in 1910, when 342 tons of ore, with an assay value of about $18, was sent to the Trail smelter. Only development-work was done in 1911, and in 1912 the property was bonded by the British Columbia Copper Company. This company carried out further developments, including the equipping of the property with a steam plant, during 1912, 1913, and part of 1914, when the bond was allowed to lapse after considerable money had been spent and part of the purchase price paid. The failure of this company to carry out its bond does not necessarily condemn the property, as the financial conditions at the time were the determining factor rather than the state of the mine. Early in 1915 the property was secured under lease and bond by Keffer & Johns, formerly consulting engineer and mining superintendent respectively for the British Columbia Copper Company, who had resigned from the company, and shortly after they turned their bond over to the Pingree Mines, Limited, and are now acting as consulting engineers for the latter company. The Pingree Mines commenced operations in the summer of 1915, and work is being carried on under the superintendency of Frank Pearce.

The ore-body on this property is of a rather unusual type, being partially of the fissure type and also to some extent a replacement deposit. The country-rock is granodiorite, but there are several limestone-bands which apparently had foundered into the diorite magma at the time of its intrusion. The ore-bodies are developed along lines of shearing and fissuring which to some extent follow these limestone-bands, but are in part entirely in the granodiorite. In the lime-

stone, mineralization has proceeded by the replacement of the rock by sulphides and quartz; in the granodiorite, quartz and silicified wall-rock form the gangue and the sulphides occur in lesser quantities.

The ore consisted primarily of sulphides of copper and iron, but it is now largely oxidized down to the lowest level. Azurite, malachite, limonite, and chrysocolla are the main oxidation minerals, and, together with chalcopyrite and thin films of bornite, make up the ore-minerals occurring in a gangue of quartz and calcite.

There are apparently two main fissures or veins, which may later be shown to be connected. The width of the ore, which occurs in fairly well-defined shoots in the fissures, is from a few inches up to 13 feet, with an average of about 4 feet. A considerable tonnage of ore is blocked out in the mine, but no figures are available. The ore so far shipped has averaged about 5 per cent. copper, with 3 oz. silver and $4 in gold to the ton. To some extent these shipments were selected ore, so that the developed ore in the mine may be somewhat lower in grade.

The shaft on the property is 200 feet deep, with drifts at the 100-, 150-, and 200-foot levels, and the crosscut tunnel gives an additional depth on the ore-body of 82 feet below the bottom of the shaft. From this tunnel three raises go up to the surface and a winze goes down 100 feet, and from the bottom of the winze drifts have been run 90 feet in each direction along the vein. The company is at present driving a tunnel 1,300 feet long which will cut the vein 100 feet below the bottom of this winze. When the ore is struck in this tunnel, if conditions warrant the expenditure, an aerial tramway will be constructed down the hill to a point on the railway. Hauling the ore out by wagon, as at present, would hardly be used if mining on a large scale were started.

Pingree Mines. The property of the Pingree Mines, Limited, is situated near the head of Eagle creek, and is reached by a continuation of the wagon-road running to the *Eureka;* the property is about two miles beyond the latter. A considerable amount of development-work has been done on the group, but no ore-bodies of importance have been discovered.

From one showing on the property some ore of good value was extracted and shipped. This, apparently, was a slide from somewhere, and all succeeding work has failed to discover the main body of which this was a piece, or any other ore-body.

As before indicated, this company has bonded the *Eureka* mine and is now confining attention to the latter.

The last work done on the *Pingree* was in the spring of 1915, under the superintendence of Frank Pearce. This work consisted of driving prospect-tunnels, none of which, however, succeeded in finding much. One is driven in 135 feet in a soft, schistose material; this was driven for $4 a foot, which speaks well for the management. In this working there is a good foot-wall, and throughout there are scattered bunches of quartz, which sometimes carry small gold values. About 300 feet above this tunnel there is an open-cut and 20-foot tunnel, showing a quartz vein lying flat and pitching out of the hill. This vein consists of white quartz and some black oxide of iron, but carries no values.

In another place there is a 12-foot shaft sunk on a small vein, from which it is reported some good ore was taken out. To the north-west and down the hill a drift-adit has been run on this vein for a distance of 150 feet, and some short crosscuts made from it. At a point 30 feet within this drive a winze was sunk last winter by Pearce, and at a depth of 30 feet drifts were run both ways on the vein. The work shows the vein to be from 1 to 4 feet wide, and to consist of white, hungry-looking quartz, with some bunches of black oxide of iron; this material carries no values. Another tunnel has been run in 150 feet to crosscut this vein, but nothing was found. Higher up the hill still, another crosscut was run in 350 feet, which was only productive of hard work.

The showing from which some ore was shipped in previous years is developed by two short drift-tunnels, but both of these have run off the vein. This vein at this place is apparently not properly in place, but the uncertainty as to where to look for the continuation has led to the previously enumerated futile work.

Perrier Group. This group of seven claims, owned by C. E. Crossley, A. H. Crossley, R. Young, Hinton, and Turner, is situated close to the Nelson and Fort Sheppard Railway, about four miles from Nelson. The mine is very conveniently located and during the last year the owners have been steadily at work. The property

is equipped with a small mill, consisting of a crusher, Huntingdon mill, amalgamating-plates, two Frue vanners, and a hoist for the shaft. Power is obtained by a Pelton wheel, 2 feet 6 inches diameter, driven by water under a 300-foot head, which operates everything but the vanners; these last are run by a small 2-horse-power Pelton wheel. A boiler and engine have also been erected and can be used if the water-power fails owing to low water in the dry season.

The formation here consists of chlorite and mica schists belonging to the Rossland volcanic series. The vein, which is a quartz-filled fissure, strikes obliquely across the schists at about N. 20° E. and dips into the hill at from 30 to 75 degrees. The gangue consists of quartz carrying galena, iron pyrites, chalcopyrite, zinc-blende, and occasionally free gold. The values are mainly in gold, with a little silver; the selected ore shipped to the smelter gives returns of $50 to $60, while the mill-feed runs from $10 up. The vein varies from 8 inches to 2 feet in width.

The main opening on the vein is a shaft 85 feet deep, and from the 75-foot level a drift has been run on the vein for 80 feet. A little overhand stoping has been done from this drift. When the property was visited three of the owners were at work sinking the shaft deeper. The vein at the bottom was 18 inches wide and well mineralized with galena and pyrite. In the drift the vein has split, and at the face there are two stringers separated by 6 feet of schistose matter, slightly mineralized and permeated with small seams of quartz. It was the intention of the owners to drive this drift ahead and stope ore out during the winter. About 60 tons had been run through the mill and 50 tons more was on the dump, but, owing to a shortage of water, the mill was not being operated.

St. Anthony Group.

There are three claims in this group, owned by Wm. Maher and partners, all surveyed, but not Crown-granted; the claims are located up the hill from the *Perrier*, about 1,000 feet above the railway-track. The lowest tunnel on the *St. Anthony* claim is a drift on a small vein striking east and west. At a point 50 feet in, a north-and-south vein is encountered, and on this a drift has been run 75 feet, and some stoping done and a winze sunk 10 feet near the end. These veins occur in granodiorite near the contact with the schistose rocks. They are irregular and often consist of a few stringers scattered across 2 or 3 feet of altered granitic matter carrying iron pyrites. Mineralization consists of galena and pyrites. At the portal of the tunnel the vein is 26 inches wide and said to assay $19 in gold and silver.

The east-and-west vein is uncovered in several places above and below the tunnel, and shows from 2 to 3 feet of vein-matter consisting of quartz and altered wall-rock (granodiorite) mineralized largely with pyrite, which often is oxidized to limonite. One open-cut below and to the west shows 3 feet of vein, which is said to have returned an average assay of $13; at this point the vein lies very flat and is probably broken over. Some galena and zinc-blende are seen here, and the latter mineral is said to be an indicator of good gold values.

One hundred feet up the hill another parallel vein is developed by means of a drift-adit 65 feet long. This vein varies in width from an inch to 10 inches and consists of quartz carrying sulphides similar to the other lead. Picked samples are said to have returned assays as high as $80. Above the tunnel the vein is exposed in an open-cut, where it shows a width of 1 foot and dips at 25 to 30 degrees to the north.

Several other veins on the property which were not seen by the writer are said by Mr. Maher to have similar showings to those already described, and all have had a little work done on them. One has a tunnel 75 feet in length, disclosing a small quartz vein, which in places shows fair values.

A small shipment of ore was made from this property in 1915, which gave the following returns: 9,322 lb. dry weight, containing 12.687 oz. gold and 15.38 oz. silver.

Fern and Gold King.

The *Fern* mine is an old property situated a few miles west of Halls, on the Great Northern Railway, which has not been worked for some years. It was operated for a time by an English company, and it is said that some very fine gold ore was taken out. It is equipped with a gravity-tram and small stamp-mill, both of which are practically useless now through falling into disrepair.

The formation here consists of basic lava rocks, highly altered, which are members of the Rossland volcanic series. The vein, which strikes north-east and south-west and stands nearly vertically, is a quartz-filled fissure varying from a few inches up to 4 feet in width. The only mineralization is with iron pyrites, and this quite sparingly. The vein was developed by four tunnels, which go in as crosscuts for a short distance and then are continued as drift-adits.

In each case, after going a few hundred feet, the vein is cut off by a fault, and exploratory work has failed to reveal the continuation of the vein, so that when the ore in the shoots exposed had been stoped out work was stopped.

Adjoining the *Fern* down the hill is the *Gold King* claim, which is owned by the Gold King Company, a syndicate recently formed. Besides acquiring the *Gold King*, this company has a two-year option on the *Fern* mine and intends to carry out some further development on that property. Work was commenced on the *Gold King* in the fall of 1915 with a few men, and it is believed that development was kept up all the winter.

On this property there is a quartz vein occurring in similar basic, volcanic rock to that of the *Fern*, and striking and dipping in a parallel direction. It is, however, farther up the creek and is not, therefore, to be considered a continuation of the *Fern* vein.

The *Gold King* vein is exposed where it crosses the bed of the creek and on both banks. On one side at a short distance from the creek a tunnel has been driven in on the vein for a distance of 70 feet. In this working the vein proper consists of from 10 to 15 inches of quartz carrying a little pyrite, but in addition the wall-rock has often been pyritized and is said to return good gold values. As a rule, the vein has a talc gouge on the hanging-wall, but it is generally frozen on the foot-wall. In places the fissure splits and there are two stringers of quartz separated by 4 feet or more of rock-matter carrying a little pyrite, all of which is said to carry gold values. At the face of the tunnel the vein is apparently cut off by a fault, but no drifting had been done along the fault to locate the continuation of the vein. Small amounts of galena are sometimes found in the quartz.

A 20-foot shaft has been sunk on the vein, almost in the bed of the creek. As the top of the shaft was timbered and the bottom had water in it, not much of the vein could be seen. Where seen the vein was from 8 to 14 inches wide and slightly oxidized. At the time of visiting the property a pump and 2-drill compressor were being installed in order to sink this shaft deeper. A boiler was to be installed to supply steam to drive the pump and compressor.

On the other side of the creek the vein shows a width on the surface of 8 to 10 inches and carries the usual amount of pyrite. A selected sample from this point assayed 1.42 oz. gold and 4.2 oz. silver to the ton. A representative sample of the mineralized wall-rock returned 0.3 oz. gold and 0.3 oz. silver to the ton, and a selected piece from the tunnel ore-dump assayed 1.7 oz. gold and 2.3 oz. silver.

YMIR CAMP.

The name Ymir camp is given to a section of country tributary to Ymir, a small town on the Nelson & Fort Sheppard Railway about twenty-five miles from Nelson. The railway here follows the valley of the Salmo river,* and right at Ymir, Wild Horse creek comes in. This creek was worked to some extent for placer gold in the early days, and the first mineral claims in the district were staked near its headwaters in 1885. In 1893, when the railway was being built, active development and mining commenced, and for several years the camp had a steady production. The *Ymir* mine, situated five miles up Wild Horse creek, was for many years an important producing mine, but the failure to find the main ore-shoot on the 1,000-foot level caused its final shut-down. During the last two years the camp has been very quiet, but the outlook for the future is more promising than it has been for some years back.

The camp takes in the territory from Salmo to Hall Siding, on the Nelson & Fort Sheppard Railway. The Salmo river flows in a valley lying between the Nelson and Bonnington ranges, and its tributary creeks on either side draw their waters from these mountains.

Yankee Girl. This mine, which is owned by the Hobson Silver-Lead Company, is situated about two miles from Ymir in an easterly direction. There are three claims in the group, the *Yankee Girl*, *Canadian Girl*, and *Yukon Fraction*, comprising 145 acres in all. The lower working-tunnel of the property commences on the *Old Bill* claim of the *Dundee* group.

The *Yankee Girl* was staked and worked for a time by Grobe, Lovell, McLeod, and Graham. Later it was acquired under lease and bond by Doyle Bros., who shipped some 250 tons of ore valued at $6,600. In 1907 the property was bonded by American capitalists, who, however, were unable to complete the purchase of it. In 1908 H. L. Rodgers bonded the group and carried out some development-work and shipped some ore. In 1909 the property was acquired by the Yankee

* Formerly called Salmon river.

Girl Gold Mines, Limited, which company shipped 4,738 tons of ore in 1910. The Hobson Silver-Lead Company acquired the mine in 1911, and since then development-work has been carried out and ore shipments made more or less continuously up to the present time.

The property is developed by means of adit-tunnels, of which Nos. 1, 2, and 3 may be characterized as the upper workings and from which all the ore so far shipped has been taken. The No. 4 tunnel is 500 feet below the No. 3, and work on the property is now confined entirely to this level. The total amount of ore shipped from the mine has been in the neighbourhood of 8,500 tons, with an assay value of about $22 a ton.

The formation consists of sedimentaries and schists intruded by granodiorite. The contact of the granodiorite with the sedimentary rocks is often very irregular, the igneous rock having sent out jagged tongues into the older formation. The *Yankee Girl* vein occupies a sheared zone which to some extent follows the contact between schists and granodiorite, but which in many places is entirely within the schists. The sedimentary measures are generally considerably metamorphosed near the contact, the common form being a highly schistose rock and often a mica-schist. The sheared zone in which the vein occurs might almost be said to be a large fault-plane, and possibly it is. The vein is from 4 to 8 feet wide and is very consistent in strike and dip. The vein-filling is made up largely of somewhat silicified schist and some almost unaltered schist, but there is also some white and blue quartz and calcite. The metallic minerals are iron pyrite, galena, and zinc-blende, with the latter two often absent. Values are mainly in gold, but where galena and zinc predominate silver values become important. Clean quartz carrying but little sulphide will sometimes assay well in gold, but as a rule it is necessary to get sulphides before there is much value in the ore. Galena and zinc-blende are often indicators of good gold value, although it is not certain that these minerals actually carry the gold.

The ore-body is of the replacement type; quartz, calcite, and sulphide minerals were introduced by hot solutions which flowed along the shatter seams of the sheared zone and, attacking the schistose rock, dissolved out a portion and deposited the ore and gangue minerals.

In many of the workings tongues of granite cut the schists, but not the vein, showing the vein to be later formed than the granitic intrusion. The vein formation probably took place during the expiring stage of batholithic activity. In some places granite forms one wall of the vein and is sometimes on one side and again on the other. The schists have a general strike of north and south, while the vein cuts across in a north-easterly direction and dips at 60 to 75 degrees to the north-west.

No. 2 tunnel, which is about 2,000 feet long, was for some time the main working-level of the present company. Several crosscuts have been made from it in both directions at right angles to the vein, following formation slips and going into the true walls. Many stopes go up from this tunnel to the No. 1, which is 150 feet above, but there is a large area of stoping-ground left which is said to contain low-grade ore suitable for mill-feed.

No. 3 tunnel is 150 feet lower than No. 2 and is about 500 feet long. Comparatively little stoping has been done from this level, but there is said to be some ore of milling grade in it.

No. 1 level is caved at the mouth and abandoned. From this working high-grade ore was taken out in the early days of the mine.

No. 4 tunnel commences on the *Old Bill* claim of the *Dundee* group and is driven in for 1,200 feet in a direction nearly parallel to the strike of the vein. It then turns off at an angle of 45 degrees to the south for 140 feet, where it strikes a small stringer which was followed to its junction with the main vein, with which it makes an angle of about 20 degrees. The main vein was then followed for 140 feet to the north-east, where work was proceeding when the property was visited. It is the intention of the management to drive this lowest adit in under the ore-shoots which were developed in the upper tunnels. In this working the vein is from 6 to 10 feet wide and has a well-defined talc gouge 3 or 4 inches in width on the foot-wall. The hanging-wall is rather indefinite, as there is no sharp line between the schist country-rock and the gangue of the vein. At the face it seemed as if the drift was running into an ore-shoot, as there was 2 or 3 feet of material well mineralized with iron pyrites and occasionally specks of galena. A sample of this ore assayed 0.64 oz. gold and 1.8 oz. silver to the ton.

It is the intention of the company to develop this winter and next year to equip the property with a mill to treat the low-grade ore. In connection with this a hydro-electric power plant will be installed drawing water from Wild Horse creek. Ample water for developing power can be obtained, and a start has already been made during 1915 to put in a ditch-line and dam.

Dundee.

This mine comprises five mineral claims covering 197.63 acres, and is situated one mile and a half north-east of Ymir, and adjoining the *Yankee Girl* group. Connection with this town is effected by a good wagon-road which is two miles and a quarter to the upper workings. The claims are located on the north side of Bear creek, and the mountain-side rising up from the creek is sufficiently steep to afford good tunnel-sites. The claims, which are all Crown-granted, are as follows:—

Old Bill, Lot 1863	51.65	acres.
White Pine, Lot 4004	37.88	„
Parker, Lot 1861	44.65	„
Lightheart, Lot 1862	51.65	„
Annie Frac., Lot 3849	11.80	„
Total	197.63	acres.

Sufficient power can be obtained from Bear creek for the operation of a small compressor throughout the year; more power can be secured in the district. There is no mining timber on the ground, the nearest being at least a mile away.

The *Dundee* mine was one of the first properties to be operated in the Ymir district. Intermittent working by means of the shaft was carried on from 1897 to 1904. In 1898 a mill and concentrator was erected, which was soon after destroyed by fire.

In all, about 300 tons of ore has been shipped from the property, which had an average assay value of from $15 to $20 a ton. Prior to 1901 46.5 tons of sulphide ore was mined and shipped, with net smelter returns of $18.45 a ton; the assay value of the ore was: Gold, 1.37 oz.; silver, 7.3 oz. In addition, 50.6 tons of concentrates were shipped, which netted $13.48 a ton after freight and treatment charges had been paid; the assay value was: Gold, 0.96 oz.; silver, 4.9 oz. This lot of concentrates was obtained from 185.6 tons of ore, which assayed: Gold, 0.363 oz.; silver, 0.4 oz. The percentage extraction of value was 77.6 per cent.

In later years work on the property has been confined to driving a long tunnel which taps the ore-body 900 feet or more below the surface level of the upper workings; this will be described later.

The *Dundee* vein is a replacement deposit along a shear fissure-zone. By this it is meant that the country-rock along the zone of shearing and fracturing and fissuring has been partially replaced and transformed into ore and gangue minerals by the action of hot aqueous solutions and gases ascending from below, under conditions of high temperature and pressure. This vein or sheared zone is somewhat irregular in strike, as it conforms to some extent to the contact between the granodiorite and the sedimentaries. In many places granodiorite forms one or other wall of the ore-body.

The gangue is principally altered country-rock, together with some quartz and calcite. The country-rock which is thus altered is the sedimentary rock, generally a slate, into which the granodiorite is intrusive. Where granodiorite forms the wall-rock very little alteration of the wall was observed, and in no case does altered granitic rock form the gangue-matter of the vein.

The gangue minerals consist of iron pyrite, galena, and zinc-blende in this order of abundance. The sulphides generally carry good gold values, and in some instances it is claimed that quartz, with little or no sulphides present, also carries very fair gold values. Silver occurs in the ratio of about 4 to 1 of gold by weight. Galena is an indication of good gold values and often of high silver. Zinc-blende is often accompanied by both gold and silver values. Pyrite alone does not generally assay very high in gold. Sulphide ore predominates, oxidation not having extended to any great depth.

The old workings on the property consist of a shaft 260 feet deep, with 415 feet of drifting and crosscutting. Some stoping has been done from the drifts, and it was from here that the 300 tons of ore was shipped.

The *Dundee* tunnel was started down the hill from the old workings and 905 feet below the shaft-collar. For a distance of 1,862 feet this tunnel is a crosscut, at which point it strikes the vein, and from there a drift has been run on the vein for 1,092 feet. Besides this, several hundred feet of crosscutting has been done from this drift to explore territory close to the vein.

In this working the vein has a general strike of N. 63° E. and dips into the hill at about 65 to 80 degrees. The only ore-shoot found in the vein in the course of this 1,000 feet of drifting is the last 100 feet at the face. As there is good ore at the face of the tunnel, it is quite likely

that this shoot of ore may be considerably longer than the 100 feet already exposed. A small stope was started up from near the face, and one car of ore was shipped which was roughly hand-sorted; this returned an assay value of $27 a ton.

The vein is up to 20 feet in width and the drift-tunnel for the most part follows the foot-wall. There is evidence in the upper workings to show that when in an ore-shoot there are two pay-streaks—one on either wall. These pay-streaks vary from 1 to 5 feet in width and are separated by barren gangue-matter. The average value of the 100-foot ore-shoot at the end of the drift-tunnel is said to be $8.50 a ton; this average is the result of many assays by the owners. The average width of the foot-wall streak is about 3½ feet, and the hanging-wall streak is about the same. This gives a total of 7 or 8 feet of ore assaying $8.50, with a width of 8 feet and exposed for a length of 100 feet. This ore-shoot is supposed to be the downward extension of a shoot exposed in the shaft-workings, 900 feet above, but whether or not the ore is continuous between these points has not yet been proven.

It would seem to be advisable to continue driving ahead this tunnel, as with a good ore-shoot just commencing the property is in a favourable condition for further work. As total costs for mining and milling the ore could be probably kept at about $5 a ton or slightly under, there would be a good margin of profit in handling $8.50 ore if a sufficient tonnage was developed to justify the erection of a fair-sized mill.

The tunnel is at present equipped with a 2-drill compressor driven by a Pelton wheel, and a fan similarly driven for providing ventilation in the tunnel. The camp has a superintendent's house, assay office, blacksmith-shop, etc.

Summing up, it may be said that the actual known and proven tonnage of ore in sight in this property is not very great, but the prospects for probable large ore reserves are very favourable, and, if properly developed and equipped, it may become a large and dividend-paying mine.

Wilcox.

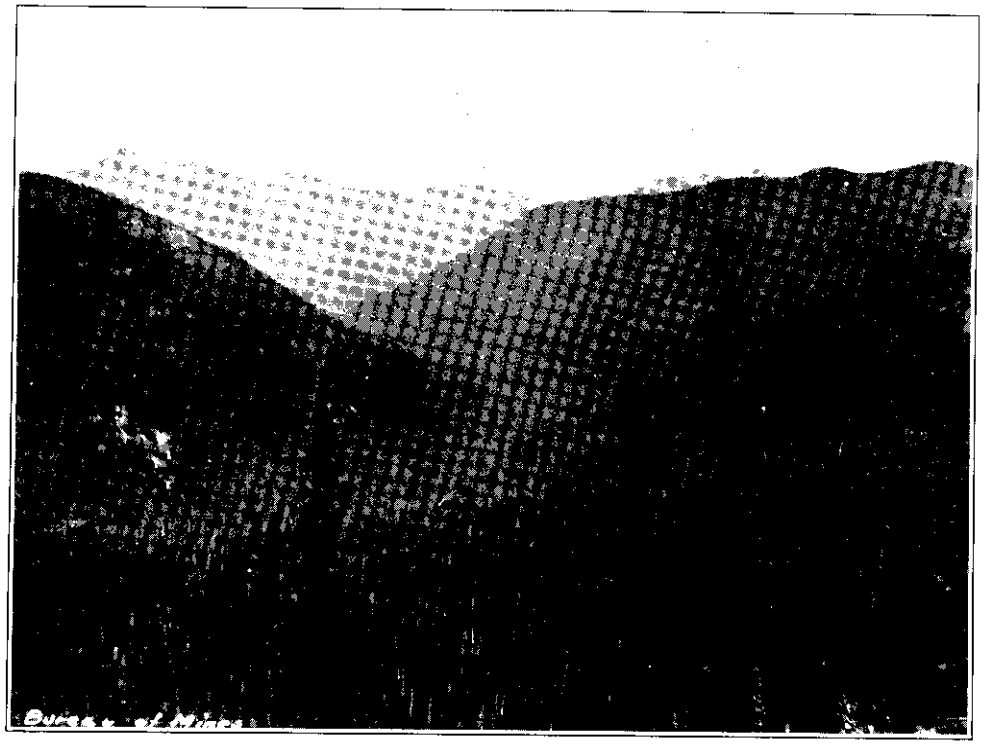
This mine is situated on Wild Horse creek, seven miles east of Ymir; six claims are included in the group, comprising 187.5 acres. Three of the claims —the *Fourth of July*, *Wilcock*, and *Bywater*—were staked in 1896 by Phil White and S. Bywater. The first ore, which was taken out near the surface and was fairly rich, was rawhided out and shipped to a smelter for treatment. In 1898-99 a 4-stamp mill was erected on the property and from time to time ore has been milled in this. The Ymir-Wilcox Development Company now owns the mine, and work during the last few years has been done under the superintendence of Arthur Lakes, Jr. The total production of ore to the end of 1911 was 8,450 tons, having a net value of $86,326. Since 1911 no ore has been milled or shipped, but some development-work has been carried out. During 1915 practically no work was done, the property being in the charge of a watchman.

The mill now consists of 10 stamps, amalgamating-plates, and four Frue vanners, driven by water-power. The water-power has lately been used to drive an electric generator in the mill; this electric power is transmitted up to the mine and there used to drive a 3-drill compressor placed in the No. 3 tunnel. Compressed air from this is used also to run the hoist on No. 2 shaft.

The mill is situated at a point 200 feet above the bed of Wild Horse creek and a good wagon-road from Ymir extends to this point. The mine-workings are up on the hill above the mill, the No. 3 level being about 800 feet higher. A 2-bucket aerial tram connects this tunnel with the ore-bins at the mill, while a baby tram brings ore from the *Fourth of July* to the No. 3 level. Water to supply power is obtained from Rapid and Avalanche creeks, but application for further power from the South fork of Wild Horse creek has been made.

At present the mill extracts about 80 per cent. of the values, but this could be materially increased by the introduction of cyanide treatment. Plenty of timber is available for mining purposes.

Geological conditions at this mine are very similar to those at the *Dundee* and *Yankee Girl*. Sedimentary and schistose rocks of Palæozoic age are intruded by granodiorite of an age contemporaneous with the Nelson granite. There are two or three veins on the property which differ from those of the *Dundee* and *Yankee Girl*, in being smaller and occurring entirely within the granodiorite instead of in the schists. The veins are of the replacement type, having been formed along sheared zones in the granodiorite; quartz and silicified and kaolinized country-rock



Looking down Canyon Creek—Nelson M.D.

Lower Tunnel, Bayonne Mine—Nelson M.D.

constitute the gangue of the veins, while the sulphide minerals present are pyrite, galena, and occasionally zinc-blende. Very little silver is found in the ore, the values being principally in gold. As a rule, no gold values are found, or are very low, unless where sulphides occur. The gold is 70 per cent. free, but the sulphides are a good indicator of the presence of gold. From 5 to 20 per cent. of the vein-matter is sulphide.

Oxidation has proceeded to a depth of 150 feet or more, and very often oxides and sulphides are considerably mixed up. The common oxidation mineral is limonite, formed from the pyrite, but traces of copper and lead carbonates are occasionally seen.

The veins, which are from a few inches up to several feet in width, are made up of altered rock, together with reticulating veinlets of quartz and irregular masses of quartz and sulphides. The walls are sometimes well defined, but in places no wall can be seen and the mineralization extends into the country-rock and gradually fades away. Lamprophyric and acid dykes cut the veins in many places and often have caused faulting of them. The main vein is cut off by what has been called a large shear-zone or fault-plane which strikes N. 43° E. and dips at 86 degrees to the south-east. This shear-zone is really the contact-line between the granodiorite and a body of schist which is a roof-pendant suspended in the granodiorite magma. There has probably been a movement along this contact subsequent to the igneous intrusion, resulting in the formation of a crushed zone 2 or 3 feet wide which consists of kaolinized rock-matter and talc. This shear-zone is well shown on No. 2 level, where the level, driven on the vein, was continued on past the contact and into the schist for a distance of 100 feet. Then drifts were made in both directions, following the talcy gouge along the contact. The drift to the north found no ore and has been filled up with waste material taken out elsewhere. Neither does the continuation of the drift through the contact and into the schist show any ore, the vein having ceased abruptly at the contact. In the drift to the south some bunches of ore were found which might indicate that the vein was simply faulted, and that by following this contact the further extension of the vein could be picked up. It seems more likely, though, that the vein was formed subsequent to the faulting, and that the mineralizing solutions flowing along the line of contact formed some small masses of ore. It is quite possible that the shearing action which produced a fissured zone in the granite failed to produce such in the schist, owing to the greater plasticity of this rock, which would allow it to flow instead of fracture, and hence the contact between schist and granite would be the end of this vein. If the pendant mass of schist is not very large in length and depth it is possible that the vein is continuous in the granite beyond and below the schist.

There is 4,958 feet of tunnelling on the property, 1,953 feet of which is drifting on the vein and the balance crosscutting, or driven in barren rock, and 894 feet of shafting and upraising.

The No. 1 tunnel on the *Fourth of July* claim is 415 feet long; the vein has been pretty well stoped to the surface and some underhand stoping done as well.

No. 2 tunnel is about 150 feet lower than No. 1 and goes in 471 feet in barren ground; then it strikes the vein and drifts have been made both ways; the drift to the west extends for 300 feet on the vein to where it is cut off by the schist-contact as before indicated. From this level raises go up to the underhand stopes in No. 1.

No. 3 level, which is about 200 feet below No. 2 is the main working-level of the property. It is a drift on the vein for a total distance of 800 feet from the portal and several short crosscuts. The width of ore varies from a few inches up to 3 feet; at the face of the tunnel there is a stringer on both walls with gangue rock between. The vein is cut by mica dykes and there are several rolls in it.

At a point 75 feet from the face a winze has been sunk to a depth of 25 feet, which shows at the bottom 1 foot of nice ore on the east side, and about 8 inches of white quartz carrying a little iron on the west side. This winze is a continuation of a raise between this level and No. 2 which is called No. 2 shaft. Between the two tunnels an intermediate level has been driven off the shaft which does not come out to the surface, and in this a good shoot of ore is exposed; to the west of the shaft this drift is 65 feet long and to the east 60 feet.

Another tunnel has been started at the surface between Nos. 2 and 3 which is 400 feet long, but this does not connect with the other workings. Nos. 4 and 5 and A and B tunnels are farther down the hill, are unimportant, and wholly or in part caved in. Some open-cuts and prospect-pits complete the total of development-work.

The manager, Mr. Lakes, estimates the following ore reserves in the mine:—

Blocked out	13,000 tons,	assaying	$14 60 a ton.
Partially blocked out	8,350 „	„	9 00 „
Probable aditional ore contiguous to lowest level	6,000 „	„	8 00 „

This makes a total of 27,350 tons, having a gross value of $312,950 and an average assay of $11.45. It is claimed that this ore can be mined and milled for $5 a ton, but even if this estimate was increased by 50 per cent—that is, to $7.50—there would still be a margin of $4 a ton in handling this ore.

Nevada. This property is situated about four miles south of Ymir on the southern side of a small creek and at an elevation of 3,700 feet above sea-level. Grobe & MacLeod, of Ymir, the owners, secured it four years ago. The formation on this hill consists of slate and schist intruded by tongues and masses of granodiorite. The sedimentary rock is generally a fine-grained siliceous rock which has been highly altered by the action of the granodiorite in the contact zone.

Small, irregular stringers of ore occur in many places on the hill both in the granodiorite and in the sedimentaries. It would appear as if the igneous intrusion had shattered the hill along a general north-east and south-west line, and that along these shatter seams some mineralization had taken place. None of the stringers so far explored can be considered as of much value, but where there is so much evidence of mineralization it is possible that a considerable ore-body may yet be found.

The claim is staked up and down a fairly steep hillside, which might be a 30-degree pitch. The stringers as a rule run up and down the hill or cut it at an oblique angle.

One tunnel is in 70 feet, with two short crosscuts; at the portal this adit shows a little galena and zinc, but nothing at the face. Fifty feet below this working there is another adit of about the same length which is run on a parallel stringer; this also petered out at the face. A cross cut 15 feet to the left breaks into granite, while the tunnel and stringer are in slaty rock.

At an elevation of 3,825 feet and near the end line of the claim another tunnel has been driven in 205 feet on a vein which twists a good deal, but has a general south-westerly strike and dips to the north-west at about 60 degrees. This vein is from 1 to 3 feet wide and consists of quartz and silicified slate carrying a little galena and iron pyrites. The face shows 18 inches of material carrying a lot of pyrite. A selected sample from this face assayed: Gold, 0.03 oz.; silver, 0.8 oz.

At an elevation of 3,550 feet and a few hundred yards east of the cabin—which is nearly in the centre of the claim—an adit-tunnel has been run in 50 feet to crosscut a stringer showing in an open-cut above. In the open-cut the ore is said to have given an assay of $70, but practically no values were encountered in the tunnel. After crosscutting the stringer the tunnel was continued for 10 feet beyond and turned to the right for 15 feet. This latter work is entirely in granodiorite.

At the time of visiting the property McLeod was at work on a showing above the cabin at an elevation of 4,000 feet. This is a little stringer showing some nice ore, and it was intended to run in a drift-adit on it.

Rio Grande. Adjoining the *Nevada* down the hill in a northerly direction is the *Rio Grande* claim, owned by Oscar and Charles Anderson, Ymir, who bought the property at a tax sale eight years ago. Geological conditions here are similar to the Navada claim; small stringers are developed in the slate at and near the contacts of intrusive tongues of granodiorite.

The main working on the property is an adit-tunnel which contains about 400 feet of drifting and crosscutting. The tunnel commences on a small stringer and follows it in for 30 feet, where the tunnel splits into two branches. The east branch continues on the vein until a diorite dyke is reached which cuts off the vein. The west branch follows seams and slips, but discloses no ore. Galena and zinc-blende and pyrite occur in places throughout the vein, but as a rule in very slight amount; 18 inches of fairly good ore was seen in one place. Fifty feet below this tunnel another adit has been started to crosscut the vein under the best-looking place in the upper tunnel. Work was progressing on this adit, which was not in far enough to have struck the vein. Other cuts and a 30-foot adit show small stringers occurring in slate, but none of these are of much importance.

Iona. This claim is situated on the north side of Porcupine creek and distant some four or five miles from Ymir; it is owned by A. Burgess. The formation here is again altered sedimentary intruded in places by an acid granitic rock. Fracturing of the hill has taken place along north-east and south-west lines similar to the opposite side of the creek, where the *Nevada* and *Rio Grande* claims are situated. Some mineralization is evident in places, but as yet no shoot of ore of commercial size has been exposed. In all these three claims there is just enough indication of ore to lead the owners to keep on working from time to time, and it is just possible that an ore-body may yet be discovered. There are several open-cuts, a shaft, a short tunnel, and a long one on the property, which explore two or three veins, but the continuations of the veins from one opening to another are not clearly defined. The shaft is 40 feet deep, but as there was no ladder the vein could not be examined at the bottom. At the surface there is a fairly distinct vein of quartz 1 to 2 feet wide, but very sparingly mineralized with galena.

The upper tunnel is 25 feet long and shows a vein carrying some iron pyrites in the quartz. Several open-cuts show pyrite and limonite in the quartz, but values are low unless where accompanied by galena.

The main tunnel is about 300 feet long, but twists about in a somewhat irregular manner. At a point 75 feet in it cuts a vein from 1 to 2 feet wide which has grains of galena and zinc-blende scattered through it. No drifting has been done on this vein, although it would seem to be worth while prospecting it to some extent. This may be the vein exposed in the shaft or it may be one showing in an open-cut where it carries iron pyrites.

Farther on in the main tunnel a quartz vein carrying a slight amount of pyrite was struck and drifted on, but it soon split up into a number of stringers feathering off into the country-rock. Other drifts and crosscuts in the tunnel, following slips and what appears to be a fault-plane, failed to reveal any ore.

Commodore Group. This group is situated on the south side of Wild Horse creek, about six miles from Ymir. It is owned by Grobe and partner, of Ymir. The claim is an old one, and several tunnels, some of which are now caved in, have been driven for distances of 50 to 200 feet. These tunnels were driven in on a vein which so far has failed to yield much ore. It is of the usual type in the district, and is for the most part filled with altered wall-rock. Some mineralization with pyrite is evident, and in a few places grey-copper is said to occur.

At the time of visiting the property two men were at work on a tunnel which had been driven in on a small stringer for a distance of 180 feet; the course of the tunnel had then been altered so as to crosscut the main vein, which should be reached within 50 to 75 feet. The stringer on which this work had been done showed no mineralization of any importance. A sample was taken from some pieces of mineralized rock near the mouth of one tunnel, but this only returned a trace of gold and 2 oz. of silver to the ton. The property is as yet only a prospect, but, as it is in a mineralized district, is worthy of some exploratory work.

Free Silver Group. This group of six Crown-granted mineral claims is situated on the North fork of Stewart creek, about two miles and a half from the town of Ymir. The elevation is about 4,900 feet. Tom Bennett, Schofield, and others are the owners. The main showings on the claim are in quartzitic and slaty rock near the contact of a granitic intrusive mass. In one place there is an open-cut and a 20-foot incline which shows a considerable mass of iron pyrites and pyrrhotite. This occurs as an irregular bunch, or kidney, in the quartzite and does not apparently have any great length in any direction. A selected sample of this material, which was nearly solid iron sulphide, assayed: Gold, trace; silver, 0.2 oz.

Other open-cuts show some small stringers occurring in the sedimentary rock and also in the granodiorite; this granodiorite near the contact is fine-grained and has evidently assimilated a lot of slate while in the molten condition. One cut which is 12 x 4 x 5 feet shows a 3-inch stringer of nice-looking galena. Farther up the hill another opening 10 x 6 x 4 feet shows a small stringer of fine-grained steel galena. These galena occurrences are too small to be of value, but indicate the possibility of ore occurrences in the neighbourhood.

A small shipment of a few hundred pounds of manganese ore is reported to have been shipped to Nelson for use in the French electrolytic zinc process. The writer did not see the place from whence this ore came.

Mayflower Group.

This group, consisting of the *Mayflower*, *May Day*, and *May Blossom*, is owned by Harbottle and associates. It is situated down the hill from the *Free Silver* and a little closer to Ymir. An open-cut discloses a narrow streak of quartz, carrying a little galena, in granodiorite which is altered and silicified for 2 feet on either side of the stringer. A tunnel has been driven in 200 feet which starts on a good wall in granodiorite and passes into a fine-grained dense blue rock near the face. A few small chunks of galena were seen at the mouth of the tunnel, but where they were obtained was not apparent. It would not seem as if this tunnel-work had been well advised.

SHEEP CREEK CAMP.

Sheep Creek camp is the name given to the territory contiguous to Sheep creek, a small rapid-flowing mountain torrent which rises in the Nelson range and flows westerly for about fifteen miles to where it joins the Salmo river at the town of Salmo. This town, situated on the Nelson & Fort Sheppard Railway thirty miles from Nelson, is the central point for the district; it is a small place with railway-station, two hotels, post-office, and a few dozen houses. A lumber-mill and shingle-mill are located near by, but these have not been operated for a year or two past.

The district embraces two widely different types of ore-deposits, one consisting of gold-bearing quartz veins and the other lead-zinc deposits of the replacement type, in limestone. The gold-deposits were the first to be exploited, while it is only in the last few years that the lead-zinc ore-bodies have proved to be of considerable importance. The quartz properties mainly centre around the *Queen* and *Motherlode* mines, which are situated up Sheep creek at a distance of eleven miles from Salmo. The other type of deposits are more scattered and are, as a rule, found where there are bunches of crystalline limestone.

The most important properties are all supplied with wagon-roads; a main road, which is kept in first-class condition, runs up Sheep creek as far as the *Motherlode* mine, and from this branch roads go to different properties.

The ore from the gold properties is generally milled on the ground, and, as a rule, some concentrates made, which are hauled by wagon to the railway at Salmo. The lead and zinc ores are also hauled to Salmo for shipment, the lead ore going to Trail and the zinc ore to the United States.

The following table shows the gold-ore production of the more important mines in this district since the year 1900:—

Gold-ore Production since 1900.

Year.	Mine.	Tons.	Gold.	Silver.	Total Value.
			Oz.	Oz.	
1900	*Yellowstone*	8,467	3,847	2,935	$ 80,953
1901	"	8,520	2,065	1,419	43,378
1902	*Queen*	4,519	2,445	924	50,990
1903	"	144	213	159	4,480
1904	"	4,846	1,624	491	33,808
1905	"	6,078	3,149	1,174	65,664
"	*Kootenay Belle*	324	1,070	633	22,426
1906	*Queen*	7,025	2,501	1,040	52,204
"	*Kootenay Belle*	739	1,157	1,055	24,431
"	*Motherlode*	72	385	137	8,025
1907	*Queen*	8,845	5,011	1,650	104,385
"	*Kootenay Belle*	895	612	179	12,738
"	*Motherlode*	47	186	75	3,881
"	*Nugget*	22	125	24	2,595
1908	*Queen*	8,798	6,235	2,308	130,006
"	*Kootenay Belle*	1,476	1,130	327	23,517
"	*Motherlode*	374	1,026	350	21,379
"	*Nugget*	1,209	1,742	684	36,342
1909	*Queen*	11,288	5,308	2,237	110,811
"	*Kootenay Belle*	1,672	817	13	16,903
"	*Motherlode*	123	631	726	13,398
"	*Nugget*	5,492	5,927	938	122,970
	Carried forward	80,975	47,206	19,478	$ 985,284

Gold-ore Production since 1900—Concluded.

Year.	Mine.	Tons.	Gold.	Silver.	Total Value.
			Oz.	Oz.	
	Brought forward	80,975	47,206	19,478	$ 985,284
1910	*Queen*	12,359	6,180	1,517	128,759
"	*Motherlode*	216	882	975	18,737
"	*Nugget*	5,248	3,673	...	75,921
1911	*Queen*	14,350	7,621	2,898	159,249
"	*Kootenay Belle*	31	236	121	4,951
"	*Nugget*	3,500	2,622	843	54,721
1912	*Queen*	11,301	3,903	1,149	81,374
"	*Motherlode*	13,446	7,873	3,003	164,501
1913	*Queen*	7,173	2,192	618	45,609
"	*Motherlode*	24,266	15,947	5,814	332,907
1914	*Queen*	9,801	5,517	1,557	114,778
"	*Motherlode*	20,000	8,130	3,200	165,100
1915	*Queen*	9,549	5,090	1,819	106,209
"	*Motherlode*	2,792	2,093	745	43,672
	Totals	215,007	119,165	42,837	$2,481,722

It will be noticed that the *Queen* mine has made a steady production each year, and is the only one to have so done.

The gold-bearing quartz veins are of the true-fissure type, occurring in a quartzite and schist formation. These veins vary from a few inches up to as much as 20 feet and always cut the quartzites and schists at an oblique angle. The gangue consists of quartz and the metallic minerals present are pyrite and pyrrhotite, with subsidiary amounts of galena and zinc-blende; *free gold is of frequent occurrence, especially in the oxidized portions of the veins.* The values are generally found to occur in well-defined ore-shoots, and outside these zones the quartz is practically barren; these ore-shoots vary from a few feet in length up to 200 or 300 feet. Igneous dykes of an acid porphyritic nature, as well as some basic dykes, cut the veins and sometimes parallel them. One important dyke runs through the country in a general north-and-south direction, and the valuable ore-bodies are contained in a zone on either side of this dyke. When the geology of the district is more thoroughly studied it may be found that these dykes have had an important part in the formation of the ore-shoots. In all the properties except the *Queen* the ore is nearly all oxidized, the pyrite being changed to limonite. The upper levels of the *Queen* also were in oxidized ore, but the present workings below the creek-level are all in sulphide ore.

Motherlode.

The *Motherlode* mine and cyanide-mill are situated on Sheep creek, eleven miles from the town of Salmo, with which there is connection by a first-class wagon-road. This mine is very well known and an extended description is hardly necessary here. About six years ago the *Motherlode* group of claims was bonded by E. McMartin, and before long the property was acquired and formed into the Motherlode Sheep Creek Mining Company. After developing for a few years the company erected a very up-to-date stamp-mill and cyanide plant, which commenced operations during the summer of 1912. The mill has a nominal capacity of about 100 tons a day, but has treated up to 125.

The mine is developed by crosscut tunnels, the present main working being the 500-foot level. *The ore is trammed out by hand and taken down the hill to the mill by an aerial bucket* tramway.

The main vein on the property is a well-defined quartz-filled fissure which cuts the quartzite and schists at an oblique angle. It varies from a few inches up to 6 feet in width, and also shows very wide variations in values. In the schist the vein is generally nothing but a fracture-seam carrying no values, but on entering the quartzite widens out into productive ore-shoots. It is often very difficult to distinguish the quartz of the vein from the quartzite of the wall-rock.

The ore consists of rusty quartz formed by the oxidation of iron sulphides, and down to the lowest levels there is very little unaltered sulphide. Occasional patches of galena and pyrite

are found, but there has been but little galena in the original ore before oxidation. The values are, of course, practically all in gold, which occurs for the most part free. In pure white quartz, however, there is but little gold, and it is evident that the gold was originally closely associated with the pyrite, the oxidation of which has to some extent set the gold free.

There are two well-defined ore-shoots in this vein, the *Motherlode* and *Independence*, each on the claim of the same name. These shoots occur where the vein cuts quartzite, and in between the vein runs through a band of schist where it carries no values. Practically all the known ore-shoots in the mine above the 500-foot level have been stoped out. A winze has been sunk on the vein from the 500-foot crosscut level and some drifting done on the vein, but results were not promising. The further development of the property will require that a lower crosscut tunnel be driven to tap the vein at some point lower down the hill. The continuation of the ore-shoots to a depth below the 500-foot level is somewhat problematical, so that the driving of such a tunnel would be in the nature of a speculative proposition. Evidently the company considers this to be the case, as the mine has been closed since October, 1915, and whether or not operations will be resumed has not been decided upon.

The most interesting feature of the mill on this property is the cyanide plant, which is the most up-to-date and modern of its kind in British Columbia. The mill was erected and installed by the Merril Metallurgical Company of San Francisco, and while there is no doubt that the tonnage of ore developed at the *Motherlode* mine did not warrant such a large and expensive mill, still, from the standpoint of economical operation, the plant is all that could be desired.

The ore is brought to the mill by a Riblet aerial tram and fed from a bin through a jaw-crusher. From here it goes to the 10 stamps, which use 4-mesh screens, where it is further crushed and goes to the 5- x 20-foot tube-mill for final grinding. Crushing is done in the cyanide solution, the solution entering at the stamps, and no amalgamation is used.

The tube-mill product is classified and the coarse material returned to the tube-mill for regrinding by the closed-circuit method. The slimes are dewatered in Dorr classifiers and then agitated in Pachuca tanks. Filtering is done in Merril filters and the gold is precipitated from the clear solution by means of zinc-dust. A high extraction is made, upwards of 98 per cent. of the values being saved, while at the same time the operating expense is low. As the ore is almost completely oxidized, it is suitable for this straight cyanidation scheme, but if the ore turned to sulphide this system might not prove as effectual. Pelton wheels are used to drive the whole mill and an air-compressor for the mine, situated in the mill building; water under a considerable head being obtained from two forks of Sheep creek and piped to the mill. In low-water periods there is not sufficient water to run both mill and compressor, and so they are put on alternate shifts.

Queen.

This mine is situated on Wolf creek a few hundred feet above its junction with Sheep creek, and about ten miles from Salmo, to which it is connected by a good wagon-road—the main Sheep Creek road which extends a couple of miles beyond the *Motherlode* mine. The *Queen* mine has been a steady producer for years back, and is so well known that very little can be added to what has been published about it from time to time in the Annual Reports of this Department; in each year's Report some reference to the mine can be found. The 1910 Report contains notes on Sheep Creek camp by Wm. Fleet Robertson, Provincial Mineralogist.

Roughly, the history of the *Queen* is that it was a prospect in 1900, and at that time was bonded by the Holmes Syndicate, which, after mining some 4,400 tons of ore, allowed the bond to lapse, considering the property to be exhausted of ore. This ore was milled in the *Yellowstone* mill, an adjoining claim which was worked out and abandoned about 1900. When the Holmes Syndicate allowed its bond to lapse, William Waldie took over the *Queen* and soon had it operating and producing steadily. Much of the success of the Sheep Creek camp must be attributed to Mr. Waldie's perseverance and energy in "staying with" the *Queen* when others had condemned it, as the success of this mine has undoubtedly caused a great deal of successful mining in the district.

After operating the *Queen* for a few years Mr. Waldie sold the mine to a company, and it is now owned by the Queen Mines, Incorporated, with E. V. Buckley in active charge. This company also acquired the *Yellowstone*, and the *Queen* ore is still being treated in the old stamp-mill on the former property, which has been doubled in size.

The mine has been developed by three tunnels driven in on the strike of the vein, the lowest of which, the No. 3, is at about the creek-level. All the ore above this No. 3 tunnel has been stoped out. From the No. 3 a winze has been sunk to a depth of 700 feet and all ore is now hoisted from this winze. The main ore-shoot down as far as the 600-foot level of this winze has also been practically all stoped out. At the time of visiting the property, drifting was in progress on the 700-foot level to open up the ore-shoots at that level, which would provide another 100 feet of stoping-ground. A considerable tonnage of broken ore was still in the stopes above, and this was being drawn on to keep the mill going. The policy of development has been to keep about 100 feet ahead with the winze and drift-work, and so far this has proved satisfactory, the ore-shoots having maintained their size and value in a persistent manner. There are apparently two main ore-shoots with a length of from 100 to 400 feet each. The width of the vein is from 2 to 20 feet and consists of a gangue-filling of quartz carrying iron pyrites, a little galena, and occasionally some free gold. The ore as milled yields from $8 to $12 a ton, varying slightly from year to year. In 1915 the mill treated 9,549 tons, which yielded by amalgamation 2,743 oz. gold and 405 oz. silver, and the concentrates contained 2,348 oz. gold and 1,413 oz. silver; this shows that the ore yielded about $10.75 a ton. The tailings losses in the mill are said to be high, but no figures are known. But it is probable that the mill-feed assays from $12 to $13 a ton.

The milling plant consists of a crusher, 20 stamps, and four Wilfley tables, all driven by Pelton wheels. Water-power is derived from both Sheep and Wolf creeks and is delivered under a head of 450 feet, and a plentiful supply is available. Sufficient power is developed to run the mill, a 10- and a 5-drill air-compressor, and a sawmill. The hoist on the winze on the No. 3 level is run by compressed air. The mill crushes 50 to 60 tons a day. About 55 per cent. of the recovered value is in the amalgam and the balance in the concentrates, which consist of pyrite, galena, and a little zinc-blende. The concentrates are hauled to Salmo and thence to Trail for smelter treatment. The mine is well equipped with the usual bunk-houses, offices, etc.

Alexandra. A short distance above the *Queen* is situated the *Alexandra* claim, which is also owned by the Queen Mines. Some development-work has been carried out on a vein on this claim at different times, and a few men were at work in the fall of 1915. The vein has been developed by three tunnels, one of which is 200 feet long and another 150 feet. The vein varies in width, from a seam up to 18 inches, and carries, in places, a little sulphide ore, which is said to assay well. No ore-shoot of commercial size has been found as yet, but development is proceeding and the chances appear to be favourable.

Kootenay Belle Group. This group adjoins the *Yellowstone*, lying on the hill between the junction of Sheep and Wolf creeks. It was worked prior to 1909 and is now owned by Mr. Rogers, of Vancouver. A stamp-mill was erected in the valley of Sheep creek and connected to the mine-workings by an aerial rope tramway, but all is now in bad repair and almost useless.

There are two nice quartz veins on the property, both of which have some nice but small ore-shoots. One vein is 4 feet wide and the other from 8 to 18 inches, and from this latter some very beautiful specimens of free-gold rock have been taken. The ore is all oxidized, similar to the *Motherlode* ore. It is claimed that this mine also has a considerable tonnage of available ore, and there is no doubt that further operation would be warranted. The owner, however, apparently prefers to hold the property for sale rather than to commence operations himself, and, as the property has remained idle for some years, it would seem as if no one was willing to pay the price asked.

Nugget. This mine is situated at the head of Fawn creek, a short distance over the ridge from the *Motherlode* mine. This mine was formerly a considerable shipper, but has done nothing for some years. It is now owned, or controlled, by R. S. Lennie, subject to a considerable mortgage. The vein, formation, character of the ore, and conditions generally are about the same at this mine as at the *Motherlode*. There is supposed to be a considerable tonnage of ore blocked out in the mine which would pay to extract and mill. But the present owner apparently wishes to sell the property rather than to work it himself. The mine is developed by tunnels and is equipped with a small 4-stamp mill which is more of a testing than a commercial plant, and would not be suitable for any large-scale operations. It is probable that the property will be worked again in the future, but just when is a matter of uncertainty.

Reno Group.

This property is situated on the eastern slope of Fawn creek, near its head, in what is known as Fawn basin. There are sixteen claims in the group, most of which were staked about three years ago. W. Poole, Mike O'Donnel, and Thomas Kirkpatrick are the owners. The formation here is quartzite and schists similar to that at the *Motherlode*. There are four or five parallel veins striking east and west which vary in width from a few inches up to 6 feet. These veins are developed by means of open-cuts and trenches, which show that the veins cut the formation at an angle of 50 to 60 degrees, and that they stand nearly vertical or with a slight dip to the south. The vein-filling is quartz and possibly a little quartzite, and, while metallic sulphides are nearly absent, it is evident from the iron oxide visible that a considerable amount of iron sulphide was at one time existent in the veins; free gold is quite frequently seen. The best ore is often "sugary" in appearance and looks more like quartzite than a true vein-quartz; this sugary quartz, somewhat stained with iron oxide, often contains a visible amount of free gold.

At the time of visiting the property Mr. Poole, his son, and Mike O'Donnel were at work on the property. Mr. Poole claims to have a very substantial ore-shoot proven up on one of the veins on the surface. This vein is exposed, more or less, for several hundred feet and is said to have an ore-shoot at least 500 feet long, carrying values from $10 up to the ton, and varying in width from 1 to 4 feet. The writer did not attempt to sample any of this vein, or others on the property, but, from the appearance of free gold in many places, it is likely that a very considerable shoot of pay-ore does exist. One tunnel was driven 75 feet a year ago in wash and loose rock, but this has since caved. Another tunnel has been started in slide-rock, which was in 25 feet when the property was seen. This tunnel should strike the vein in a short distance and will then be continued as a drift-tunnel.

This property has a very promising surface showing, and if the owners keep up their present policy of development-work it should soon enter the production stage.

Golden Fawn Group.

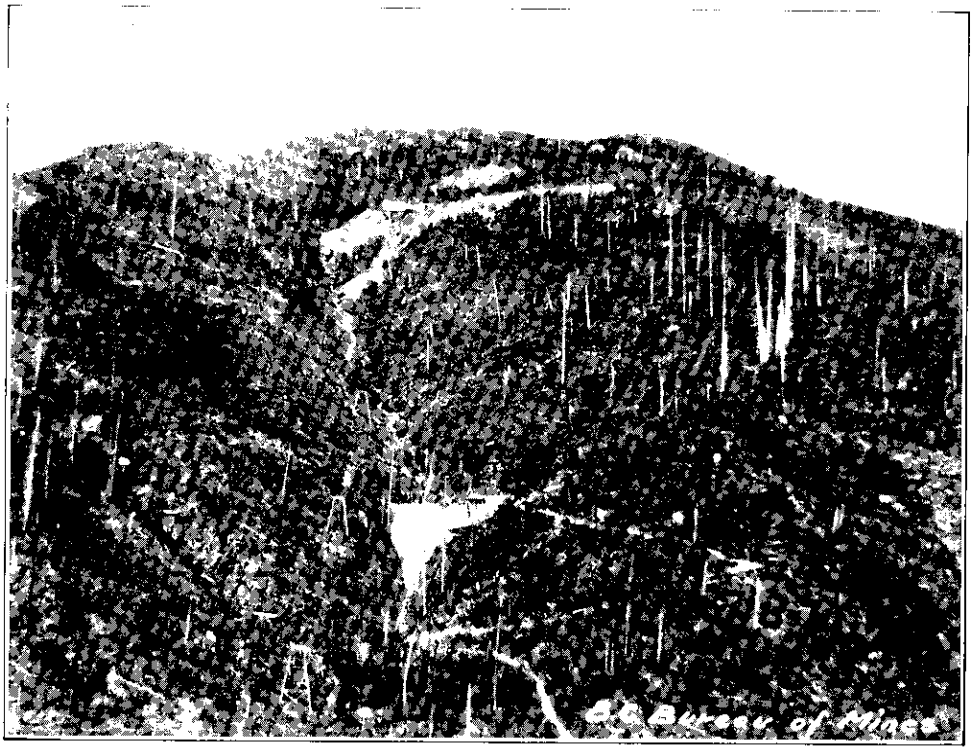
This group lies between the *Nugget* and the *Reno* groups and at a slightly higher elevation. It is owned by R. Burnham, Tom Gallon, and others. There are two small parallel quartz veins on this property about 100 feet apart, and occurring in quartzite. On one of these there are two tunnels with a difference of elevation of 100 feet. The upper tunnel is in 150 to 200 feet, and the lower one about the same distance. Very little stoping has been done from the lower tunnel and a little underhand stoping from the upper one. The tunnel on the other vein is in about 150 feet also, and has been stoped to the surface in places. The veins, while small—running from a seam up to 8 inches—are said to carry shoots of high-grade ore. No ore-shoots of great size have been developed as yet.

The property has been under bond several times, but was not being worked when visited; it is reported now to be again bonded.

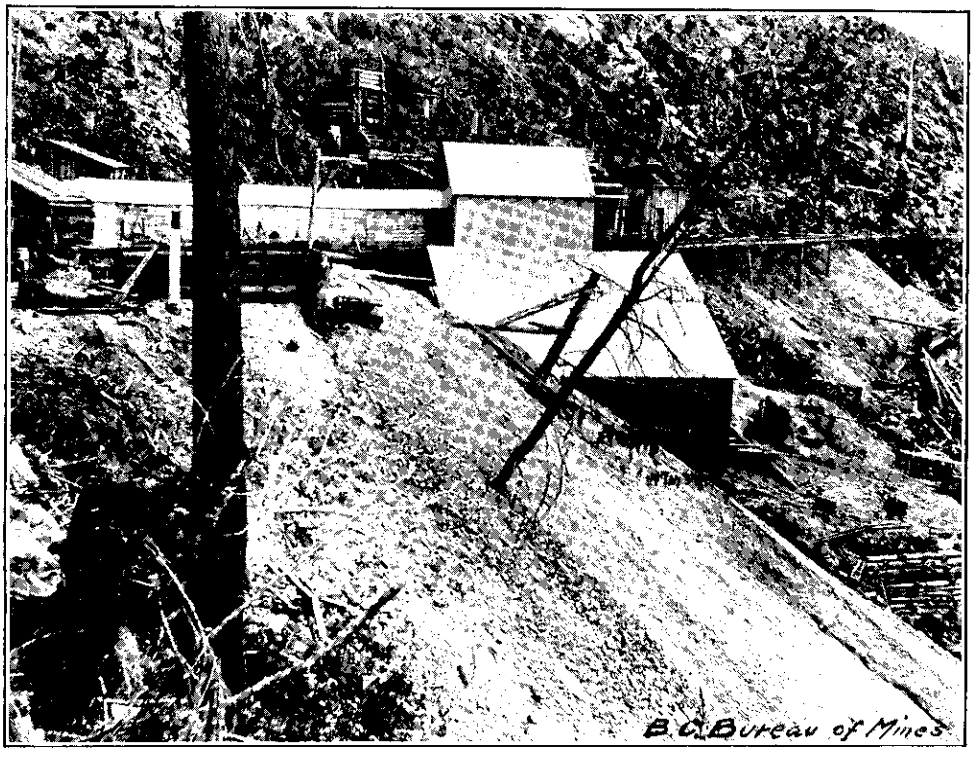
H.B. and Zincton.

A short distance up Deer creek from where it joins Sheep creek are situated the *H.B.* and *Zincton* groups of claims, which are now grouped together and under bond to the same company. The main wagon-road is followed up Sheep creek to where Deer creek comes in, and from this point a well-graded road two miles and a half long goes up the latter creek to the mine. The camp is situated on a flat on the hill on the west side of Deer creek at the head of a canyon and small falls, and the mine-workings are a few hundred feet above the camp. The claims were staked several years ago by Horton, Billings, and others, hence the name H.B., and the whole group was first bonded by the Consolidated Mining and Smelting Company, which carried out some development-work and shipped some ore, but finally threw up the bond. The *H.B.* was leased in 1914 by Salisbury & Larson, who shipped a good deal of zinc ore; this lease expired in the spring of 1915. During this period the *Zincton* was being worked to some extent by the owners. In the summer of 1915 both groups were bonded by R. K. Neill, who is said to represent Spokane capital, and active mining and development has been vigorously prosecuted.

The property is in the "lime-belt," which is a band of limestone stretching, more or less continuously, across the country from the *Emerald* to the *Aspen*. The "veins" are of the bedded type, striking with the formation, and are best described as replacement ore-deposits. The ore-bodies are fairly regular and so have been called veins, but are, strictly speaking, replacements. There are several of these ore-bodies which have a general strike of north and south and are up to 30 feet in width. The main vein, which is the one at present being worked, is developed by a



Yankee Girl Mine, showing Workings—Nelson M.D.



Lower Tunnel, Motherlode Mine, Sheep Creek Camp.

crosscut tunnel which strikes it at a distance of 200 feet from the portal. The tunnel has been continued until it cuts another smaller vein. The main vein has been drifted on in both directions and a good deal of ore stoped out. This tunnel starts on the *H.B.*, but one drift continues on into the *Zincton* claim.

Near the surface some of these "veins," or ore-bodies, contained some fair-sized shoots of lead carbonate, with nodules of galena scattered through, but the chief filling is zinciferous minerals. The ore-bodies lie wholly within the limestone and would seem to be a replacement along a particular strata or band which was favourable to the replacing action. The transition from ore to limestone is not always sudden, but often is quite gradual. The limestone is hard and crystalline, while the ore is soft, earthy, and of a brownish-red colour as a rule. The ore-bodies have undoubtedly been sulphides at one time, but oxidation has completely altered them nearly everywhere. The zinc minerals are now mainly carbonates and oxides, but in places there is a considerable development of calamine—a zinc silicate. The main drift in one place opened out into a large natural cave, from the roof and floor of which there were hanging and extending large stalactites and stalagmites of calamine. Large botroyoidal masses of the same material were scattered around. The calamine is a pearly-white vitreous mineral, but in addition there occur various gradations between the silicate and the carbonate. Some of this material can properly be called hydrozincite, a compound containing zinc carbonate and hydrated zinc oxide, often in varying proportions.* The bulk of the ore is a more or less close mixture of carbonate and oxide of zinc, with a little silica through it. It is probable that the carbonate was first formed by the alteration of a sulphide mass by means of descending meteoric waters. The formation of the silicate of zinc was later formed by the action of ascending hot alkaline waters which carried silica in solution, and, attacking the carbonates, formed the zinc silicate. A number of basic mica dykes cut through the ore-bodies and are evidently considerably younger than the ore. It is possible that alkaline waters followed in the train of these dykes and caused the silicification of parts of the ore-bodies. In many respects the *H.B.* main ore-body resembles the very complete oxidation of a sulphide ore-body like that found in the *Sullivan* mine, East Kootenay. There is no doubt, when sufficient depth is attained on the *H.B.*, that the carbonates found near the surface will turn to sulphides; just what this depth will be is impossible to foretell, but it may be somewhere about the Sheep Creek level. Like the *Sullivan*, the *H.B.* is a replacement of a band of limestone in such a way as to make it resemble a true vein, and in size the two deposits are also comparable, bearing in mind, of course, that the *H.B.* is only as yet slightly developed as compared with the former property.

On the main tunnel-level the sinking of a winze was commenced in October, which it was intended to put down to a depth of 200 feet. On the completion of this work, if the condition of the mine warranted it, the driving of a long low-level tunnel was to be commenced from a point below the canyon on Deer creek. Later information is that this tunnel has been started. The depth on the ore-body which this working will give is not known, but it should be at least 700 to 800 feet.

There is a considerable tonnage of zinc ore in the mine in the form of mixed carbonate, oxide, and silicate, with the first mentioned predominating, which will assay from 15 to 25 per cent. zinc. This material is too low grade to ship in its crude condition, but if concentrated to some extent would be readily marketable. The concentration of this ore may present some difficulties, but some method can possibly be devised to handle it. The manager, R. K. Neill, is considering this matter at the present time; he has had considerable experience in treating lead-zinc ores in the Coeur d'Alenes and should be able to solve the problem.

The *H.B.* group of mines will probably provide a very large tonnage of zinc-carbonate ore in future years, and it is to be hoped that before long a market for this product will be found in British Columbia. At the present time the ore is shipped to those smelting-works in the United States which desire carbonate ore for the manufacture of zinc oxide for the manufacture of paint. It is conceivable that in the future, if sufficient ore is proven up, the ore would be converted to oxide in Canada and sold to some of the Canadian paint companies.

* Since the foregoing was written it has been found that some of the white, pearly zinc ore which was supposed to be calamine contains a high percentage of phosphoric acid. It has been learned from Professor Parks, of the University of Toronto, that Dr. Walker, of the same institution, has made, during last winter, careful analyses and examination of this mineral, with the result that he finds it very definite in composition, that it always carries phosphate of zinc, and that it is different from any present known mineral; it is therefore a new mineral, for which Dr. Walker has suggested the name "lusitanite."

The amounts of ore shipped from this group of mines in 1915 were as follows:—

	Tons.	Silver.	Lead.	Zinc.
		Oz.	Lb.	Lb.
H.B. (lead ore)	17	47	11,590	....
H.B. (zinc ore)	3,975	....	....	2,387,514
Zincton (zinc ore)	1,196	....	....	739,695

The most of this ore was shipped in the last four months of the year, and the mine is now said to be shipping over a car-load a day. Before the mine will ever make any very large output, however, some means will have to be found to concentrate or treat the large tonnage of low-grade ore now partially developed.

The property has now been taken over by a company, incorporated by the Spokane syndicate, with a capitalization of $5,000,000. Besides driving the low-level tunnel, the development plan now includes building a narrow-gauge railway from the mine to Salmo, and thus reduce the cost of transporting the ore to the railway.

Since the above was written it has been reported in the papers that the whole group has been secured by the Hayden-Stone-Jackling interests, at a price reported to be in the neighbourhood of $1,000,000. Development and equipment of the property is to be proceeded with on a larger scale than ever.

Aspen Group. This group is situated near the head of Deer creek, about two miles beyond the *H.B.* It is owned by P. F. Horton and associates, who are at present actively developing the property. The *Aspen* is situated in the lime-belt, and on it the granite is intrusive into the lime, making a jagged contact. The lime is highly crystalline and to some extent fractured. Along some of these fractures mineralization has taken place largely by replacement. The minerals found are galena, zinc-blende, pyrrhotite, iron pyrites, and possibly a little grey-copper.

Many open-cuts and shallow openings have been made on the claims, but no large ore-body has yet been shown up. When the property was visited in September work was proceeding on three different mineral outcrops. The most northerly one is on the contact of the lime and granite, where a shaft has been sunk 10 feet and a drift to the south-east was just being started. Here a little zinc and iron sulphides are irregularly scattered through lime-silicate gangue, but nothing of importance has been found yet. The limestone here strikes north-west and dips to the north-east at about 30 to 45 degrees. The granite cuts the limestone in a general east-and-west direction, but the contact is very irregular.

The next showing lies a little south of this, and on it an incline was being sunk and was then down 20 feet, following the dip of the limestone at about 40 degrees. The mineralization at this point consisted of zinc-blende and galena, occurring in a narrow zone in the limestone. Very little mineral could be seen at the bottom of the incline, but, from the pile of ore on the dump, it was evident that there had been considerable ore near the surface.

A few hundred feet to the south there is another showing or vein, which carries a little galena disseminated through the limestone; this is said to return high silver assays. A shaft has been sunk 20 feet on this vein and work was being continued.

Just below this shaft a tunnel has been run in 150 feet; this strikes a vein which is probably the same as the vein in the shaft. After striking the vein in this tunnel a drift was run on it for a short distance to the north-east. Throughout this working the mineralization is very slight. According to the owner, this vein can be traced across five claims, and in places carries grey-copper, which yields high silver assays.

Emerald. A continuation of the lime-belt in which the *H.B.* occurs is found across Sheep creek on the south side, and in this, at a point near the divide between Sheep creek and the branch of Lost creek on which the *Molly* molybdenite mine is staked, the *Emerald* mine is located. The property consists of seventeen claims, most of which are Crown-granted, and is owned by the Iron Mountain, Limited, in which John Waldbeser is a large owner and he is also manager of the mine. The property is reached by a good wagon-road,

which branches off the Salmo-Erie road a short distance past the Sheep Creek road; it then climbs up a steep grade, rising some distance above Sheep creek, and then continues for a mile southerly to the mine, the total distance from Salmo being about six miles.

The property is equipped with a small steam-plant and compressor, but this is not being used at present. Comfortable camp buildings have been erected at the mine and a force of from ten to thirty men is employed.

There are several veins, or rather replacement ore-bodies, developed in limestone-bands, only one of which has been developed to any great extent. These ore-bodies are of exactly the same nature as those in the *H.B.*, excepting that lead minerals predominate instead of zinc, and oxidation has not proceeded so far as at that property. Galena and lead carbonates form the ore and the silver values are practically negligible, only amounting to 1 or 2 oz. to the ton. The ore carries an average of about 6 per cent. zinc. It is all shipped to Trail, and, as this zinc content is below the penalty limit, no trouble is experienced. The gangue consists of lime, lime-silicate minerals, and quartz.

The main vein is developed by two crosscut tunnels, drifts, and stopes. No. 1 tunnel is 312 feet long from the portal to the point where it cuts the main vein, and has been continued ahead to where it has cut a second ore-zone 40 feet beyond. From the No. 1 tunnel drifting has been done in both directions along the vein, the drift to the south being 765 feet long. From these drifts stopes have been run right up to the surface and numerous sub-levels put in. Winzes also have been put down and a good deal of ore taken out by underhand stoping to a depth of 60 feet below the tunnel-level. The average width of ore stoped is about 4 feet, and the vein pinches and swells from 1 to 8 feet. When the property was visited all the ore was being extracted by underhand stoping and either hoisted to the No. 1 level or dropped through a raise to the No. 2 level and out that way. Ore that does not run about 40 per cent. lead is not as a rule mined, and, if lower grade than this is taken out, it is roughly hand-sorted in the stopes so as to bring it up to this grade, it having been found that it hardly pays to handle anything less than 40 per cent. The result is that there is still in the No. 1 tunnel-workings a considerable tonnage of "concentrating-ore" carrying from 15 to 20 per cent. lead.

The No. 2 crosscut is 166 feet below the No. 1 tunnel and has been driven in 586 feet, but failed to reach the vein. This is a well-driven tunnel 8 feet high by 6 to 7 feet in width and is quite straight. The tunnel cuts through limestone, schistose rock, and some bands of garnetite, both green and red. Near the face the formation has a banded structure of white and black bands, an inch or two wide, which would seem to be mainly a development of lime silicate in black lime. Sixty feet from the face there is a 6-foot band of white limestone, which carries a few specks and grains of molybdenite—an interesting occurrence, but of no economic value. It was anticipated that the main vein would have been struck by a tunnel of this length, so, when it was not crosscut, a raise was put up from the face vertically for a distance of 60 feet; this also failed to find any ore and no further work has been done on this level. Four hundred and six feet from the portal a raise has been put through which connects with the upper tunnel; this is for convenience in the handling of waste rock and ore. The vein in the upper level has a general pitch of about 30 degrees and pitches with the formation into the hill. At the face of the lower tunnel the formation has flattened out until it is nearly horizontal, so that it is possible that the vein lies above the lower tunnel almost as a blanket lead. Another possibility is that the vein is faulted, and still another is that the ore-zone above has become one of the garnetite bands cut in the lower tunnel, although this latter supposition is hardly probable. Perhaps the best way to find the downward continuation of the ore-body will be to follow it down from the upper workings, which plan the management intends to adopt.

The drift on the vein to the north from the No. 1 tunnel is about 100 feet long, and at the face the ore is apparently cut off by a fault-plane striking north-west; further exploration here would probably discover the ore-zone. For convenience in working a raise has been put up from the No. 1 tunnel to reach the ore, which it does in 16 feet, at a point 150 feet in. From this place sub-levels have been run, 60 feet apart, along the pitch of the vein.

The second vein, which lies at a horizon of 40 feet perpendicularly above the main one, has been cut in two places from crosscuts driven from sub-levels, but comparatively little development has been done on it. Where exposed it shows 3 to 5 feet of lead carbonates, a typical sample of which, taken across 3 feet assayed: Silver, 1 oz.; lead, 19.5 per cent. On the surface

this vein has been explored by a crosscut tunnel 50 feet in length, which shows the vein to have a width of from 2 to 4 feet of good concentrating-ore—lead carbonates. This vein is certainly worth much further development.

The main vein (lower one) is exposed on the surface for several hundred feet and shows up nice ore in many places, and almost everywhere there is a good width of concentrating-ore. The manager estimates that there is about 30,000 tons of 15- to 20-per-cent. ore in the mine in the upper workings.

There are two other veins exposed on the property, one of which shows some lead carbonates, and the other is a small one lower down the hill than the main one, which is said to return assays of 46 to 50 oz. of silver to the ton; neither of these have any work done on them.

The mine was staked in 1895 and started shipping in 1906, since which time about 12,000 tons of ore has been shipped. The freighting to Salmo by wagon costs $4 a ton, and the freight and treatment charge for smelting the ore at Trail is $7.50 a ton. All the silver in the ore, which amounts to 1½ to 2 oz. a ton, is paid for. The zinc content is never high enough to be penalized, but sulphur is sometimes penalized; this sulphur comes from an excess of pyrite in the ore, which occasionally occurs.

It is probable that this property will be equipped with a concentrator before long, the plans of the management including the development of a small hydro-electric plant on Sheep creek. Power would be transmitted to run a mill situated somewhere near the mine and the compressor. Systematic development would probably also be carried out. With proper equipment the property should have a promising future before it.

Lucky Boy Group.

This group consists of the *Lucky Boy*, *Lucky Boy Fraction*, and the *Mayflower* claims, and is owned by Gus Schwinke and F. H. McCaslin. It is situated on the south side of Sheep creek, about seven miles from Salmo. These claims are in the lime-belt which traverses the country from the *Aspen* to the *Emerald*, and are, therefore, in a formation in which ore-bodies might be expected to be found. Evidences of mineralization in the form of oxide of iron and galena, zinc, and their carbonates are found in seams and fissures, but no commercial sized body of ore has yet been found. A number of cuts and several tunnels, from 50 to 100 feet long, have been driven to prospect these showings.

A shaft has been sunk 30 feet deep, which follows down on a fissure in the lime which contains some zinc-blende. After this work had been done a parallel fissure was exposed on the surface by stripping for a distance of 300 feet. This latter vein shows galena in several places, and a crosscut was being run from the bottom of the shaft to cut this vein, which it should do in about 15 feet. This galena vein is from 2 to 4 feet wide and strikes north and south with the lime formation in which it occurs. While it does not show a great deal of ore, it is worth further prospecting.

On the *Mayflower* claim a 30-foot shaft has been sunk on a vein of oxidized material which has 2 feet of soft, red material, mainly iron oxide, and 2 feet of brown clay containing some iron oxide. The red streak is said to assay 6 per cent. zinc, which would be there in the form of zinc carbonate.

On the *Lucky Boy* claim a crosscut stripping the formation ran into a "cave," or rather open fissure, in the limestone, 30 feet deep. Slight evidences of mineralization are visible here also.

Silver Dollar Group.

This group, consisting of three claims and a fraction, is situated on the outskirts of the town of Salmo. It is owned by Salisbury & Clubine and has been under option to the Consolidated Mining and Smelting Company for the last three years. This company did considerable development-work for a time, but stopped about the time war broke out. The rock formation here consists of schist, argillite, and some quartzite, all very thin-bedded and shaly. The vein on which the work has been done cuts the formation at an angle of about 45 degrees and strikes nearly east and west, with a northerly dip of about 75 degrees. This vein is from 2 to 6 feet wide and consists of gangue which is nearly identical in composition with the wall-rock; it carries a little more silica and calcite, however. Small streaks and lenses of ore are found in the vein, but no ore-shoot of commercial size has yet been discovered. The ore-minerals are zinc-blende and galena and some iron pyrites. The galena is said to carry 1 oz. of silver to the unit of lead.

The main working is an incline shaft, 163 feet deep, at an angle of about 75 degrees, following the dip of the vein. At a depth of 48 feet a drift goes east on the vein for about 75 feet to the bottom of an old prospect-shaft. The main shaft had water in it up to within about 100 feet of the surface, and so conditions at the bottom could not be ascertained. It is evident, however, from the lack of any great amount of ore on the dump, that comparatively little ore was encountered during the sinking of the shaft. To the east of the shaft the vein has been uncovered at intervals for a distance of a few hundred feet and prospected by two short tunnels. The first one to the east of the shaft is run as a crosscut for 55 feet (the first 40 feet of which is in wash) to the vein; then a drift has been run on the vein for 50 feet to the west and an 8-foot winze sunk. At the face the vein shows some streaks of galena and zinc, the largest of which is about 10 inches wide. About 5 tons of sorted ore lies on the dump, taken from this working.

The other tunnel is a crosscut for 85 feet until striking the vein, and then 20 feet of drifting has been done to the west, following the lead. L. R. Clubine, one of the owners, was at work in this drift when the property was visited. Practically no ore has been taken from this working and the face shows nothing but vein-matter. Some of the surface cuts show a little ore.

Molybdenite Group.

The group of claims on Lost creek which has been prospected during the last two years for the mineral molybdenite has now been named—or possibly nicknamed—the "*Molly* mine." There are four claims in the group, all Crown-granted, which were staked in 1913 by J. A. Benson, H. E. Bennett, and S. N. Ross. Early this year (1915) the group was bonded by the British Columbia Molybdenite Company, a Vancouver syndicate, of which Mr. Mack is manager and Mr. Elliott engineer.

The property is situated near the head of one of the branches of Lost creek, and is distant about fifteen miles from the town of Salmo, on the Nelson & Fort Sheppard railway. The last five miles of wagon-road from Salmo into the claims was only finished in September, 1915.

Two cars of crude, hand-sorted ore have been shipped from the property, the first by the owners, and the second one by G. H. and J. P. Bell, of Salmo, who operated the claims under lease and bond during the larger part of 1914. This ore was shipped to the Henry E. Woods Ore Concentrating Company at Denver, Colorado. The first car averaged 16.586 per cent. molybdenite and was paid for at the rate of 20 cents a pound for 85 per cent. of the molybdenite (MoS_2) contents; the second car assayed 12.26 per cent. molybdenite and was paid for at the rate of 50 cents a pound for 90 per cent. of the molybdenite content. In addition, a few tons of test samples have been shipped to New York, Vancouver, and other places for testing purposes. Selected samples of ore can be obtained which will assay 80 per cent. MoS_2, but there is very little of this class of material.

The market for molybdenite ores has until recently been very limited, but the war has caused a great demand for this mineral. It is used in the manufacture of molybdenite steel, which is at the present time in considerable demand for high-speed tools and in linings for guns of different kinds. The property of molybdenite steel which makes it so much sought after is its ability to hold its temper (i.e., remain hard) at a high heat. Molybdenum is also used as a stabilizer for high explosives, to prevent their deterioration and premature explosion. In addition to these uses for war materials, a small amount of molybdenite is used for the production of ammonium molybdate, which is used as a laboratory reagent and for dyeing certain kinds of goods, and also in the manufacture of a blue pigment used in the porcelain trade.

A short description of the mineral molybdenite and its characteristics may be useful. Molybdenite is a sulphide of molybdenum containing 60 per cent. of molybdenum and has the chemical formula MoS_2. It is a bluish-black mineral with a lead-grey streak with a bluish tinge, and is very soft and comparatively light; in the scale of hardness it is 1.3 and has a specific gravity of 4.6 (quartz is 2.65 and galena 13.6).

The two minerals most commonly mistaken for molybdenite are graphite and the micaceous variety of specular iron (hæmatite). Graphite is pure black and has a black streak, is usually more massive in appearance, and is only half as heavy as molybdenite. The latter mineral occurs usually in flat flakes and with a flexible foliated structure; even when occurring in small specks through rock-matter it adheres to this flaky nature. Graphite also may occur in flakes, but the foliæ are less easily cleavable. Micaceous iron is readily distinguished from molybdenite by its reddish streak and brittle character.

The market price for molybdenite ore in the United States at the present time is somewhere between $2,500 and $3,000 a ton for 90 per cent. concentrates. H. A. Watson & Co., Liverpool,

who are the official brokers appointed to purchase ores for His Majesty's Government, at about the end of 1915 were offering £5 5s. ($25.57) a unit ex warehouse in Great Britain for ore containing 85 to 90 per cent. molybdenite, less a charge of 1 per cent. for brokerage; since that time this price may have changed. All molybdenite and tungsten ore within the Empire is requisitioned by the Home Government, and a Dominion Government Order in Council prohibits the export of these ores to all countries without the Empire. A similar regulation exists in regard to zinc ores, but by special arrangement with the Customs Department, British Columbia zinc ore can be shipped in bond to the United States for treatment, and doubtless similar arrangements could be made for molybdenite ore.

The *Molly* group of claims is staked on the steep hillside on the west side of and near the head of a small branch of Lost creek. The ore-exposures are about 1,000 feet vertically above the creek-level, at which a mill-site has been staked.

This ore-deposit occurs in an acid granite near its contact with a series of schists. This granite occurs as a small boss or stock which was intrusive upwards into the schists, and the upper surface is like a flat dome. Erosion has since cleaned off the schist from the top of the stock and left the upper zone of granite exposed. The granite is characterized by having very decided joint-planes which have a strike slightly west of north and dip to the south-west at 30 to 45 degrees. This jointing is so pronounced as to give the granite somewhat the appearance of a heavily bedded sedimentary.

The molybdenite occurs in the granite in an extremely irregular manner, and cannot be said to occur in any definite system, nor does it occur in veins with any definite strike. It would seem as if the molybdenite was developed at and near the upper contact of the granite with the schist, and that, while it has a considerable areal development, it does not extend into the body of the granite to any great depth. In some places there are narrow streaks of molybdenite which are quite high grade, but as a rule the mineral is scattered in small flakes through the granite. Pegmatite dykes occur cutting the granite, and along the walls of these dykes rich streaks of ore sometimes occur.

Development-work has been done by numerous open-cuts and shallow shafts. The biggest working is a hole about 75 feet long by 5 to 20 feet wide, and with a 25-foot face at one end, from which most of the two cars of ore shipped was taken out. The company at present operating the property has made many cuts along the hill in a general north-and-south direction. One big cut is 100 feet long by 15 feet wide and an average of about 10 feet deep. The management estimates that there is now at least 4,000 tons of ore in sight which will run from 2 to 4 per cent. molybdenite, which estimate the writer considers well founded. The company is at present experimenting with the ore to find a suitable method of concentrating it up to a marketable grade. It is then intended to erect a small mill about 10 tons capacity on the mill-site at the foot of the hill near the creek-level. Water-power to drive this mill will be obtained from the creek; a flume 1,273 feet long will give a fall of 114 feet, which even at low water will give sufficient power for a small mill.

The present high price of molybdenite may not last when the war is over, and so now is the time for owners of molybdenite properties to sell their ores if possible, and to hasten the establishment of equipment to concentrate the ores to a marketable grade. The Orillia Molybdenum Company, of Orillia, Ontario, has lately commenced operating a plant to treat molybdenum ores. This company is controlled by the International Molybdenum Company, Limited, which also controls a number of important molybdenum properties in Ontario. The plant of the Orillia Company will treat the ore from all the mines, and in addition is prepared to handle a certain amount of custom ore. The process of ore-treatment used at this plant is not known, but the final products marketed are molybdic acid and ferro-molybdenum. This company is prepared to bid on any grade of ore, and the statement that the miner can only market a high-grade concentrate must therefore be revised. This plant is in effect a customs mill and the low-grade ore is probably concentrated before the final treatment. The scale of prices offered by this concern for low-grade ore are such that it would be quite feasible for a British Columbia mine to ship low-grade ore there. At the end of March, 1916, the following prices were offered, but by the time this gets in print these prices may be entirely altered. The ore is bought at the rate of $1 a pound for 85 per cent. of the molybdenite (MoS_2) it contains, with the following charges for treatment deducted:—

Ore or concentrates over 10 per cent. MoS_2				$15 00	a ton.
„	between 8-10 per cent.		MoS_2	14 50	„
„	„ 7-8	„	„	13 50	„
„	„ 6-7	„	„	12 50	„
„	„ 5-6	„	„	11 50	„
„	„ 4-5	„	„	10 50	„
„	„ 3-4	„	„	9 50	„
„	„ 2-3	„	„	8 50	„

From this tariff an ore carrying 10 per cent. MoS_2 would be worth $155 a ton, a 5-per-cent. ore $73.50 a ton, and a 2-per-cent. ore $25.50 a ton. The freight rate in car-load lots from a central point in British Columbia to Ontario would be possibly $15 a ton. Thus there would be a good margin of profit in handling 5-per-cent. ore, and by a rough selection ore of this grade could be easily mined at the *Molly* mine.

No credit is allowed by this company for any molybdic oxide present in the ore; all samples must first be leached with ammonia to remove any oxide present. Special penalties are imposed if the ore contains an excess of copper, bismuth, or arsenic. All lots of ore received are sampled by Mr. Howe, resident sampler for M. J. O'Brien, at the expense of the shipper. The usual provision for umpiring of samples, in case of dispute, is made, and settlement is made within twenty-one days after sampling. A tariff is also quoted for ore between 1 and 2 per cent., but such ore would be too low grade to stand the cost of transporting from British Columbia to Ontario.

Iron Claims.

On the Pend d'Oreille river, near where the Salmo river joins it, some small exposures of iron ore have been found and staked as iron claims. The writer made a two-day trip from Salmo to see these claims and was guided by George Bell, one of the original locators. There are about fifteen claims staked, which are owned or controlled by Harry Shallenberger, of Spokane, Wash. It is probable that some of the claims are Crown-granted, and possibly all of them.

The formation here is limestone, belonging to the Pend d'Oreille series of schists, quartzites, and somewhat crystalline limestones. The iron-exposures are said to be scattered over quite a large area, but the chief ones are on the bank of a small creek named Boundary creek, which flows into the Salmo river. The main working is a tunnel 25 feet long, which apparently cuts the strike of a small body of iron ore. This body has a width, as shown in the tunnel, of 50 feet, but does not continue for any distance along the strike, as another tunnel 100 feet to the north, which is 100 feet long, fails to show any iron. From this latter tunnel a raise has been put up 80 feet and the whole working is in lime. If there had been any continuity in length of the iron-ore body exposed in the first tunnel, this second adit would have undoubtedly encountered it.

Other smaller amounts of iron ore are exposed in open-cuts in different places. These small ore-bodies are of the nature of iron-cappings in the limestone and have probably been formed by the oxidation of original sulphides in the limestone. The iron now occurs in the form of red oxide or hæmatite, and, although a careful search was made to find, if possible, cores of iron sulphide, none were found. Evidence of the sulphide nature of the original material was obtained, however, by finding some cores of galena—lead sulphide—in two different open-cuts.

Two samples of the iron were taken, which returned the following on analysis: Soft material representing average of tunnel—iron, 53.4 per cent.; sulphur, trace. Hard lumps of ore—iron, 57.3 per cent.; sulphur, trace.

This occurrence of iron ore is not large enough to be of any commercial value as a source of iron ore, but it is possible that further prospecting might reveal the presence of lead sulphides and carbonates. It is probable that if the iron oxide continued to any great depth it would gradually change into the sulphide.

Second Relief.

This mine is a gold property which has been worked for several years past in an intermittent way, principally by leasers. It is situated on the main North fork of the Salmo river, about thirteen miles from the town of Erie. The Relief Gold Mining Company owns the property, but A. D. Westby has complete control and is in active charge at the mine. The claims in the group are the *Relief*, *Relief Fraction*, *Grand Union*, *Star Shine*, *Big Bump*, and one-half interest in the *Ida D.* A good wagon-road extends from the mine to Erie, and over this supplies are hauled in and concentrates

taken out to the railway. The mine-workings are situated on the sloping side-hill rising up from the creek, and the stamp-mill and boarding-house are near the creek-level; the elevation at the camp being 3,950 feet. A short gravity-tramway connects the mine-workings to the mill. Good timber is plentiful and, generally speaking, the mine is conveniently situated for easy working. Water-power is used to drive the mill, but a shortage of water occurs during the dry season in summer and fall.

There are three or four parallel quartz veins on the property, but only one has been developed to any great extent. These veins have a general strike of N. 20° E. and stand nearly vertical or dip slightly to the east. They are apparently true fissure-veins, occurring in a basic, igneous rock, which is probably part of the Rossland volcanic series.

The main vein, which is the lowest down the hill, is developed by three adit-tunnels and a blind intermediate level between the two upper tunnels, numbered successively from 1 to 4.

No. 1 level is a drift-adit on the vein 800 feet long, from which most of the ore has been stoped out to the surface. No. 2 is the blind-level, 90 feet below No. 1, and is 1,000 feet long. It connects with No. 3 by a raise from the latter, which is a distance of 90 feet below.

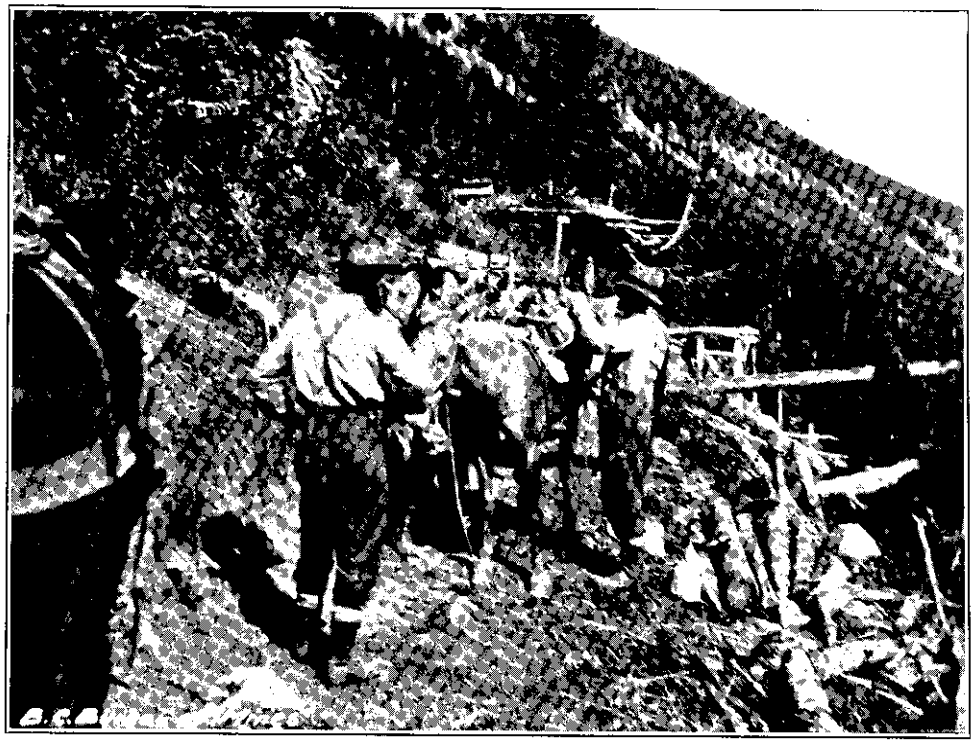
The No. 3 level is an adit-tunnel 120 feet vertically above No. 4. For the first 100 feet it is a crosscut to where a small vein was cut, which was drifted on in both directions, 50 feet to the north and a short distance to the south; this vein was, however, too small to pay to stope. The main tunnel was continued about 100 feet farther until the main *Relief* vein was crosscut. Drifts were run on the vein both ways, that to the south (or out of the hill) being 100 feet long to where the ore is cut off by a fault. The fault-plane was followed 20 feet to the east without discovering the vein, but a continuance in that direction would probably discover the lead. The drift to the north is 1,200 feet long, the face being up to the boundary of the *Ida D*, of which the operating company only owns a half-interest. A bird's-eye porphyry dyke cuts the vein in one place and mica dykes are frequent. At the face the vein is 6 feet wide, that is, including mineralized wall-rock, and is said to have an average assay across the whole face of $13. From No. 3 level to the surface the vein has been pretty well stoped out as far as rich ore is concerned, but there is said to be some milling-ore which, if the property were equipped with a mill that would make a high recovery, would pay to extract.

The No. 4 level is a crosscut for 400 feet and then is a drift on the vein for 800 feet. This drift was being driven ahead when the property was visited in September. A small vein was first cut in the crosscut and followed for a short distance to where a fault was encountered. Drifting was continued on the plane of the fault for 75 feet, where a vein was cut which may or may not be the same as the first one, but which is evidently the main *Relief* vein. The drift on this vein shows a very persistent fissure, averaging perhaps 2 feet and extending in places to 6 feet. The gangue is quartz and some country-rock, and the metallic minerals present are pyrite, pyrrhotite, and a little chalcopyrite, with the values almost entirely in gold. Heavy sulphide ore is generally rich in gold, but some masses of pyrrhotite carry but little value. The values are irregular, but nearly all the vein-matter carries some gold. It is said that an average of $8 to $12 a ton is obtainable from the whole vein.

There should be a good shoot of ore between this level and the one above which could be extracted at a profit. Below this level it will probably be necessary to sink, although a tunnel giving a little more depth could be driven.

The property is at present equipped with a Blake crusher, 10-stamp mill, Pierce amalgamator, Wilfley table, and two Frue vanners, all driven by water-power. A 125-horse-power air-compressor and a small electric-light generator are also driven by water-power. Water is brought in nearly two miles by a wooden flume and a pipe-line, a head of 193 feet being obtained for the Pelton wheels. There is also an auxiliary steam plant for use when the water fails, consisting of a steam-driven 3-drill compressor and also a 40-horse-power boiler for heating purposes.

Some years ago, when Finch & Campbell had a bond on the mine, they erected a small cyanide, sand-leaching plant, but for some reason this never worked successfully and has not been in use for some time. The mill as at present run makes a very poor extraction; as far as can be learned, somewhere between 50 and 60 per cent., which is very low for a gold ore. The result is that it is impossible to handle at a profit ore less than about $15 a ton in assay value. The present manager, A. D. Westby, has realized this, and is at the present time devoting his attention to remodelling the milling plant so as to make possible the handling of $6 to $10 ore. The plant is now being equipped with a tube-mill, which will recrush the tailings from the



Pack-train, Spokane Mine, Bayonne Camp—Nelson M.D.

Tunnel-mouth, Spokane Mine, Bayonne Camp.

Wilfley table, and a cyanide agitation plant to treat the tube-mill product. The increased milling capacity will give a daily capacity of about 50 tons, and the property should in the future make a larger gold-output than ever before.

A considerable tonnage of tailings, accumulated during former years of operation, has been impounded in the creek just below the mill by a dam, and it is intended at some future time to retreat these tailings; a lift of 75 to 100 feet would raise them back up to the top of the mill building.

The tonnage of ore treated in 1915 was 3,240 tons, yielding about $6 a ton in gold values. Assuming a 60-per-cent. extraction, this would give the grade of the mill-feed as being $10. This ore was considerably lower in grade than what is usually run through the mill, but the reason for this was that a large part of the tonnage treated last year was second-class ore taken from a dump where it had been stored in previous years. This material only assayed $6 to $8 a ton, thereby lowering the average value for the year.

It is evident, from the extensive alterations and improvements that Mr. Westby is now making in the mill, that he is satisfied that he has substantial ore reserves to draw upon. There is probably a considerable tonnage of low-grade ore between the No. 3 level and the surface that remains to be stoped out, but it will require economical mining and milling to show much profit on the treatment of this ore.

The other veins on the property, of which there are two or three, have not been developed to any great extent, but one at least has possibilities for the future. Some rich ore was taken from an old open-cut on it many years ago. Work will probably be confined to the main vein, however, for some time yet.

BAYONNE CAMP.

Bayonne camp is situated in the Selkirk range on the Kootenay Lake slope, and takes in the territory around the headwaters of Summit and Cultus creeks, both of which flow into Kootenay lake near its southern end. The easiest route into the camp at the present time is up Sheep creek and over the divide; a good wagon-road runs up this creek from Salmo to the *Motherlode* mine, a distance of eleven miles, and from this point a rather steep trail goes up the North fork of Sheep creek to the divide, where it branches, one trail going to the *Bayonne* mine and the other to the *Spokane* group. There are a number of claims around both of these properties and rough trails have been made to most of them. The old Dewdney trail ran up Lost creek to its source, crossed the divide to the head of Summit creek, which it followed down to the Kootenay river, crossing it at the Flats, to where the town of Creston is now situated, and thence on to East Kootenay. When the *Bayonne* group was staked in 1901 access to the property was had by means of the Dewdney trail, coming in from Kootenay River side, but with the building of the road up Sheep creek it was better to go in from that side.

The natural outlet for this section of country, however, is via Kootenay lake, and before the mineral properties can be properly developed wagon transportation down to the lake will have to be provided. The existing maps of this region are not very accurate and some confusion exists in regard to the names of Cultus and Canyon creeks. In the general map of the district appended to this report the writer has made corrections which, while probably not exact, show the general trend of these streams and correct the existing maps, which show Cultus creek as extending up to Wall mountain and Canyon creek as being very short. Actually Canyon creek runs up to Wall mountain and is separated at one point from a branch of Cultus creek by a very flat divide. At one time it was considered that a road to supply the *Bayonne* mine should be built up Summit creek, but there are two disadvantages to this: First, such a road would be of no value to the claims on Cultus and Canyon creeks; and, secondly, it would come out on the mud-flats of the Kootenay river—a very undesirable place from which to handle freight. The writer is of the opinion that the best way to serve the whole camp would be by building a road up Cultus creek and across the low divide to Canyon creek, and on up to the source of the latter. From this road a branch could be built to the Bayonne mine, which would serve it and the surrounding claims on the branches of Summit creek. Such a road would serve as a main trunk road and from time to time branches could be put in as were needed.

In conclusion, the writer has no hesitation in saying that the development of this camp has been held back by lack of a wagon-road, and that the mineral showings in the camp amply

warrant the Government in putting in such a road; in fact, the owners of properties in this district have a good claim to consideration from the Government.

The writer spent four days in the camp, during which time four groups of claims were examined. Many other claims are held and annual assessment-work is done on them, and several of these are reported to have good showings of ore. As time was limited, however, only a few of the more important properties were examined, but enough was seen to get a general idea of the camp and to form an opinion regarding the prospects for the future.

The formation in this vicinity is entirely granodiorite and is part of the Bayonne batholith, which covers an area of several hundred square miles. This granodiorite is intrusive into older sedimentary and volcanic formations, but, as far as the Bayonne camp is concerned, the ore-bodies are entirely in the plutonic irruptive. The ore-bodies are contained in quartz veins which, speaking generally, belong to two distinct systems, striking respectively north-easterly and east and west. These veins vary in width from a few inches up to 15 feet, and are, as a rule, very persistent and continuous in a longitudinous direction. The veins are apparently largely of replacement origin, although in places an incipient banded structure in the quartz and pyrite vein-fillings would indicate that in part the fissures were open ones. The granite walls are very often altered to some extent for varying distances away from the quartz; this alteration consists of kaolinization and pyritization of the granite which in places carries low gold values. Horses of granite are of common occurrence, and some of the veins are in places split into a number of stringers, with more or less altered granite lying between.

The vein-filling is quartz, together with some altered granite, and the main ore-mineral is iron pyrites. The values are mainly in gold, which occurs partly as free gold in the quartz and partly in association with the iron pyrites. A few of the veins carry small bunches of galena, which assays well in silver, and traces of copper and zinc minerals are seen in places.

Oxidation has proceeded to a depth of about 100 feet, the iron pyrites having become iron oxide, and apparently a slight enriching action has taken place, as the oxidized portions of the veins are somewhat richer than the sulphide zones. This is by no means certain, as the number of assays taken does not furnish conclusive evidence, but in any case the actual difference in value of the oxidized and unoxidized zones is so slight as to be unimportant. Speaking generally, the values are high and there seems no reason why some of the veins cannot be mined at a profit.

The country is, of course, mountainous, but is not excessively rugged, and is pretty well covered with trees and brush. The Sheep Creek divide is at an elevation of about 7,500 feet and Wall mountain is 7,900 feet. The *Bayonne* mine is at 7,000 feet and the *Spokane* a couple of hundred feet higher. The higher points, such as Wall mountain and Arkansas ridge, are nearly up to timber-line, and although there are scrubby trees and vegetation, bluffs and rocky outcrops are frequent.

The valleys of the main creeks are comparatively large and have evidently been gouged out and made U-shaped by glacial action. A few very small lakes or ponds occur in places. Plenty of timber for mining purposes is available and also enough water for milling purposes. Some power could probably be developed at the lower ends of Summit, Cultus, and Canyon creeks.

The character of the ore is such that it will have to be milled on the ground and the bulk of the values obtained as gold bullion by cyaniding or amalgamation, or both, with perhaps small amounts of concentrates. A good wagon-road on which to take in machinery and supplies and haul out relatively small tonnages of concentrates will be the only transportation system needed to enable the camp to be developed to the productive stage.

It should be emphasized that there is a large territory in this section which has only been slightly prospected. The *Bayonne* group was staked in 1901, but the *Spokane* group was only located in 1911, and many other claims have been taken up in recent years. In the lower altitudes the country is pretty well covered with wash, thus calling for real prospecting by the prospector rather than a casual looking-over of the ground. In the vicinity of the contact of the Bayonne granodiorite with the older sedimentaries should be a most favourable place to expect to find outcropping ore-bodies.

Bayonne.

This property is situated on the east slope of the North fork of Summit creek and distant about eighteen miles from Kootenay lake. The best way to reach the property at the present time is by the trail up Sheep creek and over the divide down Summit creek to the property. This trail is part of the old Dewdney trail and is not now in very good repair on the Summit Creek side. The trail to the *Bayonne* leaves the Dewdney trail half a mile east of the forks of Summit creek.

There are nine claims in the group—the *Bayonne, Columbus, Ohio, Virginia, New Jersey, Deleware, Kentucky, Maryland,* and *Oxford,* all Crown-granted. The group is well timbered with fir, spruce, pine, and some tamarack in all sizes up to about 3 feet in diameter. There is enough water in Bayonne creek for milling purposes, while the North fork of Summit creek and Johnny Bull creek would supply sufficient water-power to run a small mill.

There are two veins on the property, of which only one has been prospected to any extent. Five of the claims are staked along the outcrop of this vein—the *Bayonne* vein—and two on each side of these outcrop claims. This vein is exposed on two claims at points 2,500 feet apart, but is not continuously exposed for this distance. There are in all about thirty open-cuts, which expose the vein sufficiently well to make it probable that it is the one vein extending across the two claims.

Three prospect-tunnels have been driven to prospect this vein, two of which are drift-adits, and the third has been run as a half-crosscut, but not reaching the vein. The vein strikes up and down the hill, which has a rather flat slope of about 9 degrees, and therefore tunnelling on the vein does not give very much depth. The upper tunnel is at an elevation of about 7,350 feet and the lower one at 7,040 feet. The distance between the portals of the two tunnels is approximately 2,000 feet.

The upper drift is called the *Bayonne* tunnel and is about 500 feet long, with some short exploratory crosscuts. Throughout this working the vein varies in width from 2 to 10 feet and averages about 4 feet. The granitic wall-rock is, as a rule, considerably altered for some little distance from the vein, and very often the vein proper may be described as consisting of alternating bands of quartz and altered and partially mineralized wall-rock. About 300 feet from the portal of the tunnel a winze has been sunk to a depth of 20 feet; in this the vein is from 4 to 6 feet wide and is well mineralized with pyrite. Fifty feet nearer the portal a short raise connects with the bottom of a shallow prospect-shaft, previously sunk from the surface, the total depth to tunnel-level being 80 feet. At the face of the tunnel the main vein has been lost or has split up into a number of parallel stringers. Twenty feet from the face a crosscut to the right cuts an 18-inch streak of quartz, with a parallel strike to that of the main vein, at a distance of 35 feet from the main tunnel; this crosscut was continued, and at a distance of 25 feet farther another parallel quartz stringer 8 inches in width was encountered. The 18-inch streak was drifted on for about 30 feet in both directions. It shows but little mineral, and a sample taken across the full width only returned on assay 0.05 oz. gold and 0.6 oz. silver to the ton. It is possible that the continuation of the main vein would be picked up by cross-cutting from the main tunnel to the left. Four short crosscuts have been made to the south-east at different places along the tunnel, which go through the vein and altered wall-rock into the unaltered granodiorite beyond.

As is customary and usual in gold-quartz veins, the values in this one are somewhat irregular and spotted, the richer ore running in shoots. It is believed, though, that practically all the vein-matter exposed in this working can be considered as milling-ore. The writer took a few samples, picking out as far as possible places which looked somewhat lean, as it was known that ore carrying considerable pyrite would assay well. The following samples were taken:—

Description.	Gold.	Silver.
	Oz.	Oz.
18-inch* streak at face of tunnel	0.05	0.6
Across 6 feet near the winze	0.5	2.7
Across 5 feet, mostly altered granite, 180 feet from portal	0.24	0.8
Grab sample from ore-dump	1.64	5.0

The ore-dump from which the above sample was taken consisted of about 50 tons of ore put to one side as being apparently of better grade than the main dump; this ore was considerably oxidized and probably came from the outcrop.

The vein is exposed for some distance down the hill from this tunnel by means of open-cuts, then for a short distance is not seen, and again, approaching the lower tunnel, a series of

* This is not the main vein, but one of the stringers previously described.

prospect-cuts shows the vein. In all, there are about thirty openings, most of them small, on the vein on the surface, which show it to be a strong healthy vein maintaining its width and strike throughout. On the surface the vein is very considerably oxidized, the original iron pyrites having been largely altered to limonite. No free gold was seen anywhere, but it is said to occur in places. The vein has a strike of N. 60° E. to N. 85° E. and dips to the south at 80 to 85 degrees.

The lower adit driven on the vein is called the *Ohio* tunnel and is in about 1,200 feet. A raise goes up to the surface at a point about 650 feet in from the portal, and there are three short crosscuts which expose the width of the vein. In general appearance the vein is quite similar to that in the upper tunnel and averages about 4 feet in width. The following samples were taken:—

Description.	Gold.	Silver.
	Oz.	Oz.
Across 5 feet at point 250 feet from portal	1.6	3.6
Across 3 feet at point 850 feet from portal	0.08	0.4
Across 1 foot near face of tunnel	0.8	6.0
Grab sample of ore-dump	1.44	2.4

The grab sample represents a hasty attempt to get a sample of the ore-dump, which amounts to about one-quarter of the total material taken out from the tunnel-workings. A sample taken in such a way of a pile of gold-bearing quartz cannot be considered as having any value as an average; it does, however, show that some of the quartz carries good gold values.

In order to arrive at an idea of the average grade of the ore exposed in this working, it would be necessary to sample the tunnel systematically and prepare an assay plan, which, of course, the writer did not have time to do. He has, however, seen the results of many assays taken by other engineers, and from these it is quite evident that the quartz is sufficiently gold-bearing to make good milling-ore nearly everywhere throughout the workings on the property.

The mine is not yet developed to a stage where an estimate of blocked-out ore can be made, but there is no doubt that there is several thousand tons of probable ore already developed and great possibilities of the future development of ore.

The lowest adit on the property has not yet been driven far enough to strike the vein, and is therefore not of any value in the meantime.

Echo Group.

This group adjoins the *Bayonne* mine to the south and consists of the *Echo*, *St. Elmo*, *Ontario*, *Portland*, *Idaho*, and *Echo Fraction* claims; it is owned by Alex. Stewart and William Maher, whose post-office address is Nelson, B.C. The property was staked about ten years ago and a considerable amount of work was done in the first few years after staking, but in recent years very little development has been done. Most, or possibly all, of the claims are Crown-granted.

The writer was unfortunate in having to go over this property without one of the owners to show him the different veins, as later on, when in conversation with Mr. Maher, it became apparent that the more important showings had been overlooked. The claims are staked on a side-hill which is well covered with soil and trees and vegetation of all kinds plentiful. Rock-exposures are rare, and the only evidence at first found of mineral was the occurrence of considerable amounts of quartz float which carried good gold values, some of it assaying up to $300 and $400 to the ton. Systematic prospecting to discover the veins from which this rich float came was soon started, and many trenches in the surface wash down to bed-rock were run for long distances. Later on, the surface water on the hill was collected by a system of ditches and small dams and led to a main penstock, from where it was taken down the hill to make long ground-sluices exposing the bed-rock. A great deal of this ground-sluicing has been done, the whole hillside being cut up with sluices, trenches, and prospect-pits. A large part of this is naturally dead-work, but two or three veins are said to have been uncovered by means of it.

The writer saw only one of these veins; it is exposed in an open-cut at an elevation of 7,400 feet. Between granitic walls there is shown up a vein striking N. 60° E., which is about 10

inches wide, of rather promising-looking oxidized quartz. No sample was taken, which is to be regretted, as it was the only clean-cut showing of ore that the writer saw.

A short distance farther down the hill, at an elevation of 7,350 feet, a tunnel has been driven for a distance of 250 feet. This working follows a seam in the granite, but very little quartz or ore is in evidence; in places the wall-rock on either side of the fissure is altered, silicified, and pyritized for short distances, and might possibly carry low gold values. A talcy gouge up to 2 inches in width is of frequent occurrence in the fissure. A few specimens of ore at the mouth of the tunnel, which evidently came from somewhere within, show mineralization with galena and iron pyrites.

The following is an extract from a report by Martin J. Connolly on this property: "The most development is on an east-and-west vein dipping at 85 degrees to the south; trenches show it to have a width of from 2 to 14 feet. This vein is traced for a distance of 1,000 feet, and a tunnel has been driven on it for a short distance. The hanging-wall is an acid dyke 3 to 4 feet wide and much shattered, which contains $1 to $1.50 in gold. The foot-wall is well defined, iron-stained, and but little brecciated. The average of assays taken gives about $28 to the ton in gold."

The property is equipped with a comfortable bunk-house situated at an elevation of 7,050 feet and capable of housing a dozen men. Wood and water are plentiful, and generally the property is well situated as to convenience in mining.

Spokane Group.

This group, consisting of six claims—the *Spokane, Spokane No. 1, International, Continental, Granite,* and *Timberline*—is located on the south-east slope of Wall mountain, near the upper end of one of the branches of Cultus creek—South fork. The claims were staked five years ago and are owned by the Laib Bros., whose address is Salmo, B.C. The property is best reached by means of the Sheep Creek trail (previously described), which is followed to the divide, and from there a trail, built by the owners of the group, branches off to the north for four miles to the claims.

The claims are staked on a steep hillside which rises up from the creek at an angle of 35 to 40 degrees. The vein cuts the hillside obliquely, or running at an angle of about 45 degrees with the general direction of the creek. As the vein also dips slightly out of the hill, it only takes a short crosscut tunnel to reach it, and it should be possible to trace it down the hill for some distance and then prospect the vein by means of a drift adit which would gain considerable depth as it advanced.

The vein on this property is a well-defined and persistent quartz-filled fissure occurring in granodiorite and striking east and west, with a slight dip to the south. It is exposed for several hundred feet by open-cuts and stripping, and it is possible that it is the same vein which is exposed on the upper end of the claim and on into Harris's property, in which case the fissure would have a length of over 2,000 feet. The gangue-filling is quartz and the ore-minerals are iron pyrite, galena, a slight amount of chalcopyrite, and occasionally free gold. The whole vein is considerably leached and oxidized and has a red, rusty appearance from the amount of iron oxide present. The vein has apparently been formed largely by replacement, as there is very little evidence of banded structure or crustification. Horses of granite can be frequently seen and also bands of granite in all stages of alteration and replacement. Stringers go off into the walls, and both walls are generally kaolinized and impregnated with iron in the form of oxide near the surface and changing to sulphide at depth.

The vein is cut by mica-minette dykes, which fault it very slightly along the hanging-wall. The direction of strike of these dykes is nearly at right angles to the vein, and it is evident that they are of much later occurrence than the veins, and hence have no relation to the ore formation.

The development on the property consists of a number of open-cuts and two adit-tunnels. The upper tunnel is at an elevation of 7,010 feet and is 105 feet long; the first 10 feet is a crosscut, and after that it is a drift on the vein going south. Throughout, the vein varies in size from 6 inches to 4 feet and is fairly well mineralized. In places bunches of solid, or nearly solid, galena occur, but these are not to be considered as of such importance as the gold-carrying quartz. As will be seen by the appended assays, this galena carries about 0.65 oz. of silver to

the unit of lead. This, of course, is valuable ore, but the actual amount in comparison to the gold quartz is slight. The following assays were taken:—

Description.	Gold.	Silver.	Lead.
	Oz.	Oz.	Per Cent.
56. Sample across near face of tunnel	0.35	41.0	48.9
57. Sample across 18 inches quartz 30 feet from face (no galena)	0.65	4.6	....
59. Average of dump (this is whole rock-dump that came out of working..)	0.6	7.8	8.1

The lower tunnel is at an elevation of 6,900 feet directly down the hill from the upper one. It goes in as a crosscut for 135 feet until the vein is reached, and then there is a drift on the vein to the east for 22 feet and one to the west for 240 feet. At the face of this latter drift the vein is about 20 inches wide and carries a little galena in it. From the face for 30 feet back the vein averages about 20 inches and shows a little galena. A sample taken at the face across 20 inches, which gives a fair idea of the value of this shoot, assayed: Gold, 0.30 oz.; silver, 22.5 oz.; lead, 37.4 per cent.

For the next 100 feet back the vein is mostly quartz carrying iron sulphides and practically no galena. A typical sample of this ore-shoot assayed: Gold, 0.30 oz.; silver, 2.3 oz. The balance of the vein in the west drift carries varying amounts of galena and averages about 2½ feet in width.

The face of the 22-foot drift to the east shows the vein split into two parts and divided by 5 feet of wall-rock. On the north wall there is a streak 12 inches wide, a sample across which returned: Gold, 0.12 oz.; silver, 21.5 oz.; lead, 37.7 per cent.; and on the south there is 18 inches of good-looking ore considerably oxidized and with some copper-stain; an average sample of this latter assayed: Gold, 0.12 oz.; silver, 18.1 oz.; lead, 27.2 per cent. A grab sample of the ore which was sorted preparatory to shipping assayed: Gold, 0.10 oz.; silver, 48.5 oz.; lead, 75.4 per cent. Some time after the writer's visit a small shipment of 11 tons of this ore was packed out to Salmo and shipped to Trail. Smelter returns on this were: Gold, 0.12 oz.; silver, 48.5 oz.; lead, 71.2 per cent.; zinc, 1.6 per cent.

The property has on it a small cabin and wood and water are plentiful for all purposes.

Harris Property.

Adjoining the Laib property at its western end there is a claim owned by Harris, on which a vein is exposed which is supposed to be an extension of the *Spokane* vein. The only development-work is an open-cut about 20 feet long, with a 12-foot face at one end, which shows up a small quartz vein from 6 to 8 inches wide carrying a little galena and iron pyrites. It is quite possible, and very probable, that this is the same vein as occurs on the *Spokane* group. No samples were taken, but the values are said to be good. On tracing this vein into *Spokane* ground by means of open-cuts it is seen that it remains quite small for a considerable distance. Exploratory work farther west would appear to be advisable, as it is possible that wider ore-shoots might be found.

There are several other properties in the Bayonne camp which have promising surface showings, but on which very little development-work has been done. These showings all consist of quartz veins cutting the granite formation and carrying gold values.

The following condensed extracts have been made from a report by Martin J. Connolly: *Diamond Dick* group, *Topsy* claim, vein 10 inches wide, several open-cuts, assay $24; *Sunrise Fraction*, open-cut shows 30 inches quartz, assaying $30; *Strong Arm* claim, vein 1½ feet wide, striking N. 30° E. and vertical, some galena, assays $16.80; *Ocheco* group, 15-foot shaft and open-cuts showing 10-inch quartz vein, assayed $182.80 across 10 inches of oxidized ore in shaft; *Montana* group, strong lead traced one mile from granite into quartzite belt, 2½ feet of quartz, assayed $14.80; *Sunrise* group, large boulders of float quartz assaying from $74 to $197 a ton.

In the making of this examination of the Nelson Division the writer wishes to acknowledge his indebtedness to those numerous people who assisted him in many ways.

ARROW LAKE MINING DIVISION.

WALTER SCOTT, MINING RECORDER (OFFICE AT NAKUSP).

I have the honour to submit the annual report of the Arrow Lake Mining Division for the year ending December 31st, 1915.

On the *Millie Mack* group of mineral claims, belonging to H. E. Forster, a force of men have been working all summer and have a good showing of ore. Ten tons of ore have been brought down to the landing for shipment to the Trail smelter.

OFFICE STATISTICS—ARROW LAKE MINING DIVISION.

Free miners' certificates issued	40
Certificates of work recorded	13
Mineral claims recorded	13
Cash paid in lieu of work	$100

ROSSLAND DISTRICT.

TRAIL CREEK MINING DIVISION.

REPORT OF H. R. TOWNSEND, GOLD COMMISSIONER.

I have the honour to submit the report of mining operations in the Trail Creek Mining Division during the year 1915.

The only properties that were operated during the year were those of the Consolidated Mining and Smelting Company of Canada and the Le Roi No. 2 Company, and the particulars of the work done and the ore mined are as follows:—

Centre Star Group. This group shipped 180,508 tons of ore of a gross value of $2,302,720.55. The development-work was 14,418 feet of driving and crosscutting, 853 feet of raising, 182.5 feet of winzes, and 11,722.8 feet of diamond-drilling. The average number of men employed was 500.

Le Roi Group. This group shipped 131,319 tons of ore of a gross value of $1,408,553.80. The development-work was 2,864.5 feet of driving and crosscutting, 297 feet of raising, 136.7 feet of winzes, and 10,870 feet of diamond-drilling. The average number of men employed was 270.

Le Roi No. 2. This group shipped 26,538 tons of ore of a gross value of $356,104.59. The development-work was 3,471 feet of driving and crosscutting, 8 feet of raising, and 5,628 feet of diamond drilling. The average number of men employed was eighty-five.

OFFICE STATISTICS—TRAIL CREEK MINING DIVISION.

Mineral claims recorded	43
Certificates of work	42
Certificates of improvement	6
Bills of sale	5
Free miners' certificates (individual)	108
Free miners' certificates (company)	4
Free miners' certificates (special)	1

TRAIL CREEK MINING DIVISION.

NOTES BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

The Trail Creek Mining Division has only one important productive camp, that of Rossland, but this one is so important as to be the greatest lode-gold producing section of the Province. The big smelting plant and reduction-works of the Consolidated Mining and Smelting Company of Canada, Limited, is also located in this Division, at Trail, B.C. This smelter draws custom ore from all over the southern interior of British Columbia, and the extensive changes, improvements, and additions lately made to the plant are a sure sign of the healthy condition of the mining industry and the belief of greater production in the future held by the officers and directors of this company.

The Rossland mines are confined to three main groups—namely, the *Centre Star-War Eagle* group and the *Le Roi* group, owned by the Consolidated Company, and the *Josie* group, owned by the Le Roi No. 2 Company. There are other properties, of course, but as yet they are not serious producers. The three big mines at Rossland employ nearly 900 men, with a monthly pay-roll of over $100,000, which materially assists in making Rossland a very prosperous town.

of about 6,000 people. The progressive policy of development adopted by both the operating companies in this camp has placed their mines on a very solid basis, with large ore reserves and a considerable future life ahead of them.

The following information taken from the annual report of the Consolidated Mining and Smelting Company for the fiscal year ended September 30th, 1915, in reference to the Rossland mines, is of interest:—

"*Mine Production.*

	Year 1914-15.	1894 to Date.
	Tons.	Tons.
Centre Star, ore	180,410	2,386,753
Centre Star, concentrates	....	9
Le Roi, ore	134,758	1,816,995
Le Roi, concentrates	....	612

"The total amount of development in the Company's mines is about as follows: *Centre Star* group, 198,378.5 feet, 37.57 miles; *Le Roi* group, 81,615.5 feet, 15.46 miles.

"During the year the following narrow work and diamond-drilling was done:—

	Drifting and Crosscutting.	Raising.	Sinking.	Total.	Diamond-drilling.
	Feet.	Feet.	Feet	Feet.	Feet.
Centre Star	11,619.5	1,015	309.5	12,944.0	11,580.8
Le Roi	2,269.0	245	90.5	2,604.5	10,996.7

"The company's mines in Rossland are in about the same position as regards ore reserves as at this time last year. The *Le Roi* mine has increased its reserves to some extent, while the *War Eagle* and *Centre Star* mines show a slight decrease in ore reserves.

"In the *War Eagle* the principal development has been the opening-up of a new level at a depth of 2,400 feet from the surface by means of a crosscut from the sixteenth or lower level of the *Centre Star* shaft, this being connected to a winze from the lowest *War Eagle* workings, 300 feet above. There have been some new bodies of ore developed in some of the upper levels.

"In the *Centre Star*, on the sixth level, a crosscut has opened up some promising ore in new country, but it has not yet been opened up to any extent. Ore has also been found on the thirteenth level in ground which has hitherto been unproductive.

"In the *Le Roi* a drift has been run west from the *Centre Star* shaft and connected with a winze from the lowest level of the *Le Roi*, and from this drift it is intended to further prospect the ground below the lowest level of the *Le Roi*. Considerable productive ground has been opened up in the west end of the mine from the 1,650-foot level upwards."

In 1915 the ore shipments and approximate metal contents for the three main properties in the camp were as follows:—

Name.	Tons.	Gold.	Silver.	Copper recovered.
		Oz.	Oz.	Lb.
Centre Star (Consolidated Co.)	180,508	94,936	63,652	985,626
Le Roi (Consolidated Co.)	131,319	38,587	70,964	2,735,512
Josie (Le Roi No. 2 Co.)	26,538	9,000	24,686	927,616

It is of interest to note that in only one other year of the twenty-two years during which Rossland mines have produced ore has the 1915 output been exceeded; that was in the year 1903, the officially recorded quantity for which was 360,786 tons. The gold recovered that year was greater than that of 1915 by approximately 3,000 oz.

Le Roi No. 2.

The Le Roi No. 2 Company also had a successful year. The tonnage of ore mined was 26,538 tons; of this, 16,566 tons was shipped to the smelter as crude ore and the balance, or 9,972 tons, was milled. Development-work was done on the *California* and *Giant*, two claims which adjoin the *Josie* group on the west and which are held under option of purchase. Stoping was commenced on the 1,600-foot level of the *Annie* claim of the *Josie* group. In September work was resumed on the No. 1 claim of the group.

TRAIL SMELTER.

The practical transformation that during recent years has been effected at the Consolidated Mining and Smelting Company's copper- and lead-smelting works and electrolytic lead-refinery at Trail is strikingly evident to every one familiar with the important changes that have taken place. The greater part of the works has been rebuilt, enlarged, and modernized. The especial advances made in 1915 were the greatly increased use of the Cottrell dust-collecting system, the installation of copper-converters, and the considerable progress made with the erection of buildings and installation of machinery and plant in connection with the electrolytic zinc-refinery now being prepared for early operation.

Some time ago an announcement was made in the press in connection with a recently issued circular to shareholders relative to the company's operations during the fiscal year ended September 30th, 1915. This circular indicated the remarkable expansion in the capacity for production of the company's mines and works. It stated that when plans then in process of execution shall have been carried out, the lead-producing capacity of the plant at Trail will have been increased 60 per cent., and that, too, on a more economical basis than in the past. This further information was given: "Not only is the company in a position to produce zinc commercially, but at the request of the Shell Committee at Ottawa a zinc-production plant is being installed at Trail, this to have a daily capacity of 35 tons of refined zinc. The zinc-output for 1916 has been ordered by the committee at profitable prices. The Shell Committee also requested that the company should undertake the refining of copper—a new Canadian industry. While this new departure will be carried forward on a limited scale at first, it is expected to develop and involve the treatment of much of the matte and blister-copper taken from British Columbia copper-reduction works. The committee has ordered at fair prices the output of refined copper for 1916."

The considerably increased provision made for the use at Trail of the Cottrell process for the electrical precipitation of fume is a noteworthy advance, since the use of this process greatly facilitates the separation of valuable materials from waste gases and smoke from roasters, furnaces, and converters; these materials are lead, zinc, and a little silver, much of which might easily be lost if the fume and dust were not cheaply and effectively saved on its passage through flues and stacks to the open air. At Trail the Cottrell dust-collecting plant on the lead-furnaces has been nearly doubled in size, and a new plant put in to treat fumes from the roasting department. Another plant is being constructed for fumes from the copper-converters and a part of the roaster gases, and still another for the zinc-refinery plant. In this connection the following brief excerpt from an address delivered recently in New York on the subject of "Recovery from Waste Gases" is made: "The recovery of these materials often would be warranted for the additional revenue which they would produce even under present circumstances; in others it is desirable to develop processes for separating the constituents of the collected fume and dust. Investigations at one smelter showed that metals having a gross value of approximately $4,000 a day were being discharged into the atmosphere. The expense of collecting, smelting, refining, and marketing the valuable ingredients becomes an important item, and thus it behoves metallurgists, chemists, and engineers to devise cheaper methods of dealing with such problems."

After having for years shipped to Tacoma, Washington, U.S.A., the product of its copper blast-furnaces in the form of matte, the Consolidated Company has at length made provision for producing blister-copper at Trail. Two 12-foot Great Falls type copper-converters for converting copper matte have been installed, together with the requisite blowing-engine, which is a turbo-blower of 15,000 cubic feet capacity, driven by floating gears from a 900-horse-power motor.

Much experimental work having been done at Trail in connection with refining zinc electrolytically, and spelter of good quality having been produced to the amount of about

½ ton a day, from ore from the company's *Sullivan* mine, the building and equipment of works, to have a capacity of possibly 35 tons of spelter a day, was commenced last autumn. The zinc-refinery buildings include structures for grinding, roasting, leaching, electrolyzing, and melting plants, motor-generator building, and transformer-station, together with flue systems, Cottrell dust-collecting plant, and a concrete stack 200 feet high and 12 feet inside diameter. It is planned to have the plant ready for operation early in 1916. It is, perhaps, well to mention that, up to date, experiments in connection with the production of electrolytic zinc have practically been confined to the company's own ores, so that as yet it is not possible to say what can be done by this method with the prevailing zinc-lead ores of Kootenay District. The zinc-refinery buildings are of steel and tile construction. The plant covers approximately 6 acres of ground.

A short description of the Cottrell process will not be out of place at this point. Those who are interested in the subject are referred to an article by Walter A. Schmidt in the Transactions of the Canadian Mining Institute, 1915, entitled "Cottrell Processes of Electrical Precipitation"; and "Recent Progress in Electrical Smoke Precipitation," by F. G. Cottrell in the *Engineering and Mining Journal* of February 26th, 1916.

The precipitation of fume, smoke, and dust by means of electricity is a process that has only become possible on a practical scale in the last few years. The first commercial application of the Cottrell process was at the smelting-works of the Selby Smelting and Lead Company in 1907. Since then the process has been installed in many plants and is successfully operating on widely different kinds of waste gases containing fume and dust. A citation of some of these will illustrate the wide field to which the process is being applied; it is used in lead, copper, and zinc smelters and refining works; in Portland-cement plants; in gasworks and oil-refineries; in sulphuric-acid works; in chemical and refining works of special kinds, where tin, antimony, arsenic, mercury, and other fumes are precipitated; in sugar-refineries to collect sugar-dust; and in plants making dried milk, dried eggs, etc.

The removal of dust and fume, suspended matter in gases, has been a problem for many years past, and until lately has always been attacked by means of settling, filtration, scrubbing, and centrifugal processes. The possibility of settling suspended matter by electric means has been recognized for nearly a century, but it was not until improvements and inventions in electrical machinery were made that commercial success with any such process could be attained. It was largely in the perfection of electrical machinery and the working-out of the details that F. G. Cottrell finally achieved success where others had failed.

"The operation of the electrical processes, when analysed into its simplest factors, may be described as follows: The gases, along with the suspended material, are passed into an apparatus comprising a system of electrodes. These electrodes are of two types, one type of a form facilitating electric discharge from the surface thereof, the other type of such form as to minimize or prevent discharge from its surface. These electrodes are so placed in the apparatus that the two types oppose each other and a silent or glow discharge is maintained between them by impressing a sufficiently high, unidirectional, electric potential upon them. The gases are passed through this electric discharge, which may be received as a constant stream of ions, or particles of electricity, flowing from the discharge electrode to the non-discharging electrode. As the suspended particles come into this stream of ions they are bombarded by them. Those ions which strike the particles are stopped in their passage from electrode to electrode, attach themselves to the particles, and give up their electric charge to them. In this manner the particles gather sufficient electric charge to move under the force of the electric field between the electrodes, then migrate toward the electrode, and are deposited thereon while the gases pass on unaffected. In reality the principle cannot be so simply carried out and a great deal depends upon the proper design of the apparatus. The composition of the gases, the nature of the suspended particles, the temperature, and many other factors must be taken into consideration in designing a plant to handle any specific problem."*

The system installed at Trail is known as a "multiple-pipe treater," which distinguishes it from the "plate treater" system of the Cottrell process which has been installed in other plants. This latter style of treater has now been practically abandoned everywhere in favour of the "multiple-pipe" form.

These treaters consist of a number of 12½-inch iron pipes up each of which a central wire runs. This wire varies in size according to the conductivity of the gases, but in all cases its

* Walter A. Schmidt.

surface area is relatively very slight as compared with the dust-collecting surface of the iron pipe. These wires may be made of any conducting material, but are commonly made of nichrom, a nickel-chromium-steel compound. The wire forms the discharging electrode and the sides of the iron pipe are the collecting electrode. The iron wire is charged with electric current taken from a synchronous contact maker, which produces an intermittent direct current at 60,000 volts from an alternating current going into the machine at 550 volts. There is, of course, a high difference of potential between the iron wire and the periphery of the iron pipe, with a resulting high glow discharge between these at all points. The smoke—that is, furnace and roaster gases charged with suspended particles of matter and fume—is passed through and up these iron pipes in a constant stream. Each little particle of suspended matter, somewhere in the course of its passage through a pipe, is attacked by an ion and becomes charged with static electricity. As the electrical sign of these charges is the same as that on the iron wire and opposed to that of the pipe, therefore, by the law that positive attracts negative, and vice versa, the particles become attracted to and settle on the iron pipe.

The gases, which the Cottrell dust-collecting plants treat at Trail, are drawn off from the furnaces and roasters in flues which lead them to the treaters. After passing through the treaters and being relieved of their burden of dust and fume, the gases continue in flues to the main stack. The treaters are thus part of the flue system; they are built of steel throughout, set in concrete in the flues, and are erected in sections containing thirty-two pipes in each. The dust collecting on the pipes is shaken down and into a hopper at the bottom by an operator coming round and tapping the pipes with a hammer at certain stated intervals. In some plants the pipes are equipped with automatic devices for tapping, but not at Trail.

The first installation at Trail consisted of 384 pipes, 15 feet in length, in twelve sections. This treated the gases from the three lead-stacks and was somewhat overloaded. Approximately 100,000 cubic feet of gas was treated. This plant was doubled in size in 1915 and is called the No. 1 plant. No. 2 plant, erected late in 1915, consists of nine sections and will treat the gases from the various lead-roasting furnaces. No. 3, consisting of eight sections, is in course of erection, and will treat gases from the copper-converters. An interesting use of the process is to be made in this connection. In the lead-stacks a lead matte is made, which, after roasting, is returned to the furnaces. In time this lead matte becomes charged with so much copper that it is more valuable for the copper than the lead. Until now the practice has been to take this copper-lead matte and charge it into the copper-furnace; in this way the copper is obtained as copper matte, but the lead is lost in the slag; gold and silver contents are, of course, saved. It is now intended that this copper-lead matte will be blown in the copper-converters along with copper matte from the copper-furnaces. The copper will all be obtained as blister-copper and the lead will be blown off as lead oxide and lead-fume and precipitated in the Cottrell No. 3 plant. No. 4 Cottrell will be erected to treat the roaster gases from the Wedge roasters in the new zinc plant. Experimental work in treating gases from the refining-furnaces in the lead-refinery, in order to save antimony and arsenic, are still proceeding.

The dust collected in the present Cottrell plant, treating the gases from the lead-stack, is mainly sulphide of lead, containing 65 to 70 per cent. lead. The dust collected from the roaster gases contains from 50 to 60 per cent. lead and consists, roughly, of 60 per cent. lead sulphate, 20 per cent. lead oxide, and 20 per cent. lead sulphide. Lead losses in the stack have always been very high at Trail, as but little provision for settling the dust by long flues or bag-houses had been made, but with the Cottrell process these losses are being reduced to a minimum. The nominal horse-power to run all four Cottrell plants will not exceed 200 horse-power, and but little labour is needed to keep them running.

A new sampling-mill for handling lead ore was practically completed late in the year; this sampler is modern and up-to-date in all particulars. New concrete bins for bedding down roasted lead ore, lime-rock, and coke have been completed. These bins are charged by overhead railways and are drawn off from below. The various ingredients of a furnace charge are bedded down in layers, so that in drawing off below a properly mixed furnace charge is obtained.

Very important improvements have been made in the lead-roasting department. In former years but little attention was paid to the escape of fumes into the working-places, with the result that workmen were continually becoming "leaded." Lead-fumes, if inhaled for a length of time, bring on a disease which may be fatal; it is really a case of slow poisoning. But now the lead-roasting department is practically void of fumes and cases of lead sickness are rare.

The Dwight-Lloyd roasters have been covered in and the fumes drawn off by an exhaust-fan, and the discharge end cut off by a galvanized-iron partition from the operator. The Wedge roasters and Huntingdon-Hebberlin pots are so arranged as to give out practically no fumes to the near-by workmen. Hoses are at hand to keep down dust and the workmen are all supplied with respirators, which, however, most of them do not wear.

BOUNDARY DISTRICT.

NOTES BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

Mining in the Boundary District showed a considerable revival and greater ore production in 1915 as compared with the year 1914. The tonnage again exceeds that of any other district, amounting as it does to 45.7 per cent. of the whole tonnage mined in the Province. This large tonnage is produced mainly by the mines of the Granby Company, which last year produced about 85 per cent. of the output of the Boundary District. The British Columbia Copper Company, which had made a considerable output in former years, operated during 1915 on a comparatively small scale. The *Nickel Plate*, in Osoyoos Division, made its usual yearly production, while through the district generally there was more activity among the smaller properties than in the previous year.

The Boundary District is here taken to include Grand Forks, Greenwood, and Osoyoos Mining Divisions, the total mineral production for which in 1915 was as follows: Tonnage, 1,228,724; gold, 87,870 oz.; silver, 273,795 oz.; copper, 17,402,662 lb.; lead, 7,127 lb.; and the value of building materials produced was $68,654.

The total value of the mineral production of the district was $5,023,635, which amount is only exceeded in district totals by that of West Kootenay with $7,308,793, and the Coast District with $6,682,057.

GRAND FORKS AND GREENWOOD MINING DIVISIONS.

The Granby Consolidated Mining, Smelting, and Power Company, Limited, operating mines at Phoenix and the smelter at Grand Forks, also has a large mine and smelter at Anyox, in the Skeena Division. The fiscal year of this company ends on June 30th, 1915, and the annual report of the company includes reports on operations at all its mines and smelters.

The operations of the Granby Company are so large and are of such importance in the mining industry of the Province that it is considered advisable to reproduce here nearly the whole annual report of the company for the year ended June 30th, 1915. It should be noted that the Granby Company in 1915 mined and smelted 62.5 per cent. of the total ore production of the Province and produced 66.7 per cent. of the total copper-output. Following is practically the whole of this report, giving profit and loss account, balance-sheet, and the reports of the various superintendents in charge of operations:—

"TREASURER'S REPORT.

"Following is a summary of the year's business:—

"Mineral-bearing Ores treated.

Ores of.	Ore smelted, Dry Tons.	Lb. Copper recovered per Ton Ore.	Metals recovered and sold.			Value Silver and Gold per Ton Ore.
			Copper, Lb. Fine.	Silver, Oz. Fine.	Gold, Oz. Fine.	
Phoenix mines	611,097	16.12	9,850,302	116,752	23,355	$0.857
Anyox mines	462,340	34.58	15,895,757	142,725	3,581	0.308
Both plants	1,073,437	23.99	25,746,059	259,477	26,936	$0.621
Foreign ores purchased	24,583	..	892,853	118,404	4,452	..
Totals	1,098,020	..	26,638,912	377,881	31,388	..

"*Blister-copper Account—Costs.*

Ores of.	Copper.	Per Lb.	Silver.	Gold.	Total.	Per Ton Ore.
Phoenix mines	$1,141,413 79	$0.1159	$ 56,483 94	$467,396 39	$1,665,294 12	$2.725
Anyox mines	1,604,469 34	0.1009	70,340 32	72,266 49	1,747,076 15	3.778
Both plants	$2,745,883 13	$0.1066	$126,824 26	$539,662 88	$3,412,370 27	$3.179
Foreign ores purchased	150,752 83	0.1688	62,108 17	88,097 60	300,958 60	..
Totals	$2,896,635 96	..	$188,932 43	$627,760 48	$3,713,328 87	..

"*Blister-copper Account—Sales.*

Ores of.	Copper.	Per Lb.	Silver.	Gold.	Total.	Per Ton Ore.
Phoenix mines	$1,588,176 97	$0.1612	$ 56,483 94	$467,396 39	$2,112,057 30	$3.456
Anyox mines	2,498,263 82	0.1571	70,340 32	72,266 49	2,640,870 63	5 711
Both plants	$4,086,440 79	$0.1587	$126,824 26	$529,662 88	$4,752,927 93	$4.427
Foreign ores purchased	150,752 83	0.1688	62,108 17	88,097 60	300,958 60	..
Total received	$4,237,193 62	..	$188,932 43	$627,760 48	$5,053,886 53	..

"*Profit and Loss Account.*

"To Blister-copper Account—Costs		$3,713,328 87
Less value gold and silver	$816,692 91	
Less value foreign copper purchased	150,752 83	
		967,445 74
	Per Lb. Cu.	
Cost of Granby copper, 25,746,059 lb.	0.1066	$2,745,883 13
Interest on bonds	0.0105	270,419 53
Extraordinary expenditures	0.0055	140,973 25
	0.1226	$3,157,275 91
"By copper sales, 25,746,059 lb.	0.1587	4,086,440 79
Net profit for year	0.0361	$ 929,164 88
Surplus carried over from last year		2,738,921 91
Total surplus at credit, June 30th, 1915		$3,668,086 79

"*Balance-sheet—June 30th, 1915.*

"Assets—		
Mine properties		$14,468,898 39
Cost of mine purchases—now under development		663,772 87
Real estate, timber lands, machinery, buildings, dwellings, floating equipment, at Anyox, Grand Forks, and Phoenix		4,863,083 87
Shares of other companies		430,517 54
Sundry materials and supplies on hand and accounts receivable		568,465 46
Cash and metals on hand—		
Ore	$ 105,870 76	
Metals sold for future payment, less advances	1,483,353 42	
Cash in banks	167,319 10	
		1,756,543 28
		$22,721,281 41

"Liabilities—

Capital stock issued—149,985.15 shares @ $100		$14,998,515 00
Bond Series "A"—Convertible First Mortgage 6% Gold Bonds due May 1st, 1928	$1,440,000 00	
Bond Series "A Stamped"—Convertible First Mortgage 6% Gold Bonds due May 1st, 1928	2,000,000 00	
	$3,440,000 00	
Less bonds owned	50,000 00	
		3,390,000 00
Accounts payable—		
Wages	$ 180,663 50	
Supplies	431,619 45	
Interest on bonds	34,150 00	
Reserve for sundry expenses	11,329 02	
Accident reserve	5,862 62	
Liquidator dividends	1,055 03	
		664,679 62
Surplus		3,668,086 79
		$22,721,281 41

"G. W. WOOSTER, *Treasurer.*

"GENERAL MANAGER'S REPORT.

"*Mines.*

"The operations at Phoenix and Grand Forks, B.C., were shut down for four months after August 7th, 1914, and the output of ore from the Phoenix mines was curtailed after starting again in December, until April, 1915, so that the shipments from these mines during the year were less than usual.

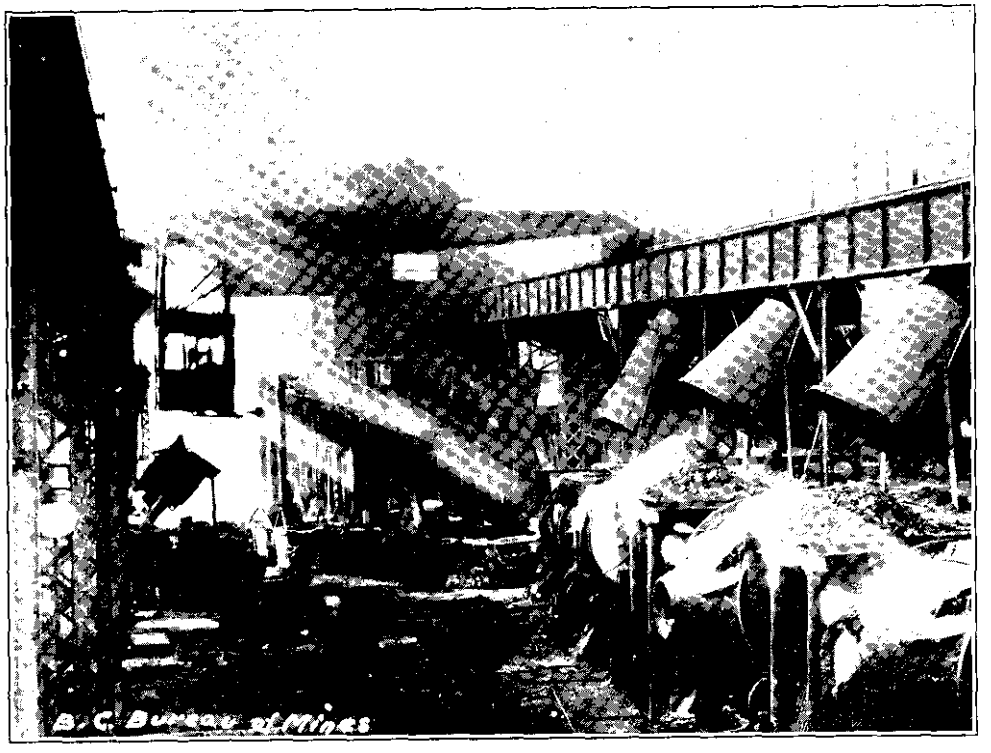
The shipments for the year were	611,000	tons.
The development-work for the year added to the tonnage reported last year	152,872	"
The reserve tonnage in these mines at the end of the year showing	4,232,405	"

"The cost of 85 cents per ton of ore shipped is about 5 cents per ton higher than the average for the previous five years. This is due partially to the shut-down of last fall, and subsequent starting of operations in the winter, but it also reflects the increasing expense of extraction attending decreasing ore reserves, and wherever possible this tendency is being offset by improving and cheapening the methods of extraction.

"The first full year of operation of the Hidden Creek mine at Anyox, B.C., has been effective in levelling and ironing out the peaks and extremes of operation and cost of production incident to breaking in a new property and putting it on a productive basis, and has shown conclusively that the general lay-out and development of the mine will afford and permit the output of any reasonable tonnage required by the smelter at a cost per ton well within the economic limits for such work.

The shipments from this mine for the year were	477,435	tons.
Very little development-work was undertaken, but this work for the year on ore showing 2.2 per cent. copper added to the tonnage reported last year about	187,500	"
The reserve ore (having 2.2 per cent. copper) at the end of the year was	9,205,837	"
There is a further reserve of low grade (0.63 per cent. copper) ore of about	8,628,000	"
The cost of mining per ton of ore shipped for the year shows	$1.03	

Furnace-shed, Granby Smelter, Grand Forks.



Converter-shed, Granby Smelter, Grand Forks.

"At the *Bonanza* mine, located about two miles up Bonanza creek—which is a tributary to Granby bay, two miles south of the smelter—nothing has been done during the year, either in the way of development or in preparation for shipping ore.

The ore roughly blocked out by the work previously done on this property shows for a grade of 2.6 per cent. copper ..... 414,775 tons.
There is, in addition to the above, a grade of 0.7 per cent. copper 489,580 ,,

"The quartz claims—consisting of thirty claims, located on Granby peninsula, which forms the easterly shore-line of Granby bay—were purchased during the year. The property has been opened up to afford a source of supply for clean quartz when it is required by the furnaces. For this purpose much preliminary work, by way of clearing and stripping the ledges at three different places and constructing rough loading chutes and wharves to load flat-deck scows, has been accomplished, and while at this writing very little quartz is being taken from this quarry, it is in readiness for shipment whenever required in the future.

"On the Kasaan peninsula of Prince of Wales island, south-eastern Alaska, your company owns the *Mamie* and *Dean* mines and has an option to purchase the *It* mine, adjoining the *Dean*. Work on all of these properties was discontinued in August, 1914, until April, 1915.

"Following the characteristics of the known copper-mines in this vicinity, these mines are comparatively small. However, the results of the work on them, up to the present writing, give sufficient encouragement to warrant the continuation of this work of prospecting for and seeking an extension and enlargement of the known ore-bodies.

From these mines there has been shipped during the fiscal year (*of a grade of 1.5 per cent. copper* ..... 15,000 tons.
The reserve showing at ..... 130,000 ,,
With a fair prospect of developing treble this tonnage with future work.

"At the *Midas* mines, Valdes, south-western Alaska, such work as was necessary to complete the aerial tramway, mine terminal of this tramway, a few buildings at the mine, and to fill in about the pile foundation of the wharf shipping-bins—to prevent destruction by teredos—was started in April of this year. At this writing this work is about complete, and with the little development-work that has been advanced in the mine during the year, this property will be ready to make shipments as soon as arrangements are made for securing power to operate the compressor.

"*Smelters.*

"The two reduction-works owned and operated by your company are located, one at Grand Forks, B.C., the other at Anyox, B.C.

"The first-named works have been in operation since 1901; the second since 1914.

"At Grand Forks the operation is a simple one, all of the difficulties of treatment and handling of the Phoenix ores having been solved some years ago; this, with practically no expense for new construction, makes possible costs very substantially under those of recent years at this plant.

"The operations of the smelting-works at Anyox have been attended with many difficulties of a minor nature, and some of greater degree, resulting in a low tonnage, and, as naturally follows, high costs, particularly for the first eight months of this year. Most of these difficulties are of a nature having to do with establishing the best methods of handling the ores, which vary considerably in their silica, iron, and alumina content.

"The further difficulties were mechanical, and those inherent to a new plant beginning its operation with new crews, and, as was the case with the mining operation at this point, the experience of the first year's operation has gone far in securing a condition of smooth running with lengthening campaigns for the furnaces, and as a consequence a greater tonnage treated per month, with constantly lowering unit costs. In this connection the writer believes that it is fair to assume that during the succeeding years of operation there will be noted the same constant lowering of unit costs as has been shown in the operations of the Grand Forks plant, and that this result will be attained in less time than it was at the older plant.

"The plant—originally designed to treat 2,000 tons of *Hidden Creek* ore per day—has been well arranged and constructed for the economical treatment of these ores. The changes that have been made are minor ones, which actual operation has demonstrated would simplify

methods and give greater efficiency. The addition of the fourth furnace and appliances for taking care of flue-dust—authorized during the latter part of the fiscal year—will undoubtedly raise the normal output of the plant as first designed fully 50 per cent. Very little foreign ore has been treated at either plant. Recoveries including foreign ore at the Grand Forks plant were:—

Copper	10,041,175 lb.
Silver	180,177 oz.
Gold	27,807 oz.

"The recoveries at the Anyox smelter were:—

Copper	16,597,737 lb.
Silver	197,704 oz.
Gold	3,581 oz.

"The writer appreciates very much and commends the efforts of the superintendents of mines and smelters; the operating forces of all departments; their assistants and the subordinates who have shown unremitting loyalty and zeal in forwarding the interests of your company and have contributed so largely to the results set forth in these reports.

"ANNUAL REPORT OF THE SUPERINTENDENT OF SMELTERS.

(W. A. Williams.)

"*Anyox Smelter.*

"In its first real year of operation this plant shows, in ores treated and in copper produced, a good healthy progress for the better. Since high water in March the plant has practically run at full capacity, having changed at that time from the old schedule of always operating two furnaces steady and the third in repair and waiting, as was formerly the practice, to keeping all three in blast as much as possible.

"The new charge-cars have helped the feeding and the distribution of the ore in the blast-furnaces, and the tendency of the furnaces to crust has become less as a result of their installation. With the better understanding which every one has of both the ores and the operation of the furnaces, the campaigns have lengthened, until campaigns of a month are now the rule. We look for this to improve as time goes on. This will give us more furnace days per year.

"The troubles encountered on the lower floor were chiefly with the settlers and spouts, owing to the great amount of low-grade, corrosive matte handled. These have been overcome and now have few stoppages from this source.

"The stoppages of the crane service which troubled us at first have been entirely overcome with the installation of the heavier 40-ton trollies with which we replaced the 20-ton trollies.

"A number of improvements have been made in order to lower costs, such as silica-bins over the converters, skull-grid for ladle-skulls, new charge-cars and matte-digging machine, all of which have been charged to 'Operation.' The No. 4 furnace and agglomerating plant were purchased this year and are now under construction. The furnace will be ready to put in commission by August 15th and the agglomerator by September 10th. We are preparing to increase our storage capacity for ore by the erection of more bins. This work is charged to 'Operation' and will be finished by November. We have found the plant fairly well designed for economical work and have made very few changes. So far, we have found it to be the better practice to regrade our matte, giving to the converters nothing less than 20 to 25 per cent. Cu matte. Everything is in good working condition.

"We commenced operations as a pyritic plant, using low coke and very little flux, No. 1 ore being used as a base to melt No. 2 ore. We have been trying to make a converter grade of matte in the first operation. The ores have not come to us as free from inert material, such as dyke and schist, as we could wish. They have been more or less erratic as to the silica contents from day to day, and the tendency in both ores is to higher silica and alumina. This fact, coupled with the shipments of about 100 tons of foreign ore per day, has made it hard to operate the furnaces as originally intended, and the coke and flux percentages have risen to some extent. With the greater development of our own ore-bodies, and with the better storage facilities at the mine and smelter, this condition should be materially helped. The making of converter grade of matte in the first smelting, we believe, will eventually be accomplished.

"With No. 4 furnace in operation, the agglomerator handling our converter slag and matte cheaper, thus giving us a greater recovery per ton of ore, owing to its handling the flue-dust;

with a fuller understanding of our problems, longer campaigns of the furnaces, and with the labour-saving installations mentioned above, we should and will make a decrease in our costs during the coming year.

"Last year's record, we believe, we will beat this winter, even if identical conditions prevail, as we know better what to expect. With an earlier start in the shipping matte to Grand Forks in order to conserve our water-supply, and with steadier campaigns, we should show better results. February is the worst period during the low water season.

"*Grand Forks Smelter.*

"It will be noted that in the furnace operations the plant was completely shut down for 122 total days. We were enabled to commence operating four furnaces about the first of January, 1915, six in February and March, seven in April, and in May we were able to operate on an eight-furnace basis.

"We smelted 617,544 tons of ore and 648,751 tons of charge.

"With this irregular running and small tonnage, the smelting and converting costs were the lowest in the history of the plant in the face of the high siliceous ores handled and the very high siliceous slags made. The per pound cost of copper is high on account of the low-grade ore handled.

"A great deal of credit is due Mr. Bishop and staff subordinate to him for this remarkable showing. The results go to show that very close attention has been given to detail.

"Under an eight-furnace operation the total pay-roll is 200 men. This means that 16.6 tons of ore were handled per man.

"The plant is in good repair. There are some improvements which we would like to make, but we do not feel justified in asking for them at this time or in spending much money on the plant.

"SUPERINTENDENT'S ANNUAL REPORT ON THE ANYOX SMELTER.

(A. J. Bone.)

"In the year ending June 30th, 1915, considerable advance was made in the metallurgy of *Hidden Creek* ores at the Anyox smelter. Each month almost without exception showed a natural improvement over the one preceding. We acquired a more extended acquaintance and experience with the ores; the workmen have grown more proficient; and, for the most part, what mechanical difficulties were presented have been overcome. At the conclusion of the year, and barely 15½ months since the original start was made, it is apparent from all angles that we are approaching that condition of smooth, steady running which characterizes operations of long-established plants.

"The ores smelted covered a wide range in analysis, from low silica, low alumina, requiring quartz and little coke to smelt, to the other extreme of high silica, high alumina, taking a basic flux and higher coke. Of late the tendency has been toward higher silica content. We are also receiving about 100 tons daily of siliceous custom ore. The result of these conditions is to curtail the use of quartz in the blast-furnaces and increase the consumption of lime rock and basic '*Mamie* ore,' and consequently the percentage of coke.

"It may be suggested that, as our slag is comparatively low in silica, the obvious remedy for increased silica in the ore would be to make slags higher in silica. In this connection it should be remembered that the bulk of the iron which enters the slag is oxidized in the furnace and combines with silica in conformity with the principle underlying slag formation in pyritic smelting—namely, that the temperature prevailing in the focus determines the particular ferrous silicate which results. Working along natural lines, our endeavour would be to make *more* slag in the furnace—not to alter its character. In other words, by obtaining a greater degree of oxidation, more ferrous oxide will be furnished to slag silica, and at the same time make less matte, but of higher grade.

"During the last quarter of the year, the first matte, when too low grade, has been resmelted with siliceous ore and brought up to 20 to 25 per cent. Even this grade can be considered low as converter mattes go, but with it the converter department can produce at the rate of 3,000,000 lb. per month with ease.

"One of our chief concerns is to make matte of suitable converter grade in the first smelting, and, though no permanent success in doing this can yet be recorded, it is not improbable that efforts in this direction will be successful.

"Recently the system of feeding the furnaces was improved through the adoption of Anaconda type charge-cars. These permit a more favourable placing of the charge, the advantage of which was immediately reflected in a marked decrease in crust formation. Incrustation in the upper part of the furnace-shaft has been responsible for terminating fully 90 per cent. of the campaigns. These for the year were very brief, averaging only 13.6 days, but with the new cars longer campaigns are the rule. A saving of labour on the feed-floor was also made possible by the new cars.

"The prolific fall of low-grade, corrosive matte imposes a duty on furnace connections and settlers probably without precedent in the practice of copper-smelting. Means to cope with this condition have been devised, and the furnaces are no longer subject to the frequent interruptions by purely mechanical mishaps which proved so embarrassing in the past.

"In the converter department new steel silica-bins were built and so located as to permit feeding silica to the converters without resorting to the use of cranes.

"The capacity of the cranes was raised from 20 to 40 tons by the installation of heavier carriages.

"The sampler has given no trouble and continues to operate satisfactorily.

"Credit is due the foreman, shiftbosses, and other subordinates for their loyalty and tireless efforts to make the plant a success.

"SUPERINTENDENT'S ANNUAL REPORT ON THE GRAND FORKS SMELTER.

(W. B. Bishop.)

"Blast-furnace Department.

"The furnace operations for the year were as follows:—

In July, 1914	8 furnaces.
In August, 1914	1 furnace for 1 day.
	8 furnaces for 6 days.

"Owing to the European situation and copper market, smelting was suspended August 7th, 1914, and resumed December 7th, 1914.

In December, 1914	2 furnaces for 5 days.
	3 furnaces for 11 days.
	4 furnaces for 4 days.
In January, 1915	4 furnaces.
In February, 1915	5.5 furnaces.
In March, 1915	5.61 furnaces.
In April, 1915	6.7 furnaces.
In May, 1915	7.55 furnaces.
In June, 1915	8 furnaces.

"The Furnace Department smelted:—

Granby ore	611,007 tons.
Foreign ore	6,537 "
Anyox matte	6,359 "
Converter slag and matte	23,326 "
Flue-dust	1,522 "

"The average percentage of coke used per ton of ore, 13.17 per cent.

"The average smelting cost for the year was $1,187 per ton, as against $1,217 for 1914, and $1,214 for 1913.

"There has been no new construction during the year, but repairs have been kept up and the plant is in first-class operating condition. Our costs are lower this year than any of the years past.

"Railroads handled all materials satisfactorily.

"There was no difficulty with labour.

"SUPERINTENDENT'S ANNUAL REPORT ON PHOENIX MINES.

(C. M. Campbell.)

"All work was stopped immediately following the declaration of war. Though the mine was reopened early in December, it was the latter part of May before shipments reached the eight-furnace basis.

"*Shipments.*

"These amounted to 610,998 tons. The following table shows an analysis of the ore shipments to date:—

	Above No. 3 Tunnel.	Victoria Shaft.	Gold Drop.	Totals.
Prior to July 1st, 1914	5,759,823	3,412,277	1,268,737	10,440,837
Year ending June 30th, 1915	122,645	387,490	100,863	610,998
Total to date	5,882,468	3,799,767	1,369,600	11,051,835

"*Development-work.*

"Totals for the different mines for the year and the totals to date are as follows:—

	Sinking.	Raising.	Drifting.	Total.
Gold Drop	..	1,693	1,073	2,766
Ironsides	10	3,471	2,174	5,655
Total for year	10	5,164	3,247	8,421
Total to date	2,497	51,259	76,160	129,916

"Diamond-drilling for the year amounted to 5,416 feet, and the total to date is now 101,228 feet.

"*Costs.*

"The average cost per ton, crushed, on cars, including all development, was 85.1 cents. This also includes the cost of the disposal of 77,329 tons of waste. Difficulties in starting up after the shut-down, higher prices for supplies, increased wages due to high price of copper, and less favourable mining conditions make this year's cost slightly higher than that of recent years.

"*Ore remaining and Grade.*

"On account of the high price of copper during the past few months we have shipped about 85,000 tons of ore, from which a recovery of about 10 lb. of copper and a correspondingly low amount of gold and silver has been obtained. This ore was from areas where drill-holes had shown the mineral zone to be too low grade to be included in the reserves. It also included sections which had to be mined, but which under ordinary conditions would have been handled as waste. The inclusion of this low-grade ore resulted in a reduction in the recovery of total ore shipped from 17 lb. to 16 lb. On the other hand, the ore reserves are increased by this amount. Development-work further increased the reserves by 66,872 tons, making a total increase of 151,872 tons. The present condition of the ore reserves is therefore as follows:—

	Gold Drop.	Ironsides.	Total.
Ore developed	1,431,000	13,853,240	15,284,240
Mine has produced and shipped	1,369,600	9,682,235	11,051,835
Remaining ore	61,400	4,171,005	4,232,405

"From this we estimate that a recovery of 17 lb. can be maintained. In addition to this, there is a considerable amount, perhaps half a million tons, of ore which will average about $^{7}/_{10}$ of 1 per cent. in copper and 40 cents in gold and silver.

"While the silver recovery has remained fairly constant, the gold recovery has increased about 10 cents per ton. This is due to the fact that when the mine was reopened in December the price of copper was low and development was directed towards those areas where better gold values were to be obtained.

"*Mining Operations.*

"With the declaration of war and the resulting low copper prices, all operations ceased early in August and the property remained shut down for four months.

"During the shut-down the No. 2 crusher, which handles the ore from No. 3 tunnel, was shipped to Anyox. There was little further need for this crusher. Nearly all the virgin ore on this level had been worked out, and as the caved ore and pillars remaining could be handled more cheaply and the waste sorted out better by the electric shovel, it was decided to wait until No. 2 level had been worked out and then remove the shovel to No. 3 level. Present indications, however, point to the *Gold Drop* being the first outlet to be worked out, and in that case the crusher from there may be the one to be moved.

"With the beginning of winter a considerable proportion of the resident population began to show signs of distress, and the company were induced to reopen in a small way with a reduced wage scale in force. With the improvement in the copper market, more outlets were reopened and more men put on. The loss of No. 3 tunnel ore was, however, a handicap, and to overcome this the mine was operated from February 21st to the end of the year without an hour's shut-down.

"*Electric Shovel.*

"The chief novelty during the year was the satisfactory operation of this new machinery purchased during the latter part of the previous period. Considering the large amount of waste to be handled, it is no easy task to get ore out at a cost that is attractive. However, during the past three months the ore from this level, considerably over half of which was from the shovel, cost about 75 cents per ton, crushed, in railroad-cars, while the cost per ton for handling all material, ore, and waste amounted to 40 cents per ton. Attention is now being directed towards improving the ore-cars and haulage facilities. Originally 5-ton side-dump cars were used exclusively. In order to dump large masses of waste, handled by the shovel with chains, side-dump cars in which the door automatically dropped were constructed. These cars have given a considerable amount of satisfaction and will be continued in use. An improvement, however, is a car which will hold close to 10 tons, with the automatic side-dump feature, but with the door so arranged that when open it will allow the passage of a rock 4 feet in diameter. One of these has already been built and . . . . . five more are under construction.

"*Wages.*

"During December wages were subject to a reduction of 25 per cent.; in January, 20 per cent.; and in February, 10 per cent. The total deductions from the pay-roll for these months amounted to $13,482. During March normal wages were paid. With 16-cent copper market in April employees received a 25-cent daily increase. During May and June, when copper averaged over 18 cents, the increase amounted to 50 cents per day. These three months, therefore, called for $16,052 in extra wages, or $2,210 more than the total deductions for December, January, and February.

"*Development.*

"Diamond-drilling was mainly responsible for the increase in the ore developed. Underground drifting also added a little. Usually, stoping operations can be depended upon to add to the tonnage of new ore, but during the past year it was a question if the excess of ore in some places was enough to offset the shortage of ore in other places. The work for the year, however, showed a net increase.

"A little work was also done on the *Bank of England* claim. The ore here is one of the foot-wall type similar to that encountered in drill-hole No. 420, referred to in last year's report. Possibly a car-load of ore may be obtained, but so far the ore taken out has been done at a loss, and unless there is an improvement work here will soon cease.

"*Gold Drop Mine.*

"Reference to the table on page 189 shows that the total ore that has been developed on this property amounts to 1,431,000 tons, but of this there is only 61,400 tons remaining. It is

improbable that much more will be opened up, as the entire ground has been pretty thoroughly prospected. We are now able to say that the stoping loss at this property will be very small, probably about 15,000 tons, or 1 per cent. This almost complete recovery can be explained by the fact that most of the ore-bodies have been small or medium-sized, and the entire tonnage could be extracted by leaving very few or no pillars. The largest ore-body, which, not considering the offshoots, contained over 400,000 tons in one central mass, was almost completely extracted. While being mined, pillars were left which were finally blasted. The broken rock was drawn clean, and almost completely. Owing to the good roof the stope remained open for several months before it caved.

"During the past year the *Snowshoe* claim has been drawn on heavily for ore. A little ore left there and on the *Curlew* and part of ore bodies 5, 9, and 12 on the *Monarch* represent the localities where the remnant of ore left is to be found.

"SUPERINTENDENT'S ANNUAL REPORT ON ANYOX MINES.

(H. J. C. MacDonald.)

"The past year is the first in which the mine has been entirely upon a shipping basis. Some changes, some additions have been necessary, but on the whole the installation has demonstrated that it is well designed for the cheap handling of rock. The year has been one of progression towards smoother operation and lower costs. As the number and sizes of our stopes increased, the amount of powder and labour to break the ore has decreased. As the demands for ore increased, our handling and general charges have shown a corresponding drop. The end of the year finds us in a position to greatly increase our output and to deliver it at a lower cost per ton.

"The shipments totalled 477,435 dry tons of ore. Of this amount, 314,043 tons were from the heavy sulphide No. 1 ore-body, and 163,392 tons were from the more siliceous No. 2 ore-body. The tonnage of ore from the two bodies demanded by the smelter became, towards the end of the year, practically equal, proving that these bodies can be smelted in their developed tonnage proportions. This adds distinctly to the value of the mine.

"The copper content in the ore has been 2.18 per cent., with a gold and silver content valued at 34 cents per ton. The monthly ore shipments during the entire year have analysed higher in iron and sulphur, lower in silica and alumina than the average estimated for the ore-bodies.

"The mining costs for the twelve months have been $1.03 per dry ton landed in the cars on the railroad to the smelter. This amount includes the handling of 29,310 tons of waste and a development charge of 10 cents per ton. The period has been one in which we have absorbed many charges which would more exactly belong to equipment and capital accounts. The wages paid to employees have been increased in proportion to the market price of copper. This has amounted to 50 cents per man shift, or 7 cents a ton, for the last two months. The costs for the last six months, exclusive of this bonus, have been 89 cents per ton. Basing our estimate upon the actual conditions and upon the results obtained during the year, with wages and supplies at the level they have averaged during the past three years, future mining costs of 81 cents a ton are attainable upon the completion of some improvements now in process of being introduced.

"The further exploration of the mineral area by diamond-drilling in and surrounding the mine was not attempted during the year. The ore reserves, with the deductions of shipments, remain at practically the same figures as reported for the previous year. To the reserves of the *Hidden Creek* mine should be added at this time the developed tonnage at the *Bonanza* mine. The latter mine is also in the immediate vicinity of the smelter and can be handled under the same organization. The following is, then, a summary of our ore reserves tributary to the smelter at Anyox:—

	High Grade.		Low Grade.		Total.	
Hidden Creek	9,205,837	2.17	8,628,000	0.63	17,833,837	1.43
Bonanza	414,775	2.66	489,580	0.70	904,355	1.60
Totals	9,620,612	2.19	9,117,580	0.63	18,738,192	1.45

"The development-work has consisted of 1,204 feet of drifting and crosscutting, with 1,732 feet of raising, a total of 2,936 lineal feet. The greater part of the work was done on the 385 level in the further blocking-out of the No. 1 ore-body on this plane. Two new ore-passes, one having a capacity of 5,000 tons of broken rock, were driven between the 385 and 530 levels and were among the important pieces of development. Sufficient work was done to make the No. 4 ore-body, which is the heaviest sulphide ore-body in the mine and valuable as a flux at the smelter, available for shipment. The development-work in many cases, especially in the No. 1 ore-body, encountered ore of higher grade than would be expected from our previous exploration.

"Considerable construction was completed, including a new bunk-house, additional cottages, and a substantial electric sub-station. There is at the present time in process of erection a second crusher-station and ore-bins, which will enable us to introduce a more economical system of crushing and shipping. This plant also makes possible a large additional storage of crushed ore. The storage is much needed in order to more closely approach the ideal condition of handling with our mine haulage a fixed number of tons a day. We are now mining and shipping at the rate of 2,000 tons a day, which is our designed output. This we expect to increase to average 3,000 tons a day upon the blowing-in of the recently added fourth smelting-furnace.

"There has been a gain during the year in the personnel of the employees and in their efficiency in their places. Due credit should be given to all for their interest in the work, through which we have been able to successfully meet many unusual conditions.

"Ore Shipments.

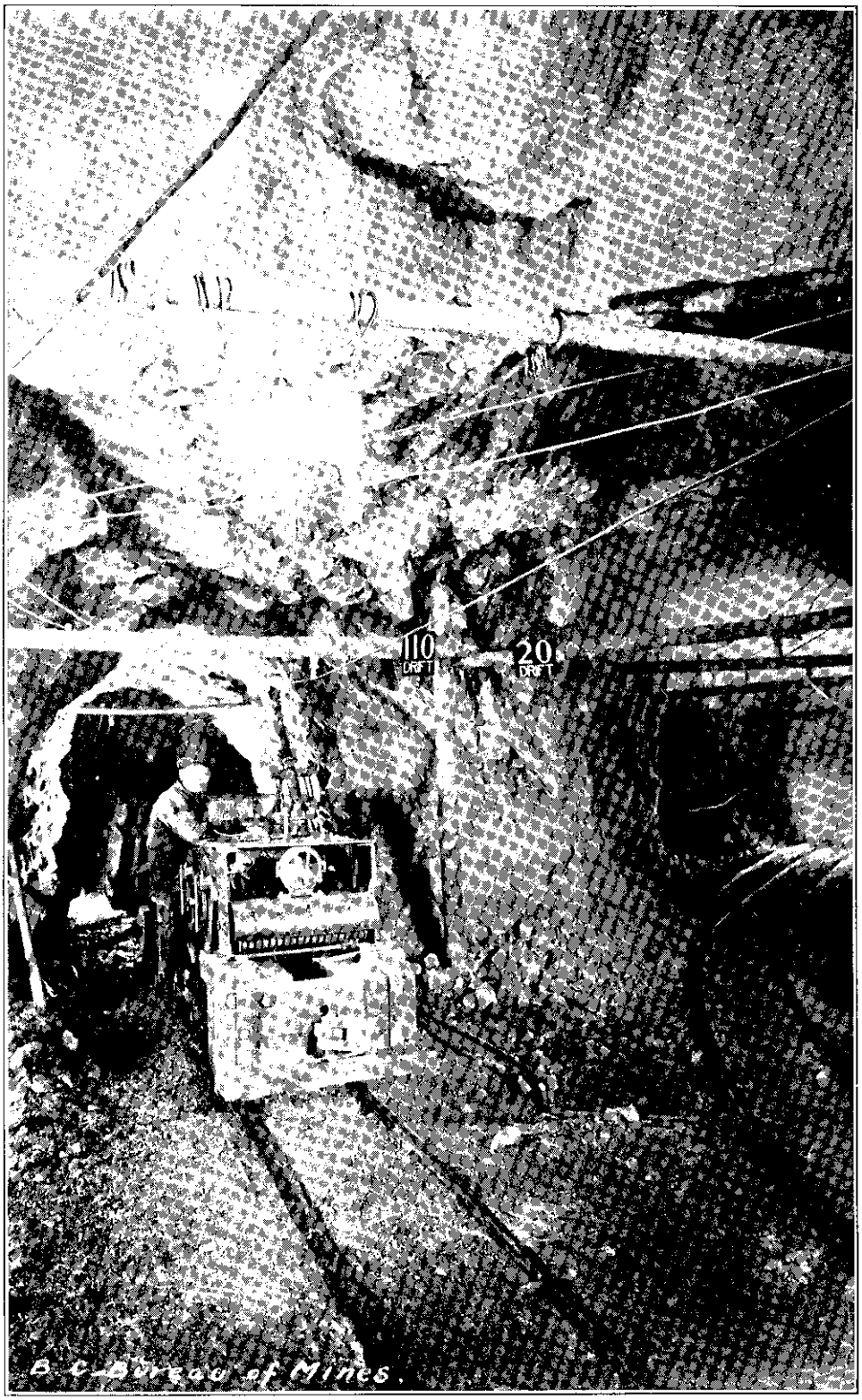
"The daily shipments have been very irregular in their bulk, through depending on two uncertain factors which controlled the ore demands. These were the metallurgical difficulties in smelting and shortage of power. The former were continually being eliminated, while the latter is a seasonable factor during the winter months that is still to be encountered. To control erratic shipments there was not ample storage capacity between the mine and the smelter to give either protection. The mine difficulties of an internal nature, as crusher troubles for example, have not at any time prevented the shipment of sufficient ore to keep the furnace in blast.

"The amount of ore drawn from each mine-chute is tabulated on the daily reports. In this manner the amount of ore drawn from the different ore-bodies, and portions of the bodies, is at all times under supervision. The character of the shipments can be determined and controlled as much as it is possible in the system of mining employed.

"Of the ore shipped, 66 per cent. was from the No. 1 ore-body, 34 per cent. was from the No. 2 ore-body, while no shipments of any amount were made from the No. 3 and No. 4 ore-bodies, although they are developed for shipment. The No. 1 ore was mined mainly above the 530 level, 77 per cent. of the ore coming from here, while 23 per cent. was mined between the 385 and 530 levels. The No. 2 ore was mined mainly from the 530 and 700 levels; 40 per cent. coming from above the 700 level, 14 per cent. from between the 630 and 700 levels, 38 per cent. from between the 530 and 630, while 8 per cent. came from below the 530 level.

"The smelter asked for further classification of the ore during the year. This involved the screening of the fines from the ore; the selection of the heaviest sulphides from the No. 1 ore-body; the shipment of siliceous material from the hanging-wall of this body, of sacked granular pyrite, and of clean pyrrhotite. The two latter came from the surface of the mine hill. These special lots and demands necessitated further outlays in construction, development, alteration, and operation to make possible their shipment. They have been discontinued for several months. The ore now shipped is nearer the run of the mine ore in equal proportions from the main ore-bodies.

"The content of the ore in copper, lime, and magnesia is very close to the estimated normal. Ore of a low siliceous and heavy sulphide nature has been in demand. We have been able to supply No. 1 ore averaging 4.6 per cent. and No. 2 ore averaging 6.3 per cent. under the estimate in silica, with the sulphur and iron content high and the alumina content low in percentage. This has come through being able to stope in the centre of the bodies rather than along the walls. This condition cannot be regarded as being capable of being maintained in the future, if full advantage is to be taken of the full tonnage of the mine.



Main Haulage-way, Granby Co.'s Mine, Phoenix.

"*Mining Costs.*

"The following analysis of our costs for the past year is made in order to use the data on the basis for the estimation of future mining costs. The discussion embraces and throws into strong relief the organization, equipment, and operation of the mine. Errors of judgment in these things may be noted; some may be explained by local conditions; some may be unexplainable, and, if brought to our attention, will add greatly to the value of this analysis. The estimate of costs attempted is for a cost per ton on shipments of 2,000 tons a day, which will be the average for the next five years. The constants taken are the price of labour below 16 cent. copper and the average price of supplies for the past three years.

"The year used as a basis—July 1st, 1914, to July 1st, 1915—is taken because it is the only year we have available, otherwise it would be avoided as containing all the elements that combine to make fluctuating costs. The economical production of a fixed, or nearly fixed, number of tons a day was impossible, as we were throughout the year called upon for shipments of widely irregular amounts, depending on the metallurgical difficulties of the smelter, with, during the winter months, the added hindrance of shortage of power. The effect of these elements, from their inherent nature, could not be judged beforehand. Given the uncertain demands, lack of storage between mine and smelter, and lack of broken ore in the mine, it was necessary to have available at all times a sufficient number of miners to fulfill maximum requirements. This labour, when their actual work was not required to mine ore to be shipped, was used in greater part on the development-work. This cost added to our cost a ton. The labour and explosives required in breaking ore was much greater the first of the year, as we were confined to working in small stopes where a large amount of rock could not be broken per foot of drill-hole and stick of dynamite. The fitting of the least number of men into the right places and the finding and training of men capable and dependable in their positions was of some extra expense, as is usual in the starting of all new operations. The equipment having to be changed, altered, or added to in places, burdened us with charges which should have more properly gone into the capital account. The extreme irregularities disappeared in the first three or four months and most of the others had entirely disappeared in the latter months. The year shows, when carefully examined, a progressive lowering in the amount of labour and supplies needed to mine a ton of ore. While in this period the items that compose the costs per ton fluctuated within fairly wide limits, a close study of them and the causes of their fluctuation gives a reasonable basis upon which to base an estimate of future costs.

"The average costs at the Phoenix mines of the Granby Company for the past five years have been carefully compared with the Hidden Creek costs, taking into regard the numerous differences in segregation. The mines in many points are similar, as the same system of mining is used with the same class of labour. The *Hidden Creek* mine will always require more labour to drill and more explosives to break the ores. Balancing this, the *Hidden Creek* mine has one outlet as against four at Phoenix, gaining, through its compactness, in the amount of supervision and fixed charges required. At Hidden creek the greater part of the development was completed before the shipping commenced, allowing the use of better-planned development, with the result that the future charges for development against the ore will be less. All the items at the two mines are comparable when certain facts are taken into consideration.

"*Smelter Train-loading.*

"With the alterations of the shipping terminal and the building of the second crusher-station completed, there will be an ore storage of 6,000 tons above the shipping-tunnel. The shipments of ore will thereby be severed from their dependency on the crushing and mine haulage. The train-loading, which now takes two shifts, can be done on one shift by a loader and two helpers. This takes for granted the supply of a sufficient number of railroad-cars.

"*Electric Haulage.*

"The haulage throughout the mine is accomplished in self-dumping steel cars of 3.7 tons capacity, hauled by 6-ton locomotives. The locomotives carry head-lights of unusual capacity as an aid to the safety of the men and to the ease and safety of the haulage. The switches on the main lines are protected by coloured switch-lights. This account does not vary directly as to the tonnage, as a variation in the tonnage may signify a train which is not working at its full efficiency.

"*Track.*

"A uniform gauge of 2 feet, laid with 30-lb. rail, is used in all the tunnels and drifts.

"*Car Maintenance.*

"There has been considerable alteration and repair work on the cars in excess of that expected in the daily haulage. The maintenance on cars of this type for the duty they will have on our main haulage-tunnels (especially if the tonnage is increased) will be severe.

"*Crushing.*

"In the first two months of the year ore was crushed and belt-conveyed to the shipping-pockets. The next month began to develop conveyor troubles, and two breaks occurred through inferior steel in the sectionalized Traylor crusher. The second break was serious enough in its effect to leave the plant without a crusher in the next four months. In this time, 169,000 tons of ore were broken by block-holding, bulldozing, and sledging on 90-lb. rail grizzlies having 14-inch spaces. The crusher was restarted in February with the belt-conveying of ore entirely eliminated.

"*Timbering.*

"The only timber utilized in the mine is that used in the construction of chutes on the sill floors. These chutes are substantially built in the rock collar of the raises to withstand bulldozing at the gates without essential damage. Where expected to withstand exceptionally heavy duty, the chutes are lined with steel plates, and an iron finger-gate operated by an air-lift is used instead of the usual type arc-gate. Three hundred and fifty-nine chutes have been repaired during the year and eleven new chutes built. The size of the timber crew has to be sufficient to undertake at any time the maximum repair-work. It is possible to keep enough work ahead in chute-building and trestle-work so that the crew has work blocked out in advance.

"*Mine Expense.*

"The introduction of carbide-lamps to replace candles has resulted in a considerable saving in lighting. Each man furnished his own lamp, while the company furnishes the carbide.

"The mine is electrically lighted on all main haulage-ways.

"*Development.*

"The development-work consisted of 1,204 feet of drifting and crosscutting, with 1,732 feet of raising and sinking, a total of 2,936 feet. About half of this work was done on the 385 level in continuing the blocking-out of the No. 1 ore-body. Two pocket raises were driven between the 385 and 530 levels, one in each of the two ore-bodies. The raise in the No. 2 ore-body greatly improved the ventilation throughout the 385 level. The No. 4 ore-body was developed by driving the 700-foot adit beneath the body and raising until it was encountered. The year completes the greater part of the development-work needed on the ore above the 385 level.

"*Estimate of Ore Reserves.*

"Our estimates given on July 1st, 1914, were very carefully checked during the year by two mining engineers, C. M. Weld and F. B. Weekes. The latter gentleman has also checked the estimates on a former occasion. They obtained at the *Hidden Creek* mine a tonnage of 8,992,275 tons of 2.14-per-cent. ore in comparison with our estimate of 9,563,500 tons of 2.17-per-cent. ore. This can be considered, under the conditions, a close agreement. We still consider our estimate, on account of close association with the development of the ore-bodies, as nearer the exact tonnage. Their sampling in the mine arrived at very close figures to those we had obtained at the same points.

"The results which they obtained on *Bonanza* were to estimate practically the same tonnage, while reducing the copper content from 2.78 to 2.30 per cent. This was done by the inclusion of waste rock in the form of dykes, which we had omitted in our calculations. These dykes form here about 12 per cent. of the bulk of the developed ore-body. Taking into account their highly siliceous and aluminous character, it will be doubtful if they can be smelted with the ore. They will have to be sorted from the ore either in the mining or by selection outside the mine. Therefore, in this case we also believe the more exact of the two estimates to be the one made at this office.

"The ore estimates remain practically at the same figure this year as last, as no endeavour has been made in the interval to put more ore in sight.

"*Bonanza.*

"The value of the *Bonanza* mine as an addition to the reserves of the *Hidden Creek* mine, tributary to the smelter at Anyox, has not been sufficiently emphasized in the former reports. This group of claims is located on Bonanza creek, which flows into Granby bay about two miles from the company's dock. The claims lie in the creek-valley three-quarters of a mile from the mouth. The distance from the ore-body to the smelter in a direct line is 10,000 feet; in a line following Bonanza creek to the mouth and from there to the smelter, 14,000 feet. The method of haulage adopted, whether aerial, tram, or railroad, will vary the distance the ore will have to be carried to the smelter between the above limits."

BRITISH COLUMBIA COPPER COMPANY, NEW YORK CITY, U.S.A., AND GREENWOOD, B.C.

The British Columbia Copper Company ceased smelting and mining operations in this district at the outbreak of war and did not recommence until June, 1915, when one furnace at the smelter was blown in and continued in operation until the end of the year. In the spring of 1916 a second furnace was also started. This company is now controlled by the Canada Copper Corporation, Limited, which is, in effect, a holding company, while the old company continues as the operating company. In explanation of this arrangement, it may be said that a few years ago, when the British Columbia Copper Company realized that the ore-bodies at the *Mother Lode* and *Rawhide* (the main source of supply for the smelter) were becoming exhausted, a number of other properties were bonded, the chief of which were the Copper Mountain claims near Princeton. The expenditure on development and purchase of these properties after a time became so heavy that the British Columbia Copper Company was unable to carry on the financing until the properties would be at a productive stage. The Canada Copper Corporation was then formed, which advanced the necessary funds to the British Columbia Copper Company and secured in return something like a first mortgage on the assets of that company. Shareholders in the old company were asked to subscribe to the new company, and many of them did. The Canada Copper Corporation is sufficiently strong financially to carry through to completion the plans for equipping the Copper Mountain properties with the necessary mill, power plant, and other adjuncts.

The fiscal year of both these companies ends with the calendar year on December 31st, and annual reports covering the year's operations are issued by each company. It is considered that the affairs of these companies are of such general interest as to warrant the inclusion here of lengthy extracts from the annual reports for the year ended December 31st, 1915, as follows:—

"REPORT OF PRESIDENT.

(Lucius W. Mayer.)

"Your Board of Directors herewith submit auditors' certified balance-sheet and Profit and Loss Account for the fiscal year ended December 31st, 1915.

"Due to the unsettled condition of business and particularly the copper market during the early months of the year under review, the company's smelter at Greenwood remained idle.

"It was decided in July last to place one of the company's furnaces in operation, and the total amount of ore smelted during the period was 122,514 tons, dry weight, and consisted of:—

Company's ores ..... 115,140 tons, dry weight.
Custom ores ..... 7,374 „ „ „

"The Profit and Loss Account shows a profit from operations during the five months of $66,033.87, from which is deducted general expense incurred during the non-operating period of $23,378.49 and amount payable under power contract with the South Kootenay Water Company of $67,572.20, making a total of $90,951.59, thus showing a deficit for the year of $24,917.72.

"Of the above-mentioned $67,572.20 charged under power contract, $27,957.25 was incurred during the year 1914, but, as it was not definitely known at that time whether the company would be called upon to meet this liability, it was therefore not charged against the operations of that year. Had this amount been taken care of during the year 1914, the accounts for 1915 would have shown a profit of $3,039.53. The smelter at the present time is being operated at a satisfactory profit.

"The known ore remaining in the mines is limited in extent and of low grade. With existing high prices for copper, it is anticipated that smelting operations can be profitably continued for approximately five months. In the meantime, exploration for new ore is being carried on and efforts are being made to further develop the custom-ore business.

"Since the first of the year negotiations for the disposal of the *Emma* mine, one of the company's properties, have been concluded, resulting in a sale of the property for the sum of $55,000.

"A year ago a revaluation of all the company's properties was made, and reports and surveys of the engineers, on which the revaluation was based, show that the book value at that time was smaller than their intrinsic worth, and, as the value of the ore in sight on Copper mountain had materially increased, there was every justification for making a revaluation and rearrangement of the book value of all the company's properties, hence the book value of the Copper mountain property was increased $1,100,000, making the total on December 31st, 1915, $3,285,551.32, while there was set aside to provide for depreciation of Greenwood properties the sum of $1,100,000, showing balance on same date for that account of $272,014.01, or a grand total for property of $3,557,565.33, as shown in balance-sheet.

"The company's engineers estimate as of December 31st, 1915, that there are on Copper mountain 9,075,000 tons of reasonably assured ore and 2,000,000 tons of probable ore, making a total of 11,075,000 tons, the grade of both classes of ore being 1.75 per cent. copper and 20 cents recoverable values in gold and silver.

"As will be noted from the balance-sheet, there has been borrowed to date from the Canada Copper Corporation, Limited, $460,000.

"BALANCE-SHEET AS AT DECEMBER 31ST, 1915.

"*Liabilities*—		
Capital stock—		
Authorized, $3,000,000 in 600,000 shares of $5 each.		
Issued, 596,709 shares of $5 each.		
Less 5,000 shares of $5 each in treasury.		
591,709 shares of $5 each		$2,958,545 00
Accounts payable		277,597 29
Loans and advances from banks		99,894 28
Canada Copper Corporation, Limited (Non-Personal Liability)—		
Amount advanced to date under the terms of a mortgage agreement dated July 1st, 1914		460,000 00
Reserve for sundry liabilities	$2,227 55	
Reserve for employers' liability	6,518 44	
		8,745 99
		$3,804,782 56
"*Assets*—		
Properties, including smelter site and plant, mines and mining equipment, and shares and bonds in other companies at valuation. (Subject to mortgage agreement of Canada Copper Corporation, Limited, Non-Personal Liability)		$3,557,565 33
Metals and smelter products, supplies, etc., as per certified inventories		116,626 55
Copper on hand and shipments in transit to refiners		92,581 01
Prepaid insurance and taxes		4,572 48
Sundry debtors—open account		14,273 72
Cash on hand and in banks		17,776 20
Deficit—		
Surplus—Balance at credit as at December 31st, 1914	$23,530 45	
Less loss on operations as shown in statement	24,917 72	
		1,387 27
		$3,804,782 56

"PROFIT AND LOSS ACCOUNT FOR THE YEAR ENDED DECEMBER 31ST, 1915.

"To Operating disbursements: Mining, smelting, freight, refining, and selling charges, general office and administration expenses	$366,172 38	
Custom ore purchased	36,218 02	
"By Proceeds of metal shipments, including those unsettled for at December 31st, 1915		$466,599 50
Miscellaneous earnings		1,824 77
"To Balance carried down, being profit for the period the plant was in operation	66,033 87	
	$468,424 27	$468,424 27
"By Balance brought down		$66,033 87
"To General expenses, and minimum power charges during the time the plant was shut down	$90,951 59	
"By Balance, being loss for the year		24,917 72
	$90,951 59	$90,951 59"

CANADA COPPER CORPORATION, LIMITED (NON-PERSONAL LIABILITY).

"REPORT OF PRESIDENT.

(Lucius W. Mayer.)

"Herewith is submitted the annual report of your company for the year ended December 31st, 1915. The report of Oscar Lachmund, general manager, is incorporated herein and discusses fully the operations of the smelter at Greenwood, B.C., which were resumed in July after a protracted period of idleness. The report also deals with the development-work on the company's Copper Mountain property, where diamond-drilling was continued throughout the year.

"The balance-sheet of the Canada Copper Corporation and also the balance-sheet and Profit and Loss Account of the operating company, The British Columbia Copper Company, Limited, are presented herewith, the accounts of the latter having been audited by Messrs. Riddell, Stead, Hodges & Winter, chartered accountants.

"The Profit and Loss Account shows a profit from operations during the five months of $66,033.87, from which is deducted general expense incurred during the non-operating period, amounting to $23,378.49, and amount payable under power contract with the South Kootenay Water Power Company of $67,572.20, making a total of $90,951.59, thus showing a deficit for the year of $24,917.72.

"Of the above-mentioned $67,572.20 charged under power contract, $27,957.25 of this sum was incurred during the year 1914, but, as it was not definitely known at that time whether the company would be called upon to meet this liability, it was therefore not charged against the operations of that year. Had this amount been taken care of during the year 1914, the accounts for 1915 would have shown a profit of $3,039.53. The smelter is at this writing being operated at a satisfactory profit.

"Since the first of the year negotiations for the sale of the *Emma* mine, one of the company's outlying properties, have been concluded, and the property has been sold for the sum of $55,000.

"A year ago a revaluation was made of all the company's properties, and the reports and surveys of the engineers on which this revaluation was based shows that the book value at that time was less than their intrinsic worth.

"The ore in sight at Copper Mountain had been largely increased, and therefore there was every justification for making a revaluation and a rearrangement of the book value of all the company's properties. Pursuant to this, the book value of the Copper Mountain properties was increased by $1,100,000, making the total on December 31st, 1915, $3,285,551.32, while there was set aside to provide for depreciation of Greenwood properties the sum of $1,100,000, showing balance on same date for that account of $272,014.01, or a grand total for property of $3,557,565.33, as shown in balance-sheet.

"The exhaustion of the ore-deposits adjacent to Greenwood was foreseen some years ago when options were secured on the Copper Mountain properties, and satisfactory progress has been made in developing ore at the latter point. As of December 31st, 1914, there had been disclosed 6,200,000 tons of reasonably assured and probable ore averaging 1.82 per cent. copper, and, in addition to this, some 750,000 tons of 1.54 per cent. copper.

"As of December 31st, 1915, it is estimated that there are 9,075,000 tons of reasonably assured ore and 2,000,000 tons of probable ore of an average grade of 1.75 per cent. copper and 20 cents recoverable values in gold and silver, the average value of both classes being the same. It will therefore be seen that the estimate for assured and probable ore reserves has been increased approximately 60 per cent. within the year.

"In connection with the programme for installing the proposed concentrating plant at Copper mountain, it has been decided to proceed forthwith with an underground development campaign which will not only serve to confirm the diamond-drilling already done, but will also be of a permanent character looking to the eventual extraction of the ores. A tunnel will be started of sufficient size to handle a large tonnage and at an elevation which will serve the upper horizon of ore. The shaft on the *Sunset* claim will be sunk to a sufficient depth to connect with this tunnel, and, in addition, drifts and crosscuts will be run to block out the ore.

"Steps have already been taken looking to the purchase of the necessary equipment to proceed with this work, and it is anticipated that the tunnel, which will have a length of approximately 2,000 feet, will be completed in less than six months from date of commencement and will be started as soon as the equipment can be installed. To cover the expense of this work, arrangements have been concluded with bankers whereby the sum of $400,000 is available for the purpose, this money being borrowed by the Canada Copper Corporation, Limited, for a period of two years, bearing 6 per cent. interest. In order that financial arrangements could be made, it became necessary to retire, as far as possible, the company's outstanding debentures, and upwards of 87½ per cent. of the $600,000 original issue has thus far been converted into stock under the plan as set forth in the circular mailed to debenture-holders bearing date November 16th, 1915.

"Attention is called to the loyal and energetic action of the operating force in working out the problems which have arisen during the year, for which the directors take this opportunity of expressing their appreciation.

"REPORT OF GENERAL MANAGER.

(Oscar Lachmund.)

"The following is a report on the operations and conditions of the properties of the Canada Copper Corporation, Limited (Non-Personal Liability), and the British Columbia Copper Company, Limited, for the year ended December 31st, 1915.

"The mines and smelting plant were inoperative during the first six months of the year. In June, preparation was made to partially resume mining and smelting operations, with the result that on July 26th, 1915, one furnace at the smelter was blown in. Since that time and until the end of the year both mining and smelting operations were carried on continuously.

"*Mother Lode Mine.*

"Work preparatory to resumption of operations was begun on June 15th, 1915. The lower levels were unwatered, tracks relaid, and trolly-wires replaced. The hoists were moved to the opposite side of the shaft, in order to recover certain pillars of ore beneath them.

"The ore shipments from this mine were 105,085 tons, dry weight.

"The average grade was: Gold, 0.037 oz.; silver, 0.21 oz.; copper, 0.8746 per cent.; silica, 28.5 per cent.; iron, 21.2 per cent.; lime, 17.7 per cent.; sulphur, 3.15 per cent.

"A rock fall from the hanging-wall in the 'quarry' cut off the ore-supply from that source for the time being, and most of the ore shipped was stoped underground from the territory south of the 'quarry.' Hand-sorting was used to a large extent to bring the ore up to a commercial grade.

"*Development.*—Drifting and raising was resumed to develop the ore-bodies, and during December some prospecting with diamond-drills was carried on. The development-work dis-

closed no new ore-bodies; drilling is being continued with the hope of finding new ore-bodies. The footage gained was as follows:—

Drifting, crosscutting, and enlarging drifts	433 feet.
Raising	666 "
Diamond-drilling	711 "

"*Costs.*—Operating expenses compare favourably with those of last year. The cost of new construction, also the expense of putting the mine in shape for production, has been charged to operating expense, bringing the cost per ton up to $0.8437 f.o.b. railroad-cars at the mine. The freight to the smelter was $0.1245 per ton, making a total of $0.9682 per ton of ore delivered at the smelter.

"*Ore Reserves.*—The amount of ore remaining in the *Mother Lode* mine is difficult of calculation. The ore having previously been mined by numerous methods, the workings now represent a series of honeycombs. The ore being taken from the shaft pillar under the old hoist foundations is rapidly becoming exhausted. The remaining available ore will be found in irregular bodies in a few floors and pillars, amounting in all to possibly 50,000 tons. In the quarry we have a large amount of material that is a mixture of ore and waste. Experiments have shown that this can be drawn and by hand-sorting be made to yield a profit at the present high price of copper. As long as the high prices prevail, it is fair to count on an additional 50,000 tons from the quarry, making the total ore reserve under present conditions 100,000 tons. This means a trifle over five months' operation unless new ore, at present unknown, is discovered.

"Last year's report placed the estimate at some 315,000 tons of ore likely to be available under favourable conditions. Work during the year under review necessarily changed this estimate, and it is not now considered likely that all this ore can be mined at a profit.

"*Lone Star Mine.*

"The ore shipped from this property amounted to 6,510 tons, dry weight, and was of the following grade: Gold, 0.032 oz. per ton; silver, 0.193 oz. per ton; copper, 2.60 per cent.

"Development-work consisted of 697 feet of drifting and raising.

"A sorting-belt was installed and 14 per cent. of the material passing over same was rejected as waste.

"The ore reserves are estimated at 170,000 tons of available and probable ore, with a good prospect of increasing this tonnage by further development-work.

"The average copper tenor of this ore is 1.60 per cent.

"*Napoleon Mine.*

"Preparations were made during December to place this mine in shape for early operations, the need for extra sulphide ore at the Greenwood smelter having arisen.

"No ore was shipped in 1915 from this mine, and the expense incurred in preparatory work will be charged against future shipments.

"*Queen Victoria Mine.*

"This mine was let under lease, and shipments to our smelter began in September.

"These amounted to 754 tons, dry weight, and averaged 0.0037 oz. gold; 0.77 oz. silver; 2.28 per cent. copper.

"*Emma Mine.*

"The *Emma* property has lain idle since fire destroyed the head-frame and hoisting plant in February, 1912. The ore is of such character as not to be desirable for smelting operations at Greenwood, and it was therefore decided to offer the property to parties in need of such ore. The mine was unwatered for the purpose of examination and negotiations are now under way to sell the property.

"*Smelting Operations.*

"Average metallurgical conditions were fair during the period of operation. A slightly reduced tonnage per furnace over former operations was obtained, due to running a more refractory charge than formerly. The supply of ore available only permitted the operation of one furnace.

"The total amount of ore smelted during the period under review was 122,514 tons, dry weight, and consisted of:—

Company ores	115,140	tons, dry weight.
Custom ores	7,374	„ „

"The coke used represented 14.44 per cent. of the total charge and averaged 22 per cent. in ash.

"The time of actual operation was 158 furnace-days and the actual amount of ore smelted per day per furnace was 775.4 tons. The work was performed by an average of 49.2 men per day, with an average wage of $3.48 per day.

"There were produced 1,850 tons of matte, averaging 48 per cent. copper per ton. The amount of slag made was 105,280 tons, containing 0.0043 oz. gold per ton; 0.072 oz. silver per ton, and 0.286 per cent. copper.

"The balance of the analysis was as follows: Silica, 38.5 per cent.; iron, 23.5 per cent.; lime, 20.5 per cent.

"The production of metals amounted to:—

Copper (fine)	1,734,385 lb.
Silver	23,002.62 oz.
Gold	5,417.0839 oz.

"*Copper Mountain.*

"Work at this property consisted principally of diamond-drilling and trenching. Extensive topographical surveys were made, with a view to outlining the installation of surface equipment, etc. Comprehensive glass models of the ore-bodies, as disclosed by trenching, drilling, and underground work, were constructed.

"Commercial ore was found at greater depths than heretofore, the drills having penetrated such bodies at 900 feet below the collar of the *Sunset* shaft. This divides the known ore-zones into two horizons, one above a line approximately 3,900 feet above sea-level, or to an average depth of approximately 300 feet below the surface, and the bulk of the remaining ore extends from the 3,900-foot elevation to 3,600 feet elevation, or approximately to an average depth of 600 feet below the surface.

"It is intended to mine the upper ore-bodies by 'open-cast' or 'glory-hole' methods, while the lower ore will probably be extracted by stoping methods similar to those in operation in the Greenwood district and by modified forms of the 'shrinkage system.' From the shape and location of the ore occurrence as at present outlined by the drills, the two 'zones' are of about equal tonnage, although future development-work may change this ratio.

"The ore as developed to date is divided into two groups—one, the main ore occurrence, found along the strike of a system of intrusive dikes, principally on the *Sunset*, *Vancouver*, and *Gardner* claims, while the other group comprises ore-bodies found to one side or the other of the principal ore-zone. Future developments may establish a distinct connection between these bodies.

"For the sake of distinction, group No. 1 will be called the 'main ore-bodies' and group No. 2 the 'outlying ore-bodies.' The reasonably assured and probable ore reserves are estimated as of December 31st, 1915, as follows:—

"Reasonably assured ore—

Group No. 1, main ore-bodies	8,670,000	tons.	
Group No. 2, outlying ore-bodies	405,000	„	
Total			9,075,000 tons.

"Probable ore—

Group No. 1, main ore-bodies	1,735,000	tons.	
Group No. 2, outlying ore-bodies	265,000	„	
Total			2,000,000 tons.
Total ore, reasonably assured and probable.			11,075,000 tons.

"The average grade of the reasonably assured ore is estimated: Copper, 1.75 per cent.; gold and silver, 20 cents per ton (recoverable value).

"The average grade of the probable ore is estimated to be the same as that of the proven ore.

"*In Conclusion.*—Attention is called to the fact that the profits from the Greenwood smelting plant for the five months of operations are largely due to the extraordinarily high price of copper.

"On account of the rapid depletion of your company's ore reserves in the Greenwood district, the period of smelting activity is limited, unless a profitable custom-ore business can be developed or new ore found. The high price of the metals has stimulated the mining industry, and it is not unlikely that the market for custom ores will further improve during the coming year.

"It is due the operating staff to mention the efficiency and loyalty in which they have manifested their desire to assist in working out the problems that have arisen during the year, and your manager avails himself of this opportunity to acknowledge his appreciation of their efforts."

LONG LAKE CAMP.

At the *Jewel* gold-mine, situated in Long Lake camp, ten miles from Greenwood, mining and milling operations were conducted by the company until the middle of August. After that time some further work was done by lessees of the property. It is not known why the owning company—the Jewel-Denero Mines Company, Limited—ceased operations, and nothing has been heard in regard to plans for the future. The production for the year 1915 was 6,724 tons, containing 2,250 oz. gold and 9,725 oz. silver.

A number of small properties around Greenwood were worked in an intermittent manner by leasers. The most important of these were the *Skylark*, which shipped 153 tons; the *E.P.U.*, 100 tons, and the *Tipperary*, 62 tons.

WESTKETTLE RIVER.

The *Carmi* and *Sally* mines in this district were operated for a part of the year under lease and bond. At the former property 1,655 tons of ore was milled, which produced 662 oz. gold and 652 oz. silver. The latter property shipped to the Trail smelter 164 tons of ore, containing 24,311 oz. silver.

In the latter part of the year the Kettle Valley Railway from Princeton, Similkameen to Penticton, in the Okanagan valley, and thence to Midway, where it joins the Canadian Pacific Railway to Greenwood, Grand Forks, Trail, and Nelson, was operated on a regular three-times-a-week schedule, but the establishment of this means of regular communication with three places at each of which there is a smelter did not serve to stimulate ore production from mines and mineral claims situated in that part of the country through which the railway passes. However, it is expected that, now that an uninterrupted railway service is established, there will be more encouragement to owners of mining properties to get out ore, and that hereafter production will be greater than it was last year.

GRANBY RIVER.

While ore was mined at the *Union*, in Franklin camp, to an amount of 517 tons, there was, on the whole, less activity in that camp in 1915 than had been expected there would be. The Union group of mineral claims is described and illustrated in a bulletin, recently issued by this Bureau, entitled "The Mineral and other Resources of the North Fork of Kettle River."* Of the ore produced in 1915, about 400 tons was shipped to the Granby Company's smelting-works at Grand Forks and the remainder to the Consolidated Company's smelter at Trail. A good idea of the average value of the ore is conveyed in a report by the mine superintendent, in which it was shown that the average gold and silver contents of more than 200 tons of ore shipped to Grand Forks was 0.85 oz. gold and 45 oz. silver a ton. The cost of hauling twenty-five miles to the railway was $13.50 a ton, freight by rail to smelter was $1.50, and charge for smelting $6.75; total freight and treatment costs, $21.75 a ton, which is a rather heavy handicap on mining in Franklin camp. A car-load shipment was made to Trail from the *Maple Leaf*, which group, lying contiguous to the *Union* group, is also described in the bulletin. The *Gloucester* group was bonded by the Granby Company and some development-work done. The *Little Bertha*, also on Granby river, but much nearer to Grand Forks, and another property in the neighbourhood, each made a small shipment to the Granby smelter.

* Now called Granby river.

OSOYOOS MINING DIVISION.

While there was a slight revival of interest in mining in parts of this Division that had not seen mining activity for some time, production was small in those parts. In Camp Hedley, on the contrary, the Hedley Gold Mining Company continued energetically its gold-mining and milling operations, with the usual profitable results.

Camp Fairview was one part of the Division in which there was a little improvement, for there further development was done on the *Susie* claim, a shaft having been sunk 160 feet on the incline and a crosscut made to the hanging-wall of the vein, with indications that there is here an ore-body of good size.

On Kruger mountain there does not seem to have been much done at the *Dividend-Lake View* or other lode mines, but from Spotted lake, in that neighbourhood, a considerable quantity of magnesium sulphate was hauled to Oroville, Washington, and shipped thence by rail to a United States firm that found use for this product.

Five men were employed on the *Horn Silver* group of four claims, situated fifteen miles south of Keremeos; 115 tons of ore shipped thence to the Granby Company's smelting-works at Grand Forks yielded a total of 23 oz. of gold and 7,779 oz. of silver. Two adits have been driven, No. 1 105 feet and No. 2 75 feet lower, about 50 feet. The ore ranges in gross value up to $30 a ton. A light tramway was constructed 3,000 feet to the wagon-road, and over this ore to the amount of 10 tons an hour is conveyed at a cost of 45 cents a ton. This development is of interest as being the first productive lode-mining done in this part of the Division.

Some work was done on claims in Olalla camp, where copper ore has long been known to occur; interest was shown in molybdenite ore also found there. Some properties were examined and reported on, and work was done for part of the year under a bond.

There was little mining done in Camp Hedley during the year outside of that carried on by the Hedley Gold Mining Company, as summarized below.

Hedley Gold Mining Co.—Mining in 1915 was done chiefly in the *Nickel Plate* mine of the *Nickel Plate-Sunnysides* group, and most of the development was in the lower levels. The main shaft of that mine is known as the Dickson incline; it is a large shaft and has been sunk about 800 feet. Stations have been cut at two levels and ore has been stoped from both. The work done during the year had for its especial object the development of ore the occurrence of which had been previously indicated by diamond-drilling, so that it might be ascertained what approximate quantity of ore was contained in the reserves of that part of the property. In carrying out this object there was much crosscutting and drifting done in the ore-bodies opened, besides which diamond-drills were freely used. The total of dividends paid in 1915 was similar to that in 1914—namely, $300,000—which is at the rate of 25 per cent. on the company's issued capital.

The company's new hydro-electric power system, briefly described in the Annual Report for 1914, the operation of which was commenced on January 2nd, 1915, was found fully equal to expectations and worked satisfactorily throughout the year.

Recent additions to mill plant and machinery were as follows: A Traylor 24- x 36-inch jaw-crusher; a second 5- x 22-foot tube-mill, with Montana-Tonopah lining; a Dorr classifier, which works with the tube-mill in a continuous system and gives excellent results; four more cyanide-tanks, of Pacific Coast fir, two being of dimensions 34 x 18 feet and two 30 x 16 feet; a third Oliver continuous filter, 8 x 12 feet, of latest design; and other plant. Two extensions of the lower part of the mill building, each 40 x 80 feet, were erected to house the new machinery, etc.; also a building over the new crusher, which was installed above the stamps.

The annual report of the Hedley Gold Mining Company for the year 1915 shows profits for the year to have been $374,745.52. Gross recovery from ore milled was $796,591.78, from which were deducted expenditures of $421,846.26. The amount of ore milled during the year was 74,265 tons, with an average assay value of $11.65 a ton.

Compared with 1914, the average assay values of the ore mined and milled in 1915 was 85 cents a ton more, so that, while the quantity in 1915 was 4,229 tons less, the total value of the gold recovered was within $749 of that of 1914.

Report of President.—"During the past year everything at the mine and mill has gone along very well. The lower levels of the mine look strong and healthy. The present developments on

these lower levels, however, are probably in the richer portions of the shoots, and with full development of these levels we only expect to maintain the general average of ore, say, around $10 to $11 a ton.

"The increased baseness of the ore with depth, which increases concentrate tonnage and lowers the grade of same, necessitates a change in our milling system. We have carefully tested out straight cyanidation of all our ore with fairly good results, and we plan to install the necessary machinery for this treatment during the early part of 1916, which we believe will be some improvement over the present method of shipping concentrates to the smelter."

In the report of General Superintendent Gomer P. Jones is given the information that the total reserve of ore at present proven in the mine is 423,552 tons, averaging $10.39 a ton.

GREENWOOD MINING DIVISION.

REPORT OF W. R. DEWDNEY, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining operations in the Greenwood Mining Division for the year 1915.

The British Columbia Copper Company, Limited.—Preparatory work prior to the resumption of actual operations began on June 18th at both mines and smelter, and actual smelting operations began July 26th, from which date the mines and plant have been in continuous operation.

Tons ore treated (including custom ore)	122,514
Production—	
Blister-copper, lb.	1,734,385
Gold, oz.	5,417.0839
Silver, oz.	23,002.62
Average number of men employed—	
Smelter	49.2
Mother Lode mine	91.7
Total wages paid—	
Smelter employees	$33,525.85
Mother Lode mine employees	$60,666.00
Principal ore shipments to the smelter—*	
Mother Lode mine	108,514 tons.
Lone Star mine (State of Washington)	6,689 „
Sunset mine	2,242 „
Queen Victoria mine (in Nelson Mining Division)	773 „
Other custom ores	6,615 „
Diamond-drilling—Drilled at *Mother Lode* mine	711 feet.

The Granby Consolidated Mining, Smelting, and Power Company, Limited—

Tons of ore shipped to the smelter at Grand Forks from Phoenix	1,035,225
Underground development—	
Sinking	10 feet.
Raising	8,065 „
Drifting	5,754 „
Diamond-drilling	9,034 „
Average number of men employed at the Phoenix mines	416

Sally Mine.—This mine, owned by the Vancouver and Boundary Creek Mining and Development Company, is situated on Wallace mountain, near Beaverdell. Operations were commenced on February 7th and continued until the end of the year, from six to eleven men being continuously employed.

Amount of ore shipped during the year	164 tons.
Gross values (mainly silver)	$11,676.14
Net values	$8,759.09

The *Kokomo* mine, owned by George Barrett *et al.*, and which adjoins the *Sally*, is being actively developed. No ore was shipped during the year.

* Not all smelted during the year.

PLACER-MINING.

Thirteen placer claims were recorded in this Division during the year and five placer-mining leases were granted. Four placer claims were rerecorded. Rock creek still continues to be a favourite locality for placer-miners. One placer claim and three placer leases were staked on the headwaters of the Kettle river, in the vicinity of Monashee mountain.

OFFICE STATISTICS—GREENWOOD MINING DIVISION.

Free miners' certificates	190
Locations, quartz	67
Locations, placer	11
Locations, placer (partnership)	2
Placer rerecords	4
Certificates of work	153
Transfers	6
Abandonments	2
Notices of forfeiture	1
Agreement	1
Powers of attorney	2
Filings	15
Certificates of improvement	3
Crown grants	3

GRAND FORKS MINING DIVISION.

REPORT OF S. R. ALMOND, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining in the Grand Forks Mining Division for the year 1915.

The mining and smelting business carried on by the Granby Consolidated Mining, Smelting, and Power Company at Phoenix and Grand Forks has been just as brisk as ever.

The mines around Phoenix owned by the company have been putting out a continuous supply of ore, estimated at about 4,000 tons a day, and the smelter at Grand Forks has been working at almost full capacity during the year.

Although both the Granby and the British Columbia Copper Company bonded groups of mineral claims in Gloucester and Franklin camp, on Granby river (the North fork of Kettle), there has not been any prominent or pronounced activity in the district, but there has been an undercurrent of inquiry from the outside respecting prospects and mines that have been worked, and several mines have restarted work in a small and cautious way.

Outside of Granby-owned mines, the *Union*, *Maple Leaf*, and *Little Bertha*, all on Granby river, are the only properties that have shipped any ore; the ores from these claims were all shipped to and treated by the Granby Company at Grand Forks.

OFFICE STATISTICS—GRAND FORKS MINING DIVISION.

Free miners' certificates	124
Locations	70
Certificates of work	146
Filings	21
Transfers, agreements, etc.	17
Certificates of improvement	1
Crown grants	1

OSOYOOS MINING DIVISION.

REPORT OF R. D. TWEEDIE, MINING RECORDER, FAIRVIEW, B.C.

I have the honour to submit herewith the annual report of the mining operations in the Osoyoos Mining Division for the year 1915.

Outside of the Hedley camp and the *Horn Silver* mine, in the Similkameen, very little mining has been carried on, in most cases sufficient work only being done to secure the necessary certificates.

I enclose copy of report of work done on the *Horn Silver* mine. Some ore was shipped during 1915, and the prospects for a successful year in 1916 are very good.

Across the Similkameen river a group of claims belonging to Messrs. Armstrongs, of Penticton, have been bonded for $50,000, the intention being to develop same during the summer of 1916.

On Cawston creek considerable staking has been done, good ore having been discovered in that vicinity. Prospecting is being carried on with good results.

Conditions appear to be favourable for extensive operations during the coming year.

"REPORT OF WORK DONE ON HORN SILVER MINE DURING 1915.

"Development-work was started on this property in January, 1915. A tunnel was driven in on the outcroppings a distance of 105 feet. Good ore was encountered the whole of this distance, the lead showing a width of from 2 to 3 feet. A second tunnel was started 75 feet below tunnel No. 1, and has been driven a distance of 100 feet. Good ore was found in this tunnel, the lead showing from 2 to 4 feet in width. The main drive for stope No. 1 has been started and driven 25 feet; a pit of 15 x 50 feet on the outcroppings was stripped of the overburden and 117 tons of ore was shipped to the smelter.

"A light aerial tramway was erected from the mine to the wagon-road, a distance of 3,000 feet; ore-bins were built; 1,500 feet of wagon-road was constructed to connect with main wagon-road; this tramway is of the single-rope type, and has a capacity of 10 tons per eight-hour shift.

"As there is no water at the mine or at the base of the mountain, a water-tunnel was driven in the dry gulch; this tunnel is 90 feet long and taps a supply of water that gives a flow of 10,000 gallons per twenty-four hours.

"A manager's house has been built, and other camp buildings will be built in the spring.

"An average force of five men has been employed for ten months of the year.

"E. W. CONDIT, *Manager.*

"*Similkameen, February 10th, 1916.*"

OFFICE STATISTICS—OSOYOOS MINING DIVISION.

Free miners' certificates issued	158
Claims recorded (mineral)	86
Claims recorded (placer)	6
Certificates of work issued	102
Certificates of improvements issued	10
Bills of sale and other documents recorded	19
Total mining receipts for the year	$1,663.40

OSOYOOS MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

Nickel Plate.

After completing his examination of the mineral claims on Owl mountain the writer proceeded to Hedley, in compliance with a request received from G. P. Jones, the manager for the Hedley Gold Mining Company, owners of the *Nickel Plate* and *Sunnyside* mines. Since 1913, when the Assistant Provincial Mineralogist visited this property, and made a report, published in the Minister of Mines' Report for that year, there have been several improvements and additions made to the mill and cyanide plants;

also a hydro-electric power plant has been installed and extensive development-work done in the mine, all of which was examined by the writer, and is fully described later in this report.

The Hedley or Nickel Plate camp was visited by the Provincial Mineralogist in 1901, and reported on in the Minister of Mines' Report for that year. Charles Camsell, of the Canadian Geological Survey, devoted two seasons—1907 and 1908—to a thoroughly systematic examination of the geology of the camp, and his report was published by the Survey in 1909 as Memoir No. 2, entitled "Geology and Ore Deposits, Hedley Mining District, B.C."

In view of the importance of the operations of the Hedley Gold Mining Company, as well as the future possibilities of the camp, aside from the company's property, the writer considers it expedient, in view of the fact that the public generally will not have an opportunity to read the memoir, to include in this report some extracts from the very comprehensive report made by Charles Camsell, who had exceptional opportunities, and was enabled to devote sufficient time for his examination, to work out the details relative to the ore-bodies very minutely.

With regard to the character of the deposits and their relation to country-rocks, Camsell says as follows: "Up to the time of completion of the field-work of this district the number of ore-deposits developed and being mined was not great. The best known of these, and that first worked and now most extensively developed, is the *Nickel Plate* ore-body. The outcrop of this lies on the eastern slope of Nickel Plate mountain at an elevation of 5,900 feet above sea-level, or 4,300 feet above the bottom of the Similkameen valley. Twelve hundred feet to the south-east of this and 250 feet below it is the northern ore-body of the *Sunnyside* mine, commonly referred to as *Sunnyside No. 4*. Lying 400 feet to the south of the last is *Sunnyside No. 3*, while *Sunnyside No. 2* lies 400 feet to the south of *Sunnyside No. 3*. A fifth ore-body known as *Sunnyside No. 1* lies on the southern border of the *Sunnyside* mineral claim, but it has not yet been much explored and its dimensions are not known. The four first mentioned are the most important and best-known ore-bodies in the whole district, and from a study of these, deductions were drawn as to the nature and occurrence of the ore-bodies of the whole camp. Other ore-bodies whose dimensions and values have not yet been thoroughly proven are known to occur on the *Mound*, *Horsefly*, *Warhorse*, *Kingston*, *Metropolitan*, and *Florence* mineral claims; but so far as known they exhibit somewhat similar characters to the four above mentioned, and are therefore included in the general description and classification. These four have themselves characteristic features and environment which place them all in the same type of ore-body, so that no division need be made. This type may be described as containing ore-bodies of roughly tabular form, without any well-defined walls, lying in metamorphosed limestone-beds, either on direct contact of an intrusive igneous body or within its sphere of influence. They contain gold as the principal valuable metal and are mined for this. They are not directly connected with any evident system of fissures, and are undoubtedly due to the igneous intrusion. They are therefore true contact metamorphic deposits, but of a type unique in themselves, inasmuch as they have arsenopyrite as the principal sulphide, and have no equivalent, so far as known, in North America.

"All the minerals that have any connection with the ore-deposits have been described in detail in a previous section. Many of these, however, are relatively unimportant, while there are others which are essential constituents of every ore-body. Of the latter, arsenopyrite is by far the most abundant ore-mineral, and is found not only in the ore-deposits, but on nearly every contact with the sedimentary. It is safe to say that no shaft has been sunk or tunnel driven which does not show mineralization to some extent by arsenopyrite.

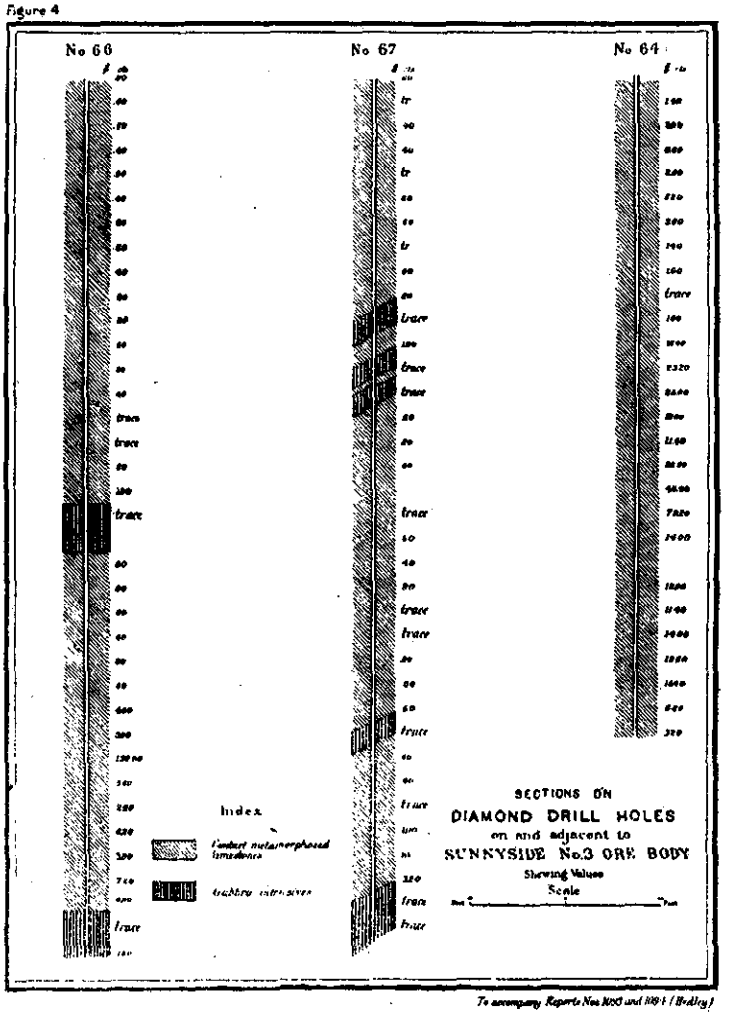
"Next in abundance, but of very much less economic importance, is pyrrhotite. This mineral is not necessarily an essential constituent of the ore-bodies, and in some deposits it is wanting; but it occurs in great abundance in certain localities, especially on Red mountain and south of the Climax canyon. Like arsenopyrite, it is found on the contacts where these rocks are strongly calcareous. Its companions are generally arsenopyrite and chalcopyrite, rarely sphalerite.

"Next to arsenopyrite, chalcopyrite is perhaps the most widespread sulphide, but it occurs in such small amounts that its presence is often overlooked. In the ores of the *Nickel Plate* and *Sunnyside* mines it is always present, though sparingly, and in only one or two other places does it become abundant enough to be conspicuous."

In the section devoted to the "Relation to fissures," Camsell says: "Large fissures as passages for ore-bearing solutions in the Hedley district are not of great importance. Considerable fracturing and fissuring accompanying orogenic movements have taken place at different

periods in the geological history of the district, but these events were later than the intrusion of the gabbro, and, consequently, later than the formation of the primary ores. From the great lack of any mineralized fissures connected with the gabbro intrusion it would appear as if the sedimentary rocks of the district were almost undisturbed, and had suffered little deformation before the intrusion of the gabbro. Naturally during the intrusion of the diorite and gabbro some fissuring must have taken place, but this appears to have been on a minute scale, and not sufficient to form large and important trunk channels for the ore-bearing solutions. Following these intrusions orogenic movement opened some fairly large fissures and developed some fault-planes, but it was so long after that the intrusive rocks were quite cold and deposition of ore had entirely ceased.

Figure 4



To accompany Reports Nos 1905 and 1914 (Bradley)

"From a study of the contents of these major fissures, it is clear that they must be referred to a date later than the formation of the primary ores. Even when they cut the existing ore-bodies they contain in themselves no ore-minerals which can be said to have been introduced at the time of the formation of the original ore-bodies. Generally, they are merely filled with barren calcite or clayey matter, and the small gold value they contain can be readily accounted for by the action of surface waters passing through the ore-bodies.

"These fissures, however, become important factors where they cut pre-existing ore-bodies in the zone of surface waters. Here they have been useful by allowing a free and easy circu-

lation of surface water in transporting and rearranging the gold values, so as to concentrate them in certain localities.

"The distribution of the gold values throughout the contact-zone is general, and in the ore-bodies themselves, erratic. Proof of each of these statements is obtained from the records of very extensive diamond-drilling performed by the Yale Mining Company (the predecessor to the Hedley Gold Mining Company) on their various claims. Three of these records are here reproduced. In every case the drill-core was carefully drawn up and boxed, and assays were made at every 5 feet of a portion of the core. No. 66 is part of the record of a drill-hole put down at an angle of 25 degrees to the east and directly across the dip of the sedimentary rocks. No. 67 is another record of a vertical drill-hole put down in sedimentary rocks which dip at an angle of 25 degrees to the west. No. 64 is the record of a drill-hole put down through the *Sunnyside No. 3* ore-body at an angle of 40 degrees almost parallel to its pitch, and about 15 feet above the gabbro foot-wall. All of these are on the same claim, No. 66 being about 120 feet north of No. 67, and running at the bottom into the *Sunnyside No. 3* ore-body. The figures indicate the values in dollars per ton of the portions of core assayed.

"Numbers 66 and 67 pass from one end to the other, through sedimentary rocks that have been completely metamorphosed by intrusions of gabbro apophyses, and some of these apophyses appear in the section. The records show the wide distribution which the gold has throughout the contact-zone, even though the value rarely exceeds 80 cents to the ton. It is noticeable that wherever the gold values exceed that figure there is a sheet of gabbro underneath. Both No. 64 and the lower part of No. 66 traverse the ore-body, and the values show the great variation in gold content in very short distances. In these drill-holes it is impossible to account for the great localization of values in certain places. No. 64 starts in low-grade rock which overlies the ore-body, and at the lower end it passes out again into low-grade rock on the opposite side."

Hedley Gold Mining Co.

This company owns about thirty mineral claims on Nickel Plate mountain and vicinity, in the Hedley mining camp, but those from which the bulk of the ore is still being mined are the *Nickel Plate* and *Sunnyside* mineral claims. As the operations of this company have been quite fully described every year in the Annual Report of the Minister of Mines since 1901, when the Provincial Mineralogist made a personal examination and report of the camp, it is hardly necessary for the writer at this time to refer to the past history or achievements of the company, especially as several of the reports that have been published during recent years have included the official annual reports made by Gomer P. Jones, the general superintendent, to the president and stockholders of the company.

During the brief visit to the *Nickel Plate* mine made by the writer at the beginning of August last, he was, through the courtesy of Gomer P. Jones, afforded an opportunity to examine the lower levels of the mine-workings, as well as the improvements and additional equipment in the stamp-mill and cyanide plant, also the hydro-electric power system that was completed during the winter of 1914-15.

The work in the mine during the past two years has been very largely concentrated on opening virgin ground from the No. 4 adit, which was driven in 1905 under the management of M. K. Rodgers, but was later abandoned by his successor, who had the rails taken up for use at another point. This adit remained in an unused condition until about two years ago, when Mr. Jones, the present superintendent, equipped it for the main haulage-way, relaid the rails, and installed an electric-lighting system; then started sinking the Dickson incline from a point in the adit about 900 feet from the portal. During 1914 this incline was sunk to a depth of 750 feet on a 30-degree angle, stations were cut at the 100-, 200-, and 600-foot levels, and stopes opened on those levels.

During the present year sinking has been resumed in the Dickson incline, and stations cut at the 700- and 800-foot levels, on both of which ore is exposed, and, according to the assay maps, carries equally as good values as on the 600-foot level, where it averaged about $20 a ton.

On these levels the ore is found overlying a sheet of gabbro, locally called andesite, thus occupying the same position geologically as in other portions of the property; the dip is at an angle of 23 degrees towards N. 70° W. and strike nearly north and south, cutting the sedimentaries, in which the gabbro has intruded, diagonally. On the 600-foot level the width of the ore-body measured horizontally is nearly 100 feet.

The bulk of the ore mined and milled during 1915 was stoped from the 600-foot level and from the fourth level of the No. 5 incline, which has been connected with the 600-foot level by an upraise 160 feet in height; so that all the ore mined is transported from the 600-foot level to the No. 4 adit level, where it is dumped into cars hauled by electric motors one mile and a half to the upper terminal of the incline tramway, and thence to the 40-stamp mill.

At the time of the writer's visit the superintendent informed him the mine was producing an average of 235 tons of ore a day, but that, as soon as the improvements in the milling plant were installed, the capacity there would be greatly increased and the tonnage mined would be proportionately greater.

The additions and improvements that were being installed in the milling plant in August last consisted of four new cyanide-tanks and one Oliver filter-press; arrangements were also being made for four additional tube-mills. The dimensions of the cyanide-tanks were: Two, 34 feet each in diameter by 18 feet deep; and two, 32 feet each in diameter by 18 feet deep. In order to properly house these tanks and to provide for housing the additional tube-mills, it was necessary to extend the mill building by erecting an addition at each end; two of the tanks were installed at the northerly end of the original mill building, and the other two at the southerly end.

The hydro-electric power system, costing $192,009.35, or $7,990.65 below the original estimate of $200,000, was completed in January, 1915. This plant was described in detail in the general superintendent's report to the president and shareholders for 1914, a copy of which was published in the Minister of Mines' Report for that year, so that it is unnecessary to repeat in this report. The plant has been in successful operation during the year, and the increased power furnished by it is ample to meet the demands caused by the installation of the additional equipment in the milling and cyanidation plants, as well as ensuring a sufficient supply for any reasonable additional power necessary at the mine and tramway in order to increase the output.

YALE DISTRICT.

KAMLOOPS MINING DIVISION.

REPORT OF E. FISHER, ACTING GOLD COMMISSIONER.

I have the honour to submit the annual report on the Kamloops Mining Division for the year ending December 31st, 1915.

During the past year there have been many inquiries about various properties in this Division, and consequently there is a feeling of optimism with regard to the mining outlook. Aside from assessment-work generally, active development-work has only been carried out on a few properties. The most important work has been done on the *Iron Mask* mine by the Kamloops Copper Company, some 5,000 to 6,000 tons of ore having been mined and treated during the past year, giving employment to a force of some sixty men, and, as will be seen from the report of the company's manager, Mr. Wallinder, the company has now a thoroughly equipped and up-to-date plant in operation, which it is hoped will now maintain a steady output.

The opening for traffic of the Canadian Northern Pacific Railway has enabled Mr. Frederick, of Cherry creek, to push forward development-work on his properties at that place, and he will shortly be making his first shipment of ore. Mr. Fennell, of Chu Chua, has also done a large amount of work on his Boulder Creek properties, and is at present engaged in rawhiding ore down to the Canadian Northern Pacific Railway for shipment.

There was considerable interest manifested last spring in a new strike of copper in the vicinity of Heffley lake and a large number of claims were staked, on some of which development-work has been started, the details of which I have not been able to obtain at present.

No placer-mining has been done during the past year.

Iron Mask.

Mr. Wallinder reports as follows: "The *Iron Mask* mine, owned by the Kamloops Copper Company, formed by E. G. Wallinder and associates, of Duluth, is situated at about 1,600 feet elevation above Kamloops lake, at a distance of six miles in a south-westerly direction from the city of Kamloops. The property comprises the following mineral claims: *Iron Mask*, *Erin*, *Copper Queen*, *Lucky Strike*, *Prince of India*, *Ben Hur*, *Sunrise*, *Jumbo*, *Bonnie Jean*, and *Civil*, comprising 228 acres in extent.

"Owing to the extent of the mineral properties, development-work has been confined principally to the *Iron Mask* and *Erin*, in which 16,200 feet of underground work has been done, consisting of 1,200 feet of shafts and 15,000 feet of drifts, crosscuts, and raises, 4,200 feet of which has been done during the past year.

"*Iron Mask*, the Company's largest mine, is equipped with a three-compartment, well-timbered shaft sunk to a present depth of 780 feet.

"The *Erin* mine, located 1,300 feet east of the *Iron Mask*, is sunk in ore to a depth of 330 feet, and a drift is being run from the 750-foot level at the *Iron Mask*, with a 400-foot raise connecting it to the *Erin*, which the management expects to have completed by April 1st, thus giving better ventilation and lowering the cost of mining; all work thus being handled at a centre point.

"*Surface Equipment.*—The properties are equipped with modern machinery of recent installation; electric power and compressed air are used for operation. The company, for its exclusive use, has erected private telephone and power-transmission lines between the mines and the Kamloops Power Station, a distance of six miles. A current of 11,000 volts stepped down at the mines to 440 volts is used.

"The hoist-house at the *Iron Mask* shaft is a substantial structure covering 1,920 feet in area, and contains the central station for distribution of current for underground and surface lighting and for power for eleven motors, as follows: One 20 horse-power in machine and carpenter shop; one 20 horse-power at *Erin* hoist; one 30 horse-power at pump on *Iron Mask* 100-foot level; one 20 horse-power at pump in mill; one 35 horse-power at pump on 750-foot level;

one 35 horse-power in lower section of mill; one 75 horse-power in upper section of mill; one 75 horse-power at hot-air compression; one 150 horse-power at No. 2 hot-air compression; one 225 horse-power at *Iron Mask* hoist; one small motor at assay office.

"The transformer-house is a substantial brick and reinforced-concrete structure covering an area of 192 square feet, in which are contained three 150-kw. oil-cooled transformers, lightning-arresters, coils, cut-outs, etc.

"This equipment has a daily capacity of raising 1,500 tons of ore from a 1,200-foot level, and is capable of operating to a depth of 1,500 feet.

"A 500,000-gallon tank and fire-hose affords ample fire-protection to the property of the company.

"At the *Erin* shaft a hoist-house has been constructed containing shop, tool-room, dry-room, and electric hoisting equipment. An ore-bin of 1,000 tons capacity has also been built.

"The main shops, having an area of 2,952 square feet, contain the machine, blacksmith, and carpenter departments, fully equipped with all machine and hand tools for the maintenance and repair of all mine machinery and equipment.

"Other buildings include dry-house for workmen, warehouse, powder-magazine, superintendent's residence, office, foreman's house, and boarding-house with accommodation for 100 men, etc.

"The concentrating-mill is of unit construction operating on gravity system, with a present capacity to treat 600 tons of ore per twenty-four hours, and capacity of mill can be doubled at minimum cost without interfering with operation of present unit or requiring additional hoisting equipment.

"Experiments are now being conducted with a process of flotation concentration, which principle promises an increased recovery.

"During the past year development-work has been extensively carried out, with a view to determining the extent of the ore-bodies."

Wonderful.

A. McConnell reports as follows: "In regard to the zinc prospect on Adams lake staked by Geo. L. Breeden as the *Wonderful*, I might say that we have done considerable development to try to prove the extent of the deposit and get some idea as to the possibility of putting this claim on a shipping basis. Our first idea was that the ore would be high enough in grade to ship direct to the smelters in the United States, but owing to the high rates for freight, etc., we found this to be practically impossible, as the zinc-ore markets at the present time are very unsteady, and the risk is too great to take a chance when freights are high and no way of securing a flat contract for the ore f.o.b. the cars here.

"On this claim we have stripped the ore for a distance of about 90 feet and about 12 feet wide, and we found quite a large percentage of ore that runs as high in value as 51 per cent. in zinc and 24 per cent. in sulphur, but owing to the inclination of the ledge it is a question as to whether it will be possible to continue with the present work owing to the encroachment of the water from Adams lake, which is at the present time coming into the workings. We are, however, of the opinion that this deposit can be opened higher up and do away with this objection.

"From what we can see of the deposit it would seem that there is a possibility that the deposit may be erratic and may perhaps run to considerable low-grade ore, which would necessitate the construction of concentrator to reduce the material so as to bring the percentage of zinc up to where it would be possible to ship at a profit. We are at the present time giving this matter considerable study, and expect in the coming spring to continue the work of investigation and endeavour to determine the extent of the deposit and the possibility of what can be done in a commercial way.

"At the present time we have out on the dump approximately 100 tons of all grades, and have sorted out to date about 5 tons that will assay 50 per cent. or better in zinc."

Fog Horn Group.

Geo. Fennell reports as follows: "The development-work done on the *Fog Horn* group during 1915 consists of one shaft 40 feet deep and a drift on ledge from bottom of shaft 40 feet in length, where we stoped out about 75 tons of ore and several open-cuts on surface, where we also took out ore.

"We also did surface work on the *Red Top* claim, consisting of open-cuts and shafts.

"The *Fog Horn* claim is developed with a 200-foot crosscut tunnel, which is within 50 feet of ledge.

"We also built thirteen miles of rawhide trail from the mine to Canadian Northern Railway road, to enable us to transport ore to railway this winter.

Lydia Group.

"We have also done considerable work on the *Lydia* group. This group consists of the *Rosenquist, Abe Lincoln, Lydia,* and *Lydia Fraction,* also *Pot Hole* mineral claim. These claims are located at the headwaters of Canyon creek, and on these claims we have opened up a large body of low-grade copper ore."

OFFICE STATISTICS—KAMLOOPS MINING DIVISION.

Free miners' certificates	208
Records (mineral)	69
Certificates of work	81
Bills of sale	18
Receipts	$1,871

KAMLOOPS MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

The Kamloops Mining Division was examined by the writer in 1913, and his report published in the Minister of Mines' Report for that year; but as it was reported that some considerable extensions had been made to the development-work on some of the properties described in that report, he was instructed by the Provincial Mineralogist to again visit the Division, and to report on the progress that has taken place.

Chatrandt's Mineral Claim.

This mineral claim is situated on Meadow creek about five miles easterly from Chatrandt's ranch, and near the mouth of Greenstone creek. Several deep open-cuts have been made, and an adit about 40 feet long has been driven, in a bluff composed of amygdaloidal diabase porphyrite (Dawson's classification) of a chocolate-brown to blackish colour. This rock is very much fractured, and outcroppings of copper-carbonate ore, with occasional particles of bornite and chalcocite, occur along the fracture-planes, but the work so far done does not expose any bodies of ore of sufficient extent to suggest commercial value.

COAL HILL.

Iron Mask.

This property, containing ten full-sized mineral claims, and six fractional claims, and covering a solid block of ground, about one mile long in a north-east to south-west direction by three-quarters of a mile in a north-west to south-east direction, is owned and operated by the Kamloops Copper Company, of which E. G. Wallinder, of Duluth, Minnesota, is president, and A. Wallinder, superintendent, who resides on the property.

The improvements and additions to the mining machinery and concentrating plants installed since 1913 are as follows: The mining camp has been improved by the erection of seven miles of electric transmission-line from the city of Kamloops to the transformer-house at the mine; erection and equipment of transformer-house, where 11,000 volts is stepped down to 440 volts; installation of electric hoist with independent motor of 150 horse-power and capacity to hoist 1,200 feet at the *Iron Mask* mine, and an electric hoist with independent motor of 40 horse-power and capacity to hoist 400 feet at the *Erin* mine; installation of two electric pumps with independent motor for each of 35 horse-power respectively, and a respective capacity to pump 100 gallons a minute, with one pump equipped to lift 800 feet, the other 1,000 feet; installation of a compressor plant with independent motor of 150 horse-power and capacity for 12 drills on 1,200 cubic feet of air; a second compressor plant with independent motor of 75 horse-power and capacity for six drills on from 700 to 800 cubic feet of air; independent motor of 75 horse-power for running the machinery in the concentrating-mill; independent motor of 10 horse-power for the carpenter and machine shop. The pumps are manufactured by Allis Chalmers; the motors by the Canadian General Electric Company; and the drills by the Canadian Ingersoll-Rand Company, Limited. The transformer-house is equipped with Canadian General Electric Company's lightning-arresters.

The concentrating plant has been rebuilt and fully equipped with the following: Three water-tanks having a combined capacity to contain 750,000 gallons; one Gates gyratory crusher with a capacity to crush 500 tons of ore a day to 2-inch mesh; one set of 42-inch Joplin rolls that crush to ½-inch mesh; large trommel with a capacity to handle 250 tons of crushed ore in eight hours; one Faust jig with five cells; one Cooley jig; one set of 24-inch Anaconda rolls that crush to $^{3}/_{16}$-inch mesh; dewatering screens; pulp-thickeners; classifiers; three Arbuthnot or Sludge concentrating-tables manufactured at Webb City, Missouri. The last mentioned is a recently invented machine, and this is the first time it has been used in Canada. The above-mentioned equipment, it is claimed by the management, furnishes a capacity for handling 25 tons of ore every hour.

In 1913, when the writer visited the *Iron Mask* mine, the present owners were busily engaged in erecting the transmission-line, and the mine itself was full of water, so that the only description he could give was taken from a study of the maps and plans made by the former owners; but during the visit in 1915 he was able, through the courtesy of the president and superintendent, to examine the underground workings as well as the concentrating-mill.

The English company which was the former owner had sunk the working-shaft to a depth of 600 feet on an incline of 68 degrees, with ore exposed by the shaft to that level, previous to selling out to the present owners; and had stoped out practically all of the ore from the surface to within about 65 feet above the 600-foot level.

The present owners started sinking from the 600-foot level and had reached a depth of 750 feet last summer. In sinking the shaft below the 600-foot level it was discovered that the ore-body was cut off, at about 690 feet below the surface, apparently by a horizontal fault, with a slight dip towards the south-west, and no ore is exposed by the shaft below that point.

On the 750-foot level there has been a vast amount of work done in an endeavour to locate the original *Iron Mask* ore-body below the fault-plane. At one point about 275 feet in a south-easterly direction from the shaft, and towards the *Lucky Strike* mineral claim, one of the *Iron Mask* group, a body of ore is exposed carrying good-grade copper values; but this is assumed to be separate and distinct from the *Iron Mask* ore-body. Another ore-body is exposed about 100 feet easterly from the shaft below the horizontal fault; the extent of this vein, which carries some high-grade copper-sulphide ore, had not been determined at the time the examination was made. Most of the underground work at that time was being concentrated in driving a diagonal crosscut towards N. 5° W. (mag.) for the purpose of connecting the underground workings on the *Iron Mask* ground with those on the adjoining *Erin* mineral claim, distant 1,300 feet. This crosscut will enter the *Erin* ground at a level about 650 feet below the surface and 350 feet below the bottom of the *Erin* shaft. It is also proposed to upraise to the surface, about midway between the old shafts on the *Iron Mask* and *Erin* claims, and hoist all ore through it from both mines into a shaft-house, to be equipped with conveyor-belts, connecting with the upper floor of the concentrating-mill.

In driving this tunnel an ore-body has been crosscut diagonally for a distance of 75 to 80 feet, but no work has been done to determine its relationship, if any exists, with the known ore-bodies on either the *Iron Mask* or *Erin* mineral claims.

The workings near the bottom of the *Iron Mask* shaft expose another almost vertical fault-plane in diorite country-rock. The movement has been very pronounced, resulting in a crushed zone, with many slickensided fracture-planes, much talcose material, and a considerable quantity of gypsum, which occurs in lumps and sheets between the cleavage-planes in the faulted zone. Apparently, this fault is more recent than the horizontal fault already mentioned.

In consequence of these complex geological conditions, the difficulties surrounding the carrying-on of development-work can readily be appreciated, as well as the advisability of installing a diamond-drill for the purpose of prospecting thoroughly and systematically the ground opened up on the 750-foot level.

Ore was being mined in the *Iron Mask* mine, during the writer's visit, from a level above the horizontal fault in a stope about 80 feet high and 60 feet long, where the ore-body is from 6 to 12 feet wide; but this ore is said to be parallel to the original *Iron Mask* ore-body, which the present owners were not mining last summer; although that body has not all been stoped out above the 600-foot level, but it has been somewhat explored between that level and the horizontal fault.

The ore mined from *Iron Mask* ground is all concentrated, and the superintendent stated that the concentrates assayed about from 10 to 12 per cent. in copper values, and that the concentration represented a ratio of about 4 tons of ore to 1 ton of concentrates.

On the *Erin* mineral claim, adjoining the *Iron Mask* on the north, and one of the group, the working-shaft has been sunk from its depth of 130 feet on September 6th, 1913, to 300 feet on September 18th, 1915. Since the first-mentioned date, at which time no drifting or cross-cutting had been done below the 80-foot level, the 150- and 300-foot levels have been opened up, and on September 18th last the writer examined the work down to the 150-foot level; but because no work was then being done on the 300-foot level, and the shaft was full of water below 180 feet, no examination could be made below that point. The superintendent stated that no level had been opened between the 150- and 300-foot levels, and that there had been 200 feet of cross-cutting and 100 feet of drifting driven on the last-named level.

All of the underground work on the 80-foot level is described in the report by the writer in the Minister of Mines' Report for 1913, consequently repetition here is unnecessary.

On the 150-foot level the same ore-body, composed chiefly of chalcopyrite, with some cuprite, malachite, and azurite, as is opened upon the 80-foot level is exposed for a distance of 300 feet by drifting along its strike in north-east and south-west directions from the shaft, and for a width at one point of 50 feet, as is shown by a crosscut which is 60 feet in length. As ore is still exposed in both faces of the drifts, the extent of the ore-body in length is undetermined. Stopes have been opened above this level, from which ore was being mined during the season of 1915, and the higher grade shipped direct to the smelter; the lower grade, wherever possible, is being allowed to remain underground until the connection with the *Iron Mask* workings is completed, when it will be sent to the concentrating-mill by that route.

In the stopes in some places the ore-body is fully 30 feet wide and averages about 10 feet wide; but what proportion of this is shipping-ore is very difficult to estimate, because the width of the vein-filler carrying the higher grade varies so much.

The foot-wall of the ore-body is solid and well defined; it is composed of a fine-grained igneous rock; but the hanging-wall is not so well defined; the rock resembles the foot-wall rock, but has been considerably fractured, and is impregnated by particles of copper ore penetrating the cleavage-planes in the fractures. Between the ore-body and the igneous rock, that is presumably the permanent hanging-wall or the south-eastern boundary of the wide fissure, there is a variable width of a blackish crushed material that has the appearance and characteristics of ledge-matter, but carrying such low values in copper minerals as to make it unprofitable to mine. This material resembles somewhat the matrix of the ore-body; is unctuous but tough, like rubber; is stained with copper carbonates and iron oxide; contains small particles of rock with sharp edges, and has many slickensided cleavage-planes, which is also characteristic of the ore-body, indicating that it has been subjected to much disturbance from movement and shearing, as well as to great pressure subsequent to the formation of the ore-bearing portion of the fissure. There is generally a fairly well-defined, but irregular line of demarcation on the hanging-wall side between the boundary of the higher-grade copper ore and the blackish-coloured material; but at many points the ore-body so gradually grades into it that it appears as though a concentration has taken place, by which the copper sulphides had been deposited in a body on the foot-wall.

The superintendent informed the writer that it was the policy of the company to hand-sort the ore shipped direct to the smelter up to 6 per cent. copper content, which generally carried sufficient gold and silver values to nearly pay for mining and hauling; then treat all lower-grade ore in the concentrating-mill, where the concentration is at a ratio of from 3 or 4 tons of ore to 1 ton of concentrates.

The ore mined from the *Iron Mask* workings is conveyed to the ore-bins on the top floor of the concentrating-mill by a belt-conveyor; from these bins it is discharged into a Gates gyratory crusher, having a capacity to crush, to a 2-inch mesh, 500 tons a day; the crushed ore is next delivered to a set of 42-inch Joplin rolls which crush to ½-inch mesh; from these the ore passes into a large trommel having a capacity to handle 250 tons every eight hours. The undersize goes direct into a five-cell Faust jig; the tailings from the jig go over a belt-conveyor to the tailings-dump; the product from the first two cells is elevated by a bucket elevator into the concentrator-bin; the product from the No. 3 cell goes to a Cooley or cleaner jig; the product from No. 4 and No. 5 cells, called "chats," is elevated by a bucket elevator to a set of 24-inch

Anaconda rolls, in which the ore is reground to a $^{3}/_{16}$-inch mesh and sent back to another Faust jig; the product from the first three cells of this is conveyed to the concentrator-bin, and that from the No. 4 and No. 5 cells to a Cooley jig after having been reground, and from the Cooley jig to the concentrator-bin; the tailings from the No. 4 and No. 5 cells of the Faust jig, as well as those from the Cooley jig, are passed through dewatering-screens, pulp-thickeners, and classifiers, and conveyed to Arbuthnot or Sludge concentrating-tables, from which the first-class concentrates go to the concentrator-bin, the middlings to a Cooley jig, and the tailings to the dump. The slimes from the dewatering-screens are collected from settling-tanks, pumped into pulp-thickeners, and passed over the Sludge tables, the product from which is treated as already described. The water from the various units in the concentrator is pumped into tanks built near the mill, which have a capacity to hold 750,000 gallons, and which also receive all the water pumped from the mine; the conservation of water is a very important consideration at this property, as there is no other available supply, except in some small alkaline lakes situated at a much lower elevation than the concentrating-mill, which was used by the former owners, but is not being utilized by the present company.

The concentrates and ore were, last summer, being hauled to the railway siding, about three miles distant, in loads of 5 tons each, in wagons drawn by horses, at a contract price of 75 cents a ton, instead of by auto-truck or traction-engine; as the superintendent stated the wagon-hauling was found to be more satisfactory and economical than by either of the other methods, both of which had been tried, and failed because of the heavy grades and bad conditions of the roadway at certain seasons of the year.

Python Group.

In company with Wentworth F. Wood, of Kamloops, one of the owners of this group of mineral claims, the writer visited the property on October 10th last, because, although it is fully described in his report in the Minister of Mines' Report for 1913, he could not at that time examine the main adit for the reason that the entrance had caved. Last summer, though, he was informed that this adit had been cleaned out, retimbered, and in condition to be examined. The workings on the *Python* group are situated on Coal hill, distant about six miles by road in a south-westerly direction from the town of Kamloops.

As it is unnecessary to repeat the description contained in the report referred to, the writer will in this report confine his remarks to the main adit. This has been driven into a ridge made up of volcanic rocks belonging to Dawson's Nicola series. The present face of this adit is about 190 feet vertically below the summit of the ridge, and almost directly under an open crosscut, about 60 feet in length, that has been made across the ridge near its summit; in this there is exposed a stockwork made up of narrow quartz veins and stringers in altered country-rock, badly crushed, and mineralized with copper-carbonate ore of low grade for a width of about 40 feet. It was for the purpose of crosscutting this body at depth that the adit examined has been driven.

The adit is 525 feet in length under cover, with an open-cut approach about 30 feet in length. For a distance of 470 feet the course of the adit, which is S. 6° W. (mag.) from the portal, is parallel with the strike of the cleavage-planes in the country-rock, which resembles diorite, but at that point a well-defined fracture-plane is noticeable. This forms the northern line of demarcation, or foot-wall, between the diorite and the mineralized stockwork that is exposed at this point in the adit, and which has its line of strike from N. 84° W. (mag.) to S. 84° E. (mag.), or at right angles to the course of the adit.

The stockwork is crosscut by the adit from the fracture-plane mentioned to the face, or for a distance of 60 feet. This stockwork is found to be made up of stringers and impregnations, chiefly of copper-carbonate ore, with some sulphides, in a gangue composed of crushed country-rock and quartz cemented together with calcite, and shows characteristics similar to the exposure in the open-cut mentioned. The grade of the mass is evidently very low, but appears to be improving near and at the face of the adit, which had not at the time of the examination been driven far enough to crosscut to the hanging-wall, or southern line of demarcation between the stockwork and country-rock.

No samples were taken, because the mineralized body is evidently a concentrating proposition; and in order to obtain such a sample as would be reliable, it would have been necessary to have secured an average one of sufficient quantity for concentration tests, for which work the writer had no facilities.

Maxine Group.

This group of mineral claims, located near the north shore of Kamloops lake, was examined by the writer last summer—although it was examined by him in 1913—because additional work of a development nature had been performed during 1914 and 1915. The location of this property is particularly favourably situated as regards transportation, as an aerial tramway about 1,600 feet in length would reach from the mine-workings to the track of the Canadian Northern Pacific Railway.

The additional work consisted of drifting a total distance of 67 feet on the upper adit level; also lowering the floor of the lower crosscut adit, preparatory to driving a drift along the strike of the vein, on an incline to intersect the bottom of the winze, 14 feet below the floor of the existing drift.

The drifting on the upper level has been driven for a distance of 55 feet towards N. 30° W. (mag.) from the crosscut, and 12 feet towards S. 30° E. (mag.). The north-west drift parallels the ore-body, which is exposed all along the east side of the drift or hanging-wall side of the ore-body, but has not been mined. The south-east drift has been driven along the ore-body, which has been mined as the work progressed. As no crosscut has been made across the copper-bearing ore in the north-west drift, the width is undetermined, but was 3 feet at the point where the vein was crosscut by the adit, with impregnations of native copper in the country-rock wall for an undetermined width. In the south-east drift the width of ledge-matter and ore at the face is 15 inches.

The mineralization consists chiefly of bornite and chalcocite, irregularly disseminated through a gangue made up for the most part of soft, unctuous, talcose material carrying calcite and some quartz, badly crushed and decomposed. An average sample across 15 inches at the face of the south-east drift on this level assayed: Gold, trace; silver, trace; copper, 1.5 per cent.

On the lower level the work of lowering the floor of the crosscut adit, which is 60 feet in length, was progressing, but had not been carried sufficiently far to reach the drift at the face of the crosscut. The winze sunk 14 feet below the floor of the drift had been unwatered, and an average sample of ledge-matter and ore was taken across 12 inches at the bottom of the winze which assayed: Gold, trace; silver, 0.2 oz.; copper, 2.9 per cent.

At the bottom of the winze the full width of the fissure between well-defined walls is nearly 6 feet; but only 12 inches was sampled, because the remaining 5 feet at this point is made up of black rock in which there are some impregnations of native copper and a narrow seam filled with copper carbonates.

The width of the fissure has increased between the roof of the drift and the bottom of the winze, about 20 feet below, from a few inches to nearly 6 feet. This fact indicates the lenticular structure of the vein, which was referred to in the report by the writer in the Minister of Mines' Report for 1913. The vein is 3 feet wide, almost filled with copper ore of high grade, where it is crosscut by the upper adit, 50 feet above the lower, and 64 feet above the bottom of the winze; consequently, very systematic and thorough prospecting is needed to determine the value of the proposition on a commercial basis.

As the conditions with regard to the development-work on other mineral claims than those described herein in the vicinity of the town of Kamloops were much the same as when the writer made an examination in 1913, and as each mineral-bearing property was fully described in his report published in the Minister of Mines' Report for that year, it is deemed unnecessary to refer to such in this report, as the description would be essentially merely repetitions.

GRANDE PRAIRIE.

Molybdenite Ore.

In pursuance with instructions received from the Provincial Mineralogist, the writer rode from Kamloops on September 29th last to Grande Prairie Settlement, distant forty-six miles, to examine some reported occurrences of molybdenite ore and gypsum in that vicinity. Grande Prairie is the name given to a wide portion of the Salmon River valley, situate about twenty miles almost due south from Ducks Station, on the Canadian Pacific Railway.

Several years back this portion of the Salmon River valley was settled by farmers, who have been quite successful. The river flows through the valley for several miles in an almost due east course; but at the extreme upper end of the settlement there is a bend, above which the river flows, from a southerly direction, in a course slightly east of north. Above the bend in the river the valley is much narrower than it is below, as here the range of hills known as

the Monte hills, the summits of which reach an elevation of 2,580 feet above sea-level, or about 1,000 feet above the level of Grande Prairie, encroaches on the valley on its western side, while the foot-hills of another range with loftier peaks in the distance, such as Boulean mountain, with an elevation of 6,000 feet, and Teheetkun mountain, 6,830 feet, encroach on the valley on the eastern side.

The rock formation of the Monte hills belongs to Dawson's Nicola series, made up of volcanics chiefly, but with limestones and argillites. An occurrence of molybdenite ore outcrops on the *Kennallan* group of mineral claims on the summit of the foot-hills, immediately overlooking the valley of the Salmon, and about 300 feet above it. This group is located on the North-east Quarter of Section 14, Township 17, Range 14 west, and South-east Quarter of Section 23, Township 17, Range 14 west.

Kennallan Group.

This property consists of the *Silver Wedding*, *Kennallan*, and *Bonaccord* mineral claims, owned by C. A. Mackay, of Port Moody; Charles A. Bodie, of Vancouver; and K. W. Mitchell, of Port Moody. This group of mineral claims was originally staked as a copper proposition many years ago, but the locations were abandoned, although many outcroppings, open-cuts, and shafts exposed molybdenite ore. At that time there was no demand for molybdenite ore, but during the war the demand has been greatly increased.

In the past the principal world's supply of molybdenum ores has come from Australia, principally Queensland. Norway is also a producer of molybdenum ores. Deposits of molybdenite are reported as occurring in Ontario, Quebec, Nova Scotia, and New Brunswick, as well as in British Columbia.

As the Assistant Provincial Mineralogist also examined an occurrence of molybdenite in the Nelson Mining Division, which he has described in this volume of the Minister of Mines' Report on page 165, and has there given the main facts relative to the technology, uses, etc., of molybdenite ore, it is unnecessary to repeat the same in this report.

The increased demand for molybdenite concentrates caused C. A. Mackay, who had previous knowledge of the property, to stake the abandoned claims with the intention of developing the ore-bodies, and, if the results warranted, erecting a concentrating mill. The claims are staked adjoining each other in an L-shaped block. The boundary-lines of the *Silver Wedding* and *Kennallan* extend from south-east to north-west.

There are apparently four distinct zones in which the rocks are mineralized, and the outcroppings, open-cuts, and shafts show molybdenite ore usually in a gangue composed of garnetite and quartz. These outcrops are detached from each other, but can be followed from a point about 500 feet in a south-easterly direction from the north-westerly boundary of the *Silver Wedding* claim, across the *Kennallan*, and on to the *Bonaccord*.

On the *Silver Wedding* mineral claim, where the first outcropping of mineralized rock occurs, an outcropping occurs in diabase country-rock, very much altered and in contact with limestone, and is further exposed by a prospect-hole about 4 feet deep in which some mineralization is noticeable. This is composed chiefly of copper carbonate, with specks of molybdenite associated with the copper mineral, but no data of value is shown. This outcrop occurs in what is called No. 1 zone, which is the most south-westerly of the four zones; No. 2 zone is located about 600 feet in a northerly direction from No. 1; No. 3 zone is located still farther in a north-easterly direction, and is apparently of the least importance; the No. 4 zone occurs about 500 feet in a north-westerly direction from the No. 1 zone.

In a north-westerly direction, about 30 feet from the prospect-hole already mentioned, another outcropping occurs, with particles of molybdenite ore disseminated through an altered rock, resembling a lime silicate that appears to fill a fissure in the diabase country-rock. An open-cut 10 feet long and 4 feet deep has been made on this outcropping, in which the molybdenite-bearing rock is about 2 feet wide. This rock shows a decided line of strike towards N. 40° W. (mag.) and dip at an angle of 52 degrees towards the south-west.

Near the dividing line between the *Silver Wedding* and *Kennallan* mineral claims, but on the first-named claim, a well-defined contact between limestone and diabase rocks is exposed. In this contact at the face of an open-cut there is molybdenite ore showing; possibly about ½ of 1 per cent. would represent the proportion of mineral to rock, across about 1 foot of limestone and garnetite rock.

Near the last-mentioned open-cut an incline shaft has been sunk on an angle of about 45 degrees towards the south-west (mag.), and is said to be 40 feet deep; but this could only be examined to a depth of about 20 feet, as below that depth the shaft was full of water. This shaft has been sunk in ledge-matter, between 2 and 3 feet wide, between the contact of crystalline limestone and diabase. The ledge-matter is made up of garnetite and a lime-silicate rock, in which occur flakes and lumps of molybdenite ore as impregnations disseminated irregularly through the rocks. At the portal of the incline shaft there is quite a large dump of the mineralized ledge-matter, from which a sample was taken representing an approximate average; this assayed: Molybdenite, 1.5 per cent.; copper, *nil.*

On the *Kennallan* mineral claim, near the dividing line between it and the *Silver Wedding*, there is a large open-cut about 40 feet long by 10 feet wide and from 2 to 4 feet deep. This has been made at the contact of a narrow tongue of crystalline limestone and diabase. In this cut molybdenite ore occurs in a lime silicate and garnetite gangue averaging 2 feet wide, and at one point, where two cross-fractures about 10 feet apart are seen, the ore is on both sides of the limestone. A selected sample from this cut assayed: Molybdenite, 3.2 per cent.; copper, *nil.*

In another open-cut about 100 feet distant in a north-westerly direction from that last mentioned, the line of strike of the contact in the formation has been changed to N. 10° W. (mag.), and dip of the crystalline limestone to an angle of 60 degrees towards the west (mag.). In this cut the contact between the igneous rock and limestone is not as well defined as in the open-cuts already described, nor is the mineralization as pronounced.

Beyond this last-mentioned open-cut in a north-westerly direction the indications show that, apparently, the north-western extremities of the No. 1 mineralized zone has been reached. It also appears as though the molybdenite-bearing portion of this zone, that may develop into a commercial success, has a possible aggregate length of about 150 feet; also that the average width of mineral-bearing ledge-matter is about 2 feet, and that there is possibly an average of about 1½ or 2 per cent. of molybdenite in the deposit; but no tonnage of "ore in sight" can be estimated, or even guessed at, until further and systematic work has been performed.

The No. 2 zone occurs along a ridge nearly parallel to that on which No. 1 zone occurs, and is exposed on both the *Bonaccord* and *Kennallan* mineral claims. This ridge is about 600 feet distant in a northerly direction and across a shallow gulch, or depression, from the No. 1 zone. At one point on the *Bonaccord* claim an open-cut has been made in diabase country-rock, in which there is a fissure about 5 feet wide filled with garnetite, quartz, and crushed country-rock that carries a little molybdenite ore associated with chalcopyrite.

In a S. 30° E. (mag.) direction from the last-mentioned open-cut, and distant about 100 feet, but on the *Kennallan* claim, there is an incline shaft said to be 40 feet deep, but full of water below about 20 feet. In this shaft is exposed a fissure in diabase about 5 feet wide, with its line of strike towards S. 36° E. (mag.) and dip at an angle of 43 degrees towards the south-west (mag.). The filling in this fissure is principally quartz, with some garnetite mineralized with flakes and lumps of molybdenite, but showing no chalcopyrite. A representative sample taken from this incline shaft at one point assayed: Molybdenite, 1.8 per cent.; copper, *nil.* About 150 feet in a south-easterly direction from the incline shaft just referred to there is a contact between igneous rock and a mass of crystalline limestone. This is exposed in an open-cut 70 feet long and an incline-cut 12 feet deep at the southerly end of the open-cut. The course of the open-cut is S. 18° E. (mag.), which is the direction of the line of strike of the contact-plane, the dip being at an angle of 39 degrees towards the west (mag.).

Between the limestone hanging-wall and diabase foot-wall there is a mineralization of molybdenite ore about 2 feet wide in a gangue composed chiefly of crushed igneous rock, with a little quartz. The contact-plane in two places in the long open-cut has been broken by intrusive granite dykes; each one is about 12 feet wide. The lines of strike of these dykes are parallel, and trend towards S. 70° W. (mag.). The ore on the dump, which was taken from the open and incline cuts, appears to be of a better average grade in molybdenite than elsewhere on the property.

Another outcropping of limestone, but associated with felsite, mineralized with molybdenite, is seen about 100 feet distant from the last-mentioned work in a southerly direction. An open-cut has been made 8 feet long on this outcropping, in which is exposed diabase rock, both overlaying and underlaying the mineralized limestone and felsite.

The No. 3 zone, in which there occur instances of rock mineralized with molybdenite, is, so far as at present known, confined to the *Bonaccord* claim; the outcroppings are seen at and near the discovery post of that claim, also at some considerable distance in a south-easterly direction from that post. Open-cuts have been made on these outcroppings, but, while the molybdenite ore is exposed, the work has not been carried far enough to demonstrate commercial value.

No. 4 zone may possibly prove to be an extension in a north-westerly direction of the No. 1 zone, but when the examination was made no work had been done to demonstrate that such is the case. The mineralized outcroppings usually are in a garnetite gangue between crystalline limestone and a granitic rock, but there are also outcroppings in which the molybdenite occurs in the granite. The percentage of molybdenite in these exposures is quite low.

The important facts with regard to the occurrence of molybdenite ore on the *Kennallan* group of mineral claims are: First, the large number of detached outcroppings in which molybdenite occurs; second, the regularity of the general line of strike of the mineralized ledges in the various zones; and, third, that the highest-grade ore invariably occurs at or near a contact between igneous rock and crystalline limestone.

Gypsum-deposits.

These occur on Bolean creek, which flows into Salmon river from the north-west about eight miles east from the hotel at Grande Prairie. The deposits were examined by the writer in 1913 and reported on, his report being published on pages 205-6 in the Minister of Mines' Report for that year. Since then there has been no change in the conditions with regard to the development of the deposits, which are all covered by leases from the Dominion Government; consequently, it is unnecessary to repeat that report here. The owners of the main deposit, the British Columbia Gypsum Company, report that they are awaiting the construction of the proposed branch of the Canadian Northern Pacific Railway from Kamloops to the International Boundary, via Kelowna, before carrying out a proposed policy of development.

ADAMS LAKE.

From Grande Prairie the writer returned to Kamloops on October 3rd, where he received instructions from the Provincial Mineralogist to examine a recently reported discovery of zinc-bearing ore said to occur near the foot of Adams Lake. This lake is about thirty-five miles in length; it is connected with the lower end of Shuswap lake by the Adams river, a turbulent stream about ten miles in length, in which distance the fall is about 200 feet.

Wonderful.

This mineral claim is situated on the west side of Adams lake, about sixteen miles from its foot, and about four miles above Skwaam bay. The owners of the property are A. McConnell, R. H. Brett, and T. Breeden, of Chase. The most direct route by which the claim is reached is that travelled by the writer, who left Chase in company with A. McConnell, one of the owners, at 6 a.m. on October 5th; crossed the foot of Little Shuswap lake in a launch; took wagon and team over a fair road up Adams river to the foot of Adams lake, where the party was met by C. Todd, of the Dominion Government Forestry Service, with a gasolene-launch in which the trip was made up the lake to the property.

An alternative route is by wagon-road up the North Thompson river from Kamloops to Louis creek, distant forty miles; thence up the Louis Creek wagon-road to the forks of the road at Blucher Hall post-office; follow the left-hand fork through the Sinmax valley to Skwaam bay to Todd's ranch; thence to the property by launch or rowboat.

The No. 1 post of the *Wonderful* mineral claim is located on the western shore of Adams lake, where the country-rock is a belt of crystalline limestone, classified by R. A. Daly, of the Canadian Geological Survey, as the Tshinakin limestone. This belt of limestone is about one mile in width, and is found on both sides of the lake; it is underlain by green schists (Daly's Bastion schists), and overlain by an enormous mass of the Adams Lake greenstones.

At the discovery post, near the No. 1 post, there is an outcropping of zinc-sulphide ore, which occurs in a fissure, with well-defined walls so far as could be seen, in the limestone; the line of strike of the fissure is N. 10° W. (mag.) and dip vertical, where it is exposed in an open-cut 20 feet long by 6 feet wide by about 3 feet deep. The gangue material is limestone, through which the ore is disseminated in varying quantities for a width of 6 feet. At some points there

is a width of solid ore between 3 and 4 inches, but usually the ore occurs in lumps in the limestone gangue. A sample taken from the open-cut, representing hand-sorted shipping-ore, assayed: Gold, trace; silver, trace; lead, *nil*; zinc, 43.4 per cent.; iron, 0.7 per cent.

The open-cut mentioned was the only work done at the time the examination was made; the chief reason for this being that the discovery of the ore was made quite recently, and the claim had only been staked a short time previous to the writer's visit; but the owners stated that their intention was to continue development-work, and also to thoroughly prospect the ground, as no prospecting had been done to demonstrate the extent along the strike of the fissure.

North Thompson River.

Ten days previous to making the examination of the *Wonderful* mineral claim just described, the writer had ridden up the North Thompson valley to Chu Chua Indian reservation to examine some recently performed development-work on Whistler mountain. At Chu Chua he met George Fennell, the postmaster, and Exel Chindgrin, a prospector, who accompanied him to the *Fog Horn* and *Lydia* groups of mineral claims, situated near the head of Joseph (Boulder) creek, on Whistler mountain above timber-line, at an elevation of 5,900 feet. This mountain is distant by horse-trail about twelve miles in an easterly direction from Blackpool Station, near the 66-mile post on the Canadian Northern Pacific Railway, but only about eight miles from the 86-mile post via Canyon creek to the North Thompson river. The reason for this difference in distance is because the railroad follows the river, which makes a big bend at the 71-mile post; but at present there is no trail connecting these mineral claims with the railroad at the 86-mile post.

In the Minister of Mines' Report for 1913 the writer described the mineral occurrences he examined, situated adjacent to the North Thompson valley as far up as the 86-mile post along the Canadian Northern Pacific Railway; but during that trip he was unable to examine any properties on Whistler mountain because the surface of the *Fog Horn* group was covered with deep snow, and the *Lydia* group had not been staked.

Whistler mountain is one of the peaks in the main range of lofty mountains which forms the watershed between the North Thompson river to the north and west, the upper Adams river and Adams lake to the east, and the Barriere river to the south. This range also marks this portion of the dividing line between the Kamloops and Quesnel Mining Divisions.

Fog Horn Group.

This group consists of the *Fog Horn* and *Cambria* mineral claims, owned by George Fennell and Exel Chindgrin, of Chu Chua. The location line of the *Fog Horn* claim is from north-east to south-west; this crosses the dividing line between that mineral claim and the *Cambria* claim, and extending to the south-west becomes the location line of the last-named claim.

The prevailing country-rock on this group is a very siliceous limestone, usually of a bluish colour, but sometimes of a black colour, when it is so altered as to make it rather difficult to distinguish it from an igneous rock. The line of strike of the country-rock is about N. 30° E. (mag.) and dip at an angle of about 80 degrees towards the north-west.

At a point near the centre of the *Fog Horn* mineral claim the country-rock is considerably fractured, altered, fissured, and sheared, the latter condition being so much so in places as to give it the appearance of a schist. The fissures, of which there are three prominent ones, are usually narrow, the maximum width of the widest one being 14 inches; this is nearly filled with solid galena ore in a quartz gangue, but with the gangue rock in small quantities as compared with the solid ore; the other fissures, which range in width from 6 to 12 inches, also carry a large proportion of solid galena as vein-filler. In only one place in the workings hereafter described does the gangue rock exceed the solid ore in quantity; this is at the bottom of a shaft and in a short drift started along the strike of a vein. The ore there shows a difference in the mineralization from that found elsewhere on the group, as it shows a percentage of zinc-blende and iron pyrites that is not found in other workings. A sample taken, representing about an average of the ledge-matter at the point sampled, assayed: Gold, trace; silver, 16 oz.; lead, 16.7 per cent.; copper, 6.6 per cent.; zinc, 16.5 per cent.; iron, 17.5 per cent.

A second sample, from another vein, taken from some sacks of ore ready for shipment, of which there are about 25 tons sacked, assayed: Gold, trace; silver, 0.8 oz.; lead, 78.7 per cent.; zinc, 4.8 per cent.

The development-work consists of a crosscut adit, a shaft, two long, deep open-cuts, and some prospect-holes.

The adit is on the *Fog Horn* claim; it is 200 feet in length, driven in country-rock the entire distance, with about 40 feet of backs at the face; this was driven in a N. 60° W. (mag.) direction, with the intention of intersecting a vein opened on the surface by a long, deep open-cut; apparently the face of the adit is somewhere nearly under the north-east end of the open-cut mentioned, but apparently not far enough to intersect the vein; anyway, a survey is necessary to establish the exact position.

The open-cut just referred to is 100 feet in length and from 10 to 12 feet deep. This exposes a narrow fissure in siliceous, limy country-rock, carrying galena ore, that has been mined to the bottom of the open-cut, sorted and sacked ready for shipment to a smelter. At the north-east end of the cut, nearly over the face of the adit mentioned, the vein strikes about N. 20° E. (mag.) and dips at an angle of 15 degrees towards the north-west (mag.) instead of at the high angle shown in other workings, and in fact in this same open-cut, farther towards the south-west.

Another open-cut has been made at a distance of about 150 feet in a westerly direction from the one just described. This is about 200 feet long by 10 feet deep at the deepest portion; it has been made in a N. 30° E. (mag.) direction along the strike of a fissure in a siliceous, limy, schistose country-rock. The vein is from 6 to 14 inches wide, carrying chiefly solid galena in a quartz gangue. The dip of the fissure is at an angle of about 85 degrees towards the north-west (mag.). Most of the ore occurring in this vein has been dug out of the cut and sacked for shipment.

At a point about 100 feet easterly from the last-mentioned open-cut, a shaft has been sunk to a depth of 35 feet below the collar, and a drift has been started from the bottom in a N. 30° E. (mag.) direction along the strike of a vein exposed in the shaft. The dip of this vein is at an angle of 70 degrees towards the south-east (mag.), or in an opposite direction from the dips of the other veins mentioned. The vein here is from 6 to 12 inches wide, carrying nearly solid galena as a filler, except in the bottom of the shaft and drift, where the ore occurs as kidneys and bunches in the quartz gangue, and carries more zinc-blende and iron pyrites than the other veins already described (*see* assay already referred to).

Last summer the owners of this property cut out a winter or sleigh road twelve miles long from the camp to Blackpool Station, on the Canadian Northern Pacific Railway, preparatory to shipping ore during the winter months.

Lydia Group. This group consists of the *Lydia*, *Lydia Fraction*, *Rosenquist*, and *Abe Lincoln* mineral claims, owned by George Fennell, Exel Chindgrin, and Alex Dobson, of Chu Chua. The property is situated near the head of Canyon creek, a tributary of the North Thompson river that flows into that river from the south, near the 86-mile post on the Canadian Northern Pacific Railway, and about six miles distant in an air-line from the *Lydia* group.

The prevailing country-rock on a portion of the group is a belt, of undetermined width, of semi-crystalline slates, talcose, greasy, and highly coloured, in a variety of tints. These appear to grade into metamorphic siliceous schists, into which porphyritic and other igneous dykes have intruded. One of these dykes is very prominent and stands out in bold relief, as it cuts through the schists at right angles to their line of strike, and for some distance forms an almost perpendicular wall about 500 feet high along the south-westerly side of Canyon creek.

The schist is mineralized, with some chalcopyrite associated with iron pyrite, as exposed on the face of a bluff near to the porphyritic dyke mentioned, for a width of about 300 feet by horizontal measure, and for an undetermined distance along its line of strike. The line of strike of the mineralized schist is S. 40° W. (mag.) and dip at an angle of 45 degrees towards the north-west (mag.).

At a point about 20 feet below the top of the precipitous ridge that forms the south-westerly bank of Canyon creek, a drift-adit has been driven for a length of 30 feet; this follows the line of strike of the mineralized schist, and exposes chalcopyrite and iron pyrite minerals occurring in the schist the entire distance, with similar material in the face.

There are no exposures of "rock in-place" on the surface, back from the bluff bank of Canyon creek in the direction of the line of strike of the mineral-bearing schist, for a distance of nearly half a mile; so that it is impossible, until open-cut work has been done, to trace any continuity owing to the grass, debris, wash, and alluvial that hides the formation; but the width

for about 300 feet is easily traceable along the face of the rocky ridge that forms the creek-bank, because the top of the porphyritic dyke has been carried away by erosion, leaving the schist bare.

HEFFERLY LAKE.

The writer returned to Kamloops from the *Fog Horn* and *Lydia* groups, via upper Louis creek, Hefferly lake, and Hefferly creek, because of a reported discovery of copper-bearing ore near Hefferly lake. This section is reached via a good wagon-road that branches off from the North Thompson valley between the Barriere river and Louis creek. The route to the Upper Louis Creek valley traverses an agricultural district, a portion of which is one of the oldest and best-improved settlements in the mountains of the Province; other portions of the route, especially part of the way down Hefferly creek, traverse very narrow valleys, consequently are not as well settled up by farmers or ranchers.

The discoveries of copper ore were reported to the writer to be located in a range of hills bordering the north shore of Hefferly lake. On arrival near the place that had been described to him, he was unable to find any of the owners to guide him over the claims that had been staked, but succeeded in finding the stakes, as well as some prospect-holes and open-cuts, on two claims, one of which was reported to have been bonded by the Granby Consolidated Mining, Smelting, and Power Company, and as being the most prominent and promising of those located. These are described as follows:—

Monarch and Lake View.

The *Monarch* mineral claim is owned by Hugh McLeod and partners, of Vancouver. The *Lake View* mineral claim is owned by Archie MacDonald, of Hefferly lake. These mineral claims, although not adjoining each other, are bracketed together for the purpose of this report, because the geology, mineralized outcroppings, and general characteristics are so very similar that any report descriptive of one of them would, to all intents and purposes, be descriptive of the other.

Both of the claims are located in a range of low hills that borders the north shore of Hefferly lake, and very near the wagon-road. The *Lake View* mineral claim is about half a mile in an easterly direction from the *Monarch*.

The prevailing country-rock is a breccia, in which there are several outcroppings of gossan, some of them being of considerable extent, but showing no mineralization except impure iron ore.

As it was generally reported that the outcroppings and mineral exposed in several open-cuts carried fair copper values, the writer himself took two samples, one from each of the mineral claims; and also obtained a sample taken by one of the owners, which it was claimed was a fair representation of the material that had yielded copper values by assay. These samples assayed as follows:—

Brewer's Samples.—Lake View mineral claim: Gold, trace; silver, trace; copper, trace; iron, 15.5 per cent. *Monarch* mineral claim: Gold, trace; silver, trace; copper, *nil;* iron, 13.3 per cent.

Owner's Sample.—Lake View mineral claim: No sample. *Monarch* mineral claim: Gold, trace; silver, trace; copper, trace; iron, 51 per cent.

NICOLA MINING DIVISION.

REPORT OF W. N. ROLFE, MINING RECORDER.

I have the honour to submit herewith the annual report and office statistics of the Nicola Mining Division for the year ending December 31st, 1915.

From a broad standpoint there has been very little change in the general situation as regards metalliferous mining through the Division, but assessment-work has been well kept up, with a very considerable number of new locations recorded.

Some satisfaction has been expressed on the bonding of several mineral claims situated on Ten-mile creek, known as the *Aberdeen* group, to a syndicate headed by T. J. Corwin, of Seattle, Washington, U.S.A.; it is also confidently reported that work will be resumed in the spring on a group of claims located, and partly developed, in the vicinity of Stump lake, which have been lying idle for many years.

On the *Aberdeen* a force of twelve men is now employed; a shaft has been sunk 40 feet in depth, and drifts run in on the ore for 35 feet at the 33-foot level. Drifting is also in progress both ways from the shaft at the 50-foot level, the vein extending for 5 feet between walls, and being apparently continuous. Assay returns show that the average value of the ore yields about 4 per cent. copper, 2 oz. in silver, with a trace of gold.

In the Aspen Grove section a shipment of 40 tons of copper ore was made in the late fall from the *Copper Star* to the Greenwood smelter, but the returns did not realize expectations, probably owing to lack of expert knowledge as to ore values.

OFFICE STATISTICS—NICOLA MINING DIVISION.

Locations recorded	84
Free miners' certificates	115
Certificates of work	77
Bills of sale	4

NICOLA MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

ASPEN GROVE CAMP.

Leaving Tulameen village on August 18th, the writer rode to Aspen Grove Post-office, where he stopped, to comply with instructions received from the Provincial Mineralogist to examine any recent work done in the territory adjacent, and known as the Aspen Grove camp.

This camp was visited by the Provincial Mineralogist personally in 1901, and described in the Minister of Mines' Report for that year; also by the Assistant Provincial Mineralogist in 1913, and described in the Minister of Mines' Report for the same year. The camp was also examined by Chas. Camsell, of the Canadian Geological Survey, in 1910, and by R. A. Johnson, also of the Survey, in 1904.

Aspen Grove camp has had a somewhat checkered career since the first discovery of copper ore was made, by H. Schmidt, of South Dakota, in the late fall of 1899. Various causes have retarded development, the chief of which has been the low grade of ore found on the majority of the mineral claims, of which there have been approximately 200 located, and about sixty of these Crown-granted. The main portion of the camp at the present time is within a distance of about twelve or fourteen miles in an air-line from Canyon House, the nearest point where railway transportation can be reached. Between Canyon House and Aspen Grove camp there is a good auto or wagon road, the distance by which is about twenty miles, or about the same as between the camp and Nicola or Merritt via a good auto or wagon road.

For these reasons it would appear that the future of the camp is in the hands of the property-owners, because if a sufficient tonnage of ore of a commercial grade is developed, it is to the interest of the railway company to build a branch line to haul it out. The mineral claims are approximately all owned by local ranchmen and prospectors, except a few, in which some of the business-men in Merritt and Nicola are interested; consequently, lack of sufficient capital to extend the development-work already done is an insurmountable difficulty that can only be overcome by the advent into the camp of practical mining men or corporations with ample capital to invest to carry on extensive and systematic development. In the writer's opinion prospecting with diamond-drills is essential to demonstrate the value of the properties.

The main difficulty the writer met with during his examination was the fact that in nearly every case the old workings, which are somewhat extensive on many of the mineral claims he visited, could not be properly examined or systematically sampled because of water in the shafts; consequently, it was impossible to make a thorough or even a satisfactory superficial examination of the majority of the most promising properties.

The conclusion arrived at, after seeing those properties described later in this report, is that the camp merits a thoroughly systematic examination and sampling, also extensive development, because, although undoubtedly the bulk of the ore is of too low grade to ship, it does appear that since the success of the flotation method of concentration with oil has been demon-

strated such method might be applied in this camp to advantage so far as treatment of the ore is concerned, if development resulted in proving that the ore-bodies are of sufficient extent to warrant works of large capacity.

Daisy Group.

This group consists of four mineral claims—the *Daisy*, *Rose*, *Violet*, and *Pansy*, owned by Wm. Augstad, of Aspen Grove; W. T. Shatford, M.L.A., of Penticton; and A. R. Carrington, of Merritt. The property is situated on Bates creek, in Roberts pass, about two miles north from Missezula lake, and about six miles south-east from Aspen Grove Post-office, on one of the lines surveyed and cross-sectioned by the Kettle Valley Railway Company prior to construction of this railway via Spearing creek. It is also near a proposed wagon-road, partly built to connect Aspen Grove with Princeton via Bates creek, Missezula lake, and Summers creek, as a shorter route than the present one via Tulameen village and Granite creek.

The prevailing country-rock in the neighbourhood of this property is a very much altered volcanic, apparently belonging to Dawson's Nicola series or Camsell's Tulameen series, with high bluffs of basalt occupying a considerable area to the east from Roberts pass.

On the *Daisy* mineral claim, one of the *Daisy* group, in a dyke of an altered volcanic rock, there occurs a fractured zone of considerable but undetermined extent, both in length and width. The innumerable narrow fissures are filled with copper minerals, chiefly carbonates. This mineralization extends into the dyke rock, through which particles of mineral are disseminated irregularly, but appearing to occur in sufficient quantity to give the rock a commercial value if concentrated, and to warrant the application of a thoroughly systematic method of prospecting. The mineralization in the fissures is very pronounced, and composed, to a great extent, of high-grade ore; but these fissures, so far as exposed, are too narrow to be mined separately, and while hand-sorting might be done, the question of cost has to be considered. When this is taken into account, it will most probably be ascertained that it is inadvisable to attempt to apply such crude methods, but that it is more satisfactory to mine on a larger scale, and adopt the flotation process of concentration, provided systematic prospecting demonstrates that the extent of the mineralized rock is sufficient to warrant working the property on a commercial scale.

There are three open-cuts on the *Daisy* claim, two of which are 30 feet long respectively; also a short adit about 10 feet under cover driven from the face of one of the cuts. Each of these workings is a crosscut into the dyke, and in each are exposed similar conditions as to fracturing and mineralization. A sample typical of ore that can be hand-sorted from the mass assayed: Gold, trace; silver, 1.8 oz.; copper, 7.8 per cent.

The line of strike of the volcanic dyke is N. 40° W. (mag.) and the general dip of the fissures is about 55 degrees towards the south-west (mag.).

Big Sioux Group.

This property consists of five mineral claims located adjoining each other, with three in line from north to south, the centre claim being the *Big Sioux*, and three located to the south and west of that claim. The group is owned by H. H. Schmidt, of South Dakota, and has not been Crown-granted. All of the work has been performed on the *Big Sioux* claim, which was staked in 1899, being the earliest location made in the camp, and on which the first discovery of copper was made by the present owner, a prospector from South Dakota.

In the Minister of Mines' Report for 1901, this, as well as several other properties, are described by the Provincial Mineralogist, and in the Report for 1913 briefly mentioned by the Assistant Provincial Mineralogist. Reference to these reports shows that the work done since the latest report was made is confined to cross-trenching on the surface. The most important of these open-cuts is one that is located in a south-easterly direction from the shaft, described in the Report by the Provincial Mineralogist, and about 100 feet in a north-westerly direction from the adit, described in the Report by the Assistant Provincial Mineralogist. In this open-cut, which is 50 feet long, there is a mineralized zone crosscut for 15 feet, near the entrance of the cut, in which copper-carbonate ore is the prevailing mineral. The remainder of the cut has been driven through an altered andesitic dyke, with but little mineralization, until near the face, where copper carbonates again occur disseminated through the dyke rock, which is very much fractured and brecciated. Apparently this occurrence of mineralization has the same line of strike, and is an extension of the zone in which the shaft was sunk, that is referred to by the Provincial Mineralogist in his Report published in 1901; but, if so, the stringers of high-grade ore exposed while sinking the shaft, and of which there is about 50 tons on the dump, are

wanting where the open-cut has been made, because the ore exposed by this cut, from its appearance, will not carry 2 per cent. of copper.

A grab sample taken from the high-grade dump by the writer, to show the possibilities of that portion of the ore-body, assayed: Gold, trace; silver, 8 oz.; copper, 20.2 per cent.

The Provincial Mineralogist, in his Report for 1901, refers to the fact that he roughly sampled the same dump, and an assay showed that his sample contained: Gold, 0.2 oz.; silver, 2.4 oz.; copper, 12.6 per cent.

There was no one on the property at the time of the writer's visit, but H. H. Schmidt was expected to shortly make his customary annual trip to do his assessment-work.

It is to be regretted that further work has not been done at the shaft, which should be sunk to a deeper level, and the ore-bearing zone drifted on along the strike, in order to prove the extent of the zone, and especially of that portion that carries the high-grade ore.

No satisfactory examination can be made under the present conditions, and any samples taken from either the high- or low-grade portions of the ore body, or bodies, are liable to be misleading unless thoroughly systematic sampling is done, which would entail the taking of large samples, and concentrating them in order to ascertain whether or not a commercial success would result from mining operations. This the writer was unable to do, as the facilities were not at hand to unwater the shaft, or to properly take large samples from the mineralized portions of the open-cut.

Hit or Miss.

This mineral claim adjoins the *Big Sioux* group on the south, and is owned by A. E. Howse, of Nicola, and associates. There are two shafts on this property, but as both contained water to within a few feet of the collar of each, it was not possible to make any examination of either or to ascertain the depth.

A mineralized zone in which one shaft is sunk has its outcrop on a knoll; the minerals showing in the outcrop are copper carbonates and flakes of chalcocite. The strike of the zone is S. 40° W. (mag.) and the dip of the mineralized bands in the zone is vertical.

The second shaft is situated about 200 feet in a southerly direction from the one referred to, and apparently in a mineralized zone lying parallel to that first mentioned, or possibly further development-work may demonstrate that both shafts are sunk in the same zone, as the country-rock and mineralization are very similar in both outcrops, in which the values are undoubtedly low grade, but possibly might pay if the ore is concentrated. The writer did not attempt to take any samples because of inability to get down the shafts.

In the description of this mineral claim by the Assistant Provincial Mineralogist in the Minister of Mines' Report for 1913, he refers to only one shaft, the one last mentioned in this report, and the assay return of a sample taken across 6 feet as "0.6 per cent. copper content."

Giant.

This property is situated about 3,000 feet south from the *Hit or Miss* mineral claim and is owned by H. H. Schmidt, of South Dakota. The general conditions on the *Giant* mineral claim, with regard to the characteristics of the country-rock, are similar to those occurring on the other claims already described in this report; but the mineralization is somewhat different, as on this property chalcopyrite and iron pyrite ores predominate instead of copper carbonate; there is also a small amount of copper-glance. The first-named ores occur chiefly as lenses in the mineralized zone, with the iron pyrite in the greatest quantity, while the last-named ore occurs as impregnations in the volcanic rock.

The work on this property consists of an adit driven for a distance of 225 feet under cover in a S. 25° W. (mag.) direction, with an open-cut approach 30 feet in length; there are also several other open-cuts, in one of which a mineralized zone has been crosscut for a distance of 15 feet without exposing any walls.

The adit referred to was apparently driven for the purpose of crosscutting a mineralized zone in a volcanic dyke of undetermined dimensions. This purpose was partly accomplished for a short distance under cover from the portal of the adit, but from that point the line of strike of a fractured, sheared, mineralized portion of the country-rock, from 2 to 6 feet wide, was followed for about 75 feet, or to a point about 100 feet from the portal; beyond this point to a point near the face of the adit no mineral is in evidence. Near the face, though, particles of chalcopyrite and iron pyrite, with the latter predominating, occur in the dyke rock as impregnations, and the course of the adit appears to crosscut into the dyke, but has not been driven sufficiently far to determine its extent.

The values contained by the rock are undoubtedly quite low grade, and further systematic prospecting is necessary to determine the extent of the mineralized zone; this, in the writer's opinion, is justified.

Copper Standard Group.

This group contains six Crown-granted mineral claims, owned by Isaac Eastwood, of Merritt, and partners. This property is situated about two miles in a southerly direction from the northern end of the Aspen Grove mineral belt, and near the western boundary, so far as at present known.

The writer examined the *Copper Standard* mineral claim, one of the group, and found that no work had been done since it was Crown-granted; or since it was examined by the Assistant Provincial Mineralogist in 1913, who referred to the property in the Minister of Mines' Report for that year, to which report the writer has nothing to add.

Cincinnatti Group.

There are eight Crown-granted mineral claims in this group, which is situated about 3,000 feet southerly from the *Copper Standard* group. The property is owned by J. E. Bate, of Aspen Grove, and associates. Although no work has been done since the Crown grants were issued, and all of that work is described by the Assistant Provincial Mineralogist in his report in the Minister of Mines' Report for 1913, the writer visited the property, at the request of J. E. Bate, the principal owner, and took one typical sample of the mineralized zone on the *Medal Fraction* mineral claim, which appears to traverse the property for an undetermined distance. The work that has been done is not sufficient to demonstrate the extent, either in length or width, and so far practically nothing is known with regard to the continuity at depth, because an adit driven at a lower level and projected to crosscut the mineral bearing zone has not yet done so.

The following is a list of assays made from samples taken from the various claims in the *Cincinnatti* group of mineral claims at different times:—

Samples taken by Provincial Mineralogist.			Samples taken by Assistant Provincial Mineralogist.			Samples taken by Wm. M. Brewer.		
Gold.	Silver.	Copper.	Gold.	Silver.	Copper.	Gold.	Silver.	Copper.
Oz.	Oz.	Per Cent.	Oz.	Oz.	Per Cent.	Oz.	Oz.	Per Cent.
0.02	Trace	1.2	...	...	1.5	Trace	0.2	1.5
...	...	1.53	...	...	2.3	...	...	...
0.04	Trace	1.5	...	...	1.1	...	...	...
...	...	...	...	...	1.7	...	...	...
...	...	...	...	...	0.5	...	...	...

When these results are compared, it is interesting to note how little difference there is between the various samplings, indicating the homogeneity of the material that makes up the mineral-bearing zone.

Copper Star.

This mineral claim, which has never been mentioned in any earlier reports on this camp, is located almost at the extreme northern boundary of the Aspen Grove mineral belt, and within half a mile from the main wagon-road between Merritt or Nicola and Princeton, by which route the distance from this property to either Merritt or Nicola is less than eighteen miles.

Originally this mineral claim was staked as the *V.V. and E.*, but that record was allowed to lapse by the heirs of the original locator, who died a few years ago, and it was relocated by Wm. McNeill and Allen Shuttleworth, who own pre-emptions adjoining it.

The original locator evidently had a great deal of confidence in the future of the property, because in addition to the work he did in prospecting the claim, which was considerably more than the average prospector performs, he erected platforms for sorting-tables and ore-bunkers, all well and substantially built of logs.

The discovery of copper mineral was first found on a low, rocky, isolated ridge composed of the altered volcanic rock common to the Aspen Grove mineral belt. This ridge rises about 30 or 40 feet above the alluvial wash which practically surrounds it, and on which good crops of wild and timothy hay, as well as oats, vegetables, and other farm products, are grown.

The ridge is volcanic rock, the extent of which is at present undetermined, but the outcropping, examined by the writer, where bare rock is exposed by nature, covers an area of about 200 feet square, with indications pointing to outlying portions of the dyke being covered by alluvial for a very considerably larger area.

The rock is fissured, fractured, and mineralized with bornite, chalcocite, and copper-carbonate ores, occurring both as fissures and as impregnations in the adjacent rock. The characteristics are shown in the workings for a width of between 30 and 40 feet and an undetermined length.

An open-cut, apparently driven as a crosscut into the dyke for a distance of 15 feet and a length of 30 feet along the apparent strike, by 15 feet high at the face, is the chief prospecting-work that has been performed. The entrance to the open-cut is connected with the ore-bins and sorting-tables. Beyond the face of the cut several shallow trenches have been made in the surface of the dyke, which proves the width of the mineralization to be about 20 feet wider than is shown in the larger or main open-cut, and a higher grade of ore is exposed than was mined from that cut.

This prospecting-work establishes the fact that the mineralization of the rock is at least of considerable extent so far as the showings on the surface at this point are concerned; also that the ore can be rather easily hand-sorted, which latter fact was shown last fall when a shipment of 45 tons was made to a smelter. This shipment assayed, according to the returns: Silver, 2.2 oz.; copper, 8.7 per cent.; but the ratio of concentration by hand-sorting is unknown. From the general appearance of the ore-bearing zone where the work has been done, the writer is of the opinion that the impregnated and fissured portion of the dyke will carry about 2 or 3 per cent. in copper value without sorting. The proposition is essentially one well adapted for a method of concentration. One advantage possessed by this property is that the indications point to the possibility of a very low mining cost for some time to come, because, apparently, a large tonnage of ore can be quarried before sinking will become necessary.

One Hundred and One Group.

This group contains the mineral claims numbered consecutively from *101* to *109*, located in a block from north to south, 3,000 feet wide by 7,500 feet in length. The property is situated outside of the Aspen Grove mineral belt, one mile and a half in an air-line in a north-easterly direction from Lot 1213, on which Pothole creek empties into Quilchena creek, in the southern portion of the camp.

The group of mineral claims is owned by J. E. Bate and partners, and was located on the assumption that the country-rock, a coarse-grained felsite, contained molybdenite ore. The writer was informed by J. E. Bate, who accompanied him during the examination, that samples of the rock had been sent to assayers for determination, and some of them had made returns that it contained as much as 10 per cent. of molybdenum. On the strength of these returns the owners of the claims have sunk several prospect-pits, each from 5 to 10 feet deep and from 10 to 20 feet long, besides driving an adit 25 feet in length to crosscut the so-called mineralized zone.

Although the writer could not see any indications of molybdenite or any other mineral except a little iron in the rock, he carefully took samples of the material at three different points, which it was claimed carried molybdenite ore, and forwarded them to the Government Assayer at Victoria, whose returns for each sample were: Molybdenum, *nil;* this substantiated the judgment formed by the writer from the appearance of the rock.

Sovereign and Big Dutchman Groups.

There are a total of ten mineral claims contained in these groups, six in the first and four in the last-named group, all owned by J. E. Bate and associates. The boundary-line of the *Big Dutchman* group adjoins the north-east boundary-line of the *Sovereign* group, and as the mineralization and geology on both groups are very similar, the writer has united the two groups in one report. The examination was not at all satisfactory, for the reason that all shafts were full of water and adits in bad condition. No work has been done on the *Sovereign* group since 1913, and that is all described in the report of the Assistant Provincial Mineralogist published in the Minister of Mines' Report for that year; while most of the work on the *Big Dutchman* group was done prior to 1901, when the Provincial Mineralogist made an examination, and described this work in his report which was published in the Minister of Mines' Report for that year.

Since the writer's return to Victoria he has referred to these reports, and after comparing them with his notes is convinced that the ground is so well covered in the earlier reports that there is nothing he can add, or, for that matter, that can be added by any engineer, until the old workings are unwatered and cleaned out, so that a thorough examination underground can be made, which has not been possible at any time in the past when a representative of the Mines Department has visited the camp.

NICOLA VALLEY.

Leaving the Aspen Grove camp on Sunday evening, August 22nd, the writer rode to Merritt to continue his work in the Nicola valley, where coal, copper and iron ores, as well as gypsum, occur.

The coal-mining industry is the most important in this section, and has been since 1901, when the first really serious attempts to prospect for coal by diamond-drill borings were inaugurated.

During that year the Provincial Mineralogist examined the coalfield, and his report was published in the Minister of Mines' Report for 1901, but at that time prospecting had only commenced. In 1904 Dr. R. W. Ells, of the Canadian Geological Survey, made a reconnaissance of the Nicola coalfield, his report being published in Vol. XVI., pages 42A to 74A, Annual Report of Geological Survey for 1904. During 1913 this section was visited by the Assistant Provincial Mineralogist, whose remarks relative thereto are published in the Minister of Mines' Report for that year.

So far as the copper-mining industry in the Nicola valley and adjacent territory, such as on Ten-mile creek, is concerned, the operations have been carried on spasmodically. For example, in 1900 there was considerable activity shown on Ten-mile creek, especially on the part of prospectors, in staking claims, and a few thousands of dollars were expended by some syndicates in attempting to develop mines; but the delay in building railroads, which would furnish cheap transportation for hauling ore, was stated by the managements to be, to a great extent, responsible for closing down work in 1902 and for the inactivity in mining for copper ore from 1902 until 1908. During the last-mentioned year a prospector and miner named Robert Wiltshire made some shipments from the *Copper Belle* mine, described later in this report. Later, this mine was closed down for the reason that Wiltshire had no capital to continue development-work. Wiltshire then started out on a prospecting trip, and it is presumed was killed by a bear or in some other manner, as his pack and saddle horse were found some months after his departure, but he has never been heard of since. The property in due course passed into other ownership, but has remained non-productive owing to lack of funds to extend development-work.

During 1915 Martin Bresnik and Jacob Zink reopened one of the idle copper properties on Ten-mile creek, and made two small shipments of sorted ore, which had to be conveyed in wagons twenty miles to the railway-station at Coutlee; consequently only high-grade ore or concentrates could be handled.

NICOLA COALFIELDS.

There has been less activity than usual in the collieries in this coalfield during 1915, due to various causes. The mine-owners generally attribute the depression to the fact that, since the substitution of fuel-oil for coal on locomotives, they have lost the bulk of the demand for the Nicola Valley coal, because they cannot compete with the price of oil. The freight rates charged for haulage from Merritt, the distributing centre, to outside marketing points is also complained of. This last-mentioned complaint, though, will probably be rectified next year, when the railway-line, built jointly by the Great Northern and Kettle Valley Railway Companies, is operating direct to the Coast via the Coldwater and Coquihalla valleys to Hope, thence down the Fraser river to Vancouver.

While four companies own coal lands and have equipped collieries, only three attempted to produce during 1915. These are the Middlesboro Collieries, Limited; the Inland Coal and Coke Company; and the Pacific Coast Colliery Company of British Columbia. The fourth company, the Diamond Vale Colliery Company, has been idle for the past two years, owing principally to lack of funds.

The portion of the coalfield that has been demonstrated to possess commercial value lies to the south of the town of Merritt and to the south of the Nicola river, in the vicinity of the

junction of that river with the Coldwater, and occupies an area about four miles long by three miles wide, practically all of which is included in the holdings acquired by the four colliery companies already referred to.

The properties of the Inland Coal and Coke Company and of the Pacific Coast Colliery Company of British Columbia occupy the western portion of this field, and practically include the line of contact between the coal-bearing sedimentaries belonging to Dawson's Coldwater group and the older volcanics belonging to his Nicola series, which forms the well-defined western boundary of the coalfield.

The property of the Middlesboro Collieries, Limited, is the old Garesche-Green area, adjoining those properties just referred to on the east, and also forming the western boundary of the property of the Diamond Vale Collieries, Limited. The last-named property does not extend to the eastern boundary of the coal formation, and no effort has been made to demonstrate the value of that portion of the field east from the eastern boundary of the property of the Diamond Vale Colliery Company, presumably because of the great depth of alluvial drift which overlays the rock formation.

With regard to the eastern end, or boundary, of the Nicola-Coldwater coalfields, Dr. Ells says: "The main area of the volcanic rocks on the south side of the Nicola gradually approaches the river in a north-east direction and meets those of the north side of the basin a short distance below the foot of Nicola lake, near the bridge, so that the village of Nicola lies at the north-east extremity of the basin.

The southern and south-western margins of the coal-basin are determined by the ridge of volcanics, in which area the great mass of Iron mountain is a conspicuous feature.

Dr. Ells next refers to an erroneous theory that has been advanced, to the effect that the coal-measures underlaid the volcanics on the western boundary of the basin, as follows: "The supposition held by some that these rocks (volcanics) overlie the coal-basin is not warranted in any particular, as the sandstones and associated strata rest upon these volcanics instead of passing under them."

The northern boundary of the coal-basin, north of the Nicola river, is well defined by the high range of hills between Nicola lake and Coutlee village.

Dr. Ells divides the productive coal areas of the Nicola coalfield roughly into four groups:—

"First: That of the Lower Nicola or Ten-mile Creek basin, about three miles below Coutlee village.

"Second: That of the Coal gully, containing several seams, one of which has been opened up and mined locally for several years.

"Third: The Coldwater seam, about a mile and a half to the east, where one seam is exposed in two outcrops on the bank of the stream at an interval between the two exposures of nearly a fourth of a mile. These two are sometimes known as the Garesche-Green area.

"Fourth: The Quilchena basin, which is entirely separated from the others, and distant about ten miles to the east."

The coal areas in the first and fourth of the above-mentioned divisions have not been developed commercially up to the present time, consequently are not referred to further in this report.

The coal areas in the second and third divisions contain the holdings of the operating coal companies. Development-work, which placed these coal areas on a commercially productive basis, was commenced previous to the completion of the Nicola branch of the Canadian Pacific Railway, or about nine years ago; the first shipments being made in 1907, since which time, up to the end of 1915, the total output of coal has reached 1,067,237 tons of 2,240 lb. to the ton.

Middlesboro Collieries, Ltd.

During the writer's visit to the Nicola coalfields at the end of August, 1915, he was, through the courtesy of Robert Fairfoul, the mine manager, invited to examine the new mine in No. 4 seam, which was first opened in June, 1914, after the old No. 4 mine was flooded and the workings sealed in order, if possible, to extinguish the fire which broke out during that year in the adjacent underground workings.

The portal of the new No. 4 slope, which affords entrance to the new mine in No. 4 seam, is situated a short distance east from the old No. 4 slope, which has been flooded up to 600 feet below the portal. The new slope had been sunk to a depth of 800 feet on a 15-degree incline

at the time of the writer's visit; good coal was exposed at a depth of 125 feet, the seam being 16 feet thick; but the top portion of the seam, which is the portion mined, was not exposed until the slope reached 150 feet in depth; then mining by the room-and-pillar system was commenced. Up to the present the work in this new mine has been confined to prospecting and developing rather than to extracting coal for market.

The main fault in the field, known as the Coal Gully fault, is exposed in the No. 4 slope. Development has demonstrated that the down-throw, by reason of this fault, is 91 feet; but, as the coal to the south-west of the fault, the line of strike of which is from north-west to south-east, has a sandstone roof, while that to the north-east of the fault occurs under a shale roof, it appears impossible that the coal in both instances can belong to the same seam.

The levels to the west from the new slope will ultimately connect with the old No. 4 mine, but to the east and south there is practically a virgin coalfield.

Communication has been established to the surface from a level to the west through an air-shaft, where a fan has been installed, driven by a 10- x 12-inch Sheldon engine, and capable of producing 38,000 cubic feet of air a minute at a speed of 250 revolutions a minute. This fan is 36 inches in diameter, 42 inches wide, and has been built entirely of steel in the company's machine-shop. It has been built to stand a speed of about 800 revolutions a minute, at which speed its capacity should be easily doubled.

The haulage from the new mine is at present done with a compressed-air hoist to the surface, where the cars are attached to a steam-locomotive and hauled to the tipple about half a mile west from the portal of the slope.

Inland Coal and Coke Co.

Joseph Graham, the general manager of this company, informed the writer that he was taking advantage of the depressed business conditions to open a new mine on a seam of coal occurring at a higher horizon than those heretofore developed, and that he expected, during the autumn of 1915, to have this work carried sufficiently far to ship coal from the new mine during the coming winter.

Pacific Coast Colliery Co. of B.C.

The Pacific Coast Colliery Company of British Columbia, a company with headquarters in Minneapolis, owns areas adjacent to those of the Inland Coal and Coke Company. The coal-seam developed in this property appears to be a direct continuation to the dip—and under the valley—of the seam being worked by the Inland Coal and Coke Company. This latter company has secured a bond on the property through a development syndicate—the Pacific Coast Coal Syndicate, which is under the same management as the Inland Colliery—and the development of the property is being seriously carried on. During the year 1915 some 1,065 tons of coal was mined from these development workings.

MINERAL CLAIMS.

Copper-Belle Group.

This group consists of the *Copper Belle*, *Blue Belle*, *Farewell*, and *Copper Crown* mineral claims, and is situated in a prominent ridge of volcanic rocks on the south side of the Nicola river, about three miles west from the town of Merritt, and at an elevation of about 100 feet above the river. This property was worked in 1908 by Robert Wiltshire, who made some shipments to the Trail smelter. Later he closed down operations on account of being unable to obtain necessary capital to carry on development, and left for a prospecting trip. Since then his death has been reported, and the property acquired by Robert Henderson and partners, of Merritt, who made one shipment of copper ore in 1913. This consisted of 47 tons of sorted ore that assayed 7.5 per cent. copper and was treated at the Tacoma smelter.

The ore-body occurs as a blanket, with its line of strike nearly east and west and its dip at an angle of about 20 degrees towards the south. The mineralization is composed of micaceous iron, chalcopyrite, copper carbonates, and calcite in a quartz gangue.

The mineral outcroppings occur as lenses which are quite persistent, and can be easily traced along the mountain-side from one open-cut to another, but not in unbroken continuity. The extent of the mineral is problematical, as sufficient work has not been done at any one place to determine the continuity to a greater depth than about 20 feet on the slope of the dip. The width varies from a few inches to 2 feet, and the length of the various lenses also varies from a few feet to about 30 feet.

All of the development has been by means of open-cuts, some of which have been extended by underhand stoping into shallow incline shafts, from which the ore shipped was mined.

There is more or less ore exposed in each of these openings and on small dumps, but no systematic method of development has ever been carried out, so that but little idea can be formed as to the extent or persistency of the ore at any beyond a shallow depth.

One sample was taken from the deepest of these openings, which represents about the grade of shipping-ore that could be hand-sorted without much difficulty. This assayed: Gold, trace; silver, 1.2 oz.; copper, 6.8 per cent.

While the property apparently has value as a small mine and merits further development, there are no indications apparent to the writer to warrant the assumption that it can be developed into a very extensive proposition.

On the *Farewell* and *Copper Crown* mineral claims, near the eastern end of the group, some attempts have been made to prospect the ground systematically, and an adit has been driven on the *Farewell* claim for a length of 30 feet under cover. In this is exposed bunches of micaceous iron, with some little chalcopyrite and iron pyrites in a badly altered volcanic rock which is considerably stained with copper carbonates. A sample of this material showed by assay that it carried no values, as the returns were: Gold, trace; silver, trace; copper, trace.

Anaconda Group.

This group adjoins the *Copper Belle* group on the east, and consists of three mineral claims, named the *Anaconda*, *Star*, and *Sentinel*, owned by Robert Henderson and partners, of Merritt. The claims in this group are staked from north to south, with the *Anaconda* at the north end of the group.

These locations are made along a ridge composed of volcanic rocks, in which occurs a ledge of micaceous iron considerably weathered and decomposed on the surface. A shallow shaft has been sunk in this outcropping, and, at a depth of about 10 feet, solid micaceous iron is exposed, with apparently no other mineral content.

About 60 feet below the shaft, and at a point about 100 feet east from it, an adit has been driven 30 feet, in which is exposed bunches of micaceous-iron ore in an altered volcanic rock.

Another adit has been driven to crosscut the rock formation from a point some 50 feet lower down the hillside, and although this is about 200 feet in length, there is no evidence of any mineralization in the rock.

Iron Queen and Iron King.

These mineral claims are situated in a deep gulch that cuts almost through the range of hills that border on the south side of Nicola lake, and about three miles easterly from the village of Nicola. The property is owned by William Schmock, of Merritt, and Richard Hazelhurst, of Nicola.

A deposit of bog-iron ore occurs on these mineral claims, which, judging from the surface outcroppings, has considerable superficial extent, but to what depth the ore reaches is a problem that has not yet been solved. The gulch in which the iron-ore outcrops occur extends in a general course from N. 25° W. (mag.) to S. 25° E. (mag.), and is continuous almost the entire distance through both of the claims. The width of this gulch is some 300 or 400 feet, and, to a greater or less degree, a large proportion of the surface is covered with the ore.

Some development to demonstrate the width of the deposit has been attempted by digging a series of long trenches across the gulch, the longest being fully 200 feet by about 3 feet deep, and about the same width. In all of these trenches the iron ore is exposed on the sides and bottoms. In some the ore is higher in grade than in others, as will be seen from the assays of two representative samples, which assayed as follows:—

No. 1 Sample.—Iron, 22 per cent.; phosphorous, trace; silica, 51.5 per cent.; sulphur, 0.27 per cent.

No. 2 Sample.—Iron, 52 per cent.; phosphorous, *nil;* silica, 3.7 per cent.; sulphur, 0.60 per cent.

The No. 2 sample was taken from an open-cut 35 feet in length, 15 feet of which is deep, with the face 10 feet high, and for the remainder of the distance is shallow. Iron ore is exposed the whole length of this cut, which crosscuts this portion of the deposit diagonally. The trenches in the low-lying portion of the gulch crosscut the deposit there at right angles, and demonstrate that it has an approximate length of about 2,000 feet and a width from about 50 up to 200 feet.

Peacock Group.

This group consists of the *Peacock*, *Banner*, and *Boulder Cap* mineral claims, owned by Thomas Hunter, of Nicola. The property is situated on Clapperton or Mill creek, about five miles from the village of Nicola. It was examined by the Provincial Mineralogist in 1907, and his report is published in the Minister of Mines' Report for that year. After reading that report the writer finds that no work has

been done in addition to that therein described, and deems it unnecessary to repeat the description herein, especially as the workings were full of water, and the outcropping in the bed of the creek was really the only portion of the ore-body that could be seen. This is a large mass of quartz in which are impregnations and veinlets of azurite, malachite, and bornite.

The writer took one sample from this outcrop, which was chipped off at haphazard, and assayed: Gold, 0.02 oz.; silver, 1.6 oz.; copper, 3.7 per cent. A grab sample was also taken from the dump at the collar of one shaft; this assayed: Gold, 0.02 oz.; silver, 1.6 oz.; copper, 3 per cent.

The Provincial Mineralogist in his report refers to a selected sample taken by himself as assaying: Gold and silver, small quantities; copper, 4.1 per cent.

Gypsum-deposits.

On the second and third benches on the southern slope of the range of hills that overlook that portion of the Nicola valley north from the town of Merritt, and about two miles distant, there occur several isolated deposits of gypsum, the extent of which is problematical, but apparently not very great. Some years back attempts were made to mine and ship this material, but during recent years these have apparently been abandoned.

These deposits were visited by the writer, but the examination was unsatisfactory, as most of the old pits and open-cuts were more or less filled with debris, and only the soft earthy surface material associated with impurities was to be seen.

A sample taken from an open-cut on the third bench assayed: Gypsum, 89.2 per cent.; insoluble, 0.8 per cent.; carbonate of lime, 10.1 per cent.; iron, alumina, and magnesia, traces.

These deposits are referred to by the Assistant Provincial Mineralogist in his report published in the Minister of Mines' Report for 1913, since which time no work has been done.

MAMETE OR TEN-MILE CREEK.

About ten miles west from the foot of Nicola lake, near the village of Lower Nicola, a creek carrying a considerable volume of water empties into the Nicola river from the north. This was known as Ten-mile creek in the early days; later it was called Guichon creek, and more recently the name Mamete has been applied to it; that name being taken from the lake of the same name from which the stream flows, the lake being situated about twenty miles in a northerly direction from the junction of the two streams.

During 1899 and 1900 several of the old-time prospectors worked along Mamete creek, searching for mineral in the near-by mountains, and quite a number of mineral claims were staked from a point about ten miles north from the Nicola river to within about two miles below the foot of Mamete lake.

In the Nicola valley near the mouth of Mamete creek no rock-outcrops are seen. The valley is entirely filled with drift material made up of clays, sands, and gravels to a depth of at least 300 feet, for borings to that depth have failed to reach the underlying rocks, as stated by Dr. Ells in his report on the Nicola coal-basin. This condition is also generally found along Mamete creek for about ten miles above the mouth, or to its junction with one of its tributaries named Eight-mile creek, which flows from the north-east. Dr. Ells records the fact that at one point about midway between the Nicola river and Eight-mile creek there are some exposures of shales and sandstone of the coal formation, indicating that this entire area is probably underlain by the sedimentary rocks of the Coldwater formation.

Above the confluence of Eight-mile creek with Mamete creek the rocks consist chiefly of a series of granitic eruptives. In this vicinity a number of mineral claims were located in 1900 and grouped as the Aberdeen camp.

Aberdeen Camp.

This camp was visited in 1904 by R. A. A. Johnston, of the Canadian Geological Survey, who acted as assistant to Dr. Ells during his examination of the Nicola coal-basin during the same year, and a report of the Aberdeen camp is included with the report by Dr. Ells, and was also copied and published in the Minister of Mines' Report for 1905.

The writer did not visit the Aberdeen camp during 1915, because there was no one in the camp, and from the most reliable information he could obtain there had not been any work performed on the property since the examination made by R. A. A. Johnston.

During the past winter, and since this report was written, the writer is informed that a syndicate has been formed in the United States to take over the group of mineral claims from

which the camp takes its name, and that these operators have been working during the past winter. From the information received by the writer, the syndicate proposes to extend the development-work and arrange to ship ore during the present season.

Copper King Group.

This group consists of the *Copper King*, *X*, *Z*, and *B* mineral claims, owned by Martin Bresnik and Jacob Zink, of Merritt. The property is located about two miles and a half west from the wagon-road up Mamete creek, and about two miles south from the foot of Mamete lake, at an elevation of about 3,000 feet above sea-level.

The prevailing country-rock in this vicinity is granite, much of which is very much altered, sheared, faulted, and fissured. In the fractured zones in the granite there occur several irregular stringers and lenses of high grade chalcocite ore, and there are also portions of these zones in which impregnations of copper carbonate, bornite, chalcopyrite, calcite, and garnets are scattered through varying widths of the altered granite country-rock, sometimes reaching a maximum of 5 feet; but invariably the higher grade chalcocite ore is found in the stringers and narrow lenses.

On the *Copper King* claim there has been several feet of underground work performed. On the eastern portion of the claim this consists of an incline shaft, said to be 30 feet deep, but as it was full of water at the time of the writer's visit, it was not examined; there are also two deep open-cuts each about 30 feet in length, which are approaches to short adits, one 15 feet long under cover; the other 10 feet long under cover.

In the first-mentioned adit, which has been driven in a west (mag.) direction, there are places where the ore-body has a width of about 4 feet, made up of chalcocite, bornite, chalcopyrite, garnet, and calcite; but on the face it is represented by three narrow stringers of high-grade chalcocite. A fault is noticeable in this adit, about midway between the portal and face, which has thrown the ore-body from its normal position.

The adit that has been driven 10 feet under cover has its course parallel to the one first mentioned. In this a parallel ore-body is exposed, which at the face is 12 inches wide, made up of copper carbonate, chalcocite, chalcopyrite, and bornite, with calcite and garnet rock in a gangue of altered granite

A shipment of 21 tons 700 lb. of the ore mined from these workings was made last spring to the Trail smelter, which assayed 11 per cent. copper, with small gold and silver values. An average sample taken by the writer across 12 inches of ore at the face of the 10-foot adit assayed: Gold, trace; silver, 1.6 oz.; copper, 5.2 per cent. Another sample representative of ore sorted for shipping assayed: Gold, trace; silver, 4 oz.; copper, 6 per cent.

In that portion of the *Copper King* mineral claim just referred to there does not appear to be any well-defined vein-structure, but rather a deposition of mineral by replacement; nor has sufficient work been done to demonstrate fully the persistence, grade, and extent of the mineralization.

On the western side of the *Copper King* mineral claim, and about 1,300 feet distant from the work already described, there is another occurrence of copper minerals. The outcroppings are near the summit of a steep ridge that forms the easterly wall of a wide gulch, the bed of which is about 60 feet below the outcroppings mentioned.

The prevailing country-rock is granite, in which occur mineralized zones of undetermined extent where the country-rock is fractured, fissured, and very much altered. The characteristics of this mineralization are very similar to those on the easterly side of the *Copper King* mineral claim, but the mineral-bearing zone is wider in the westerly portion, while the stringers of high-grade ore are not of as frequent occurrence; consequently, it would appear as though some system of concentration will be required to produce a product of such grade as will permit shipping.

One feature connected with the mineralization on the westerly side of the *Copper King* mineral claim is the presence of a noticeable percentage of molybdenite ore, associated with some of the copper minerals, which renders the ore valueless as a source of molybdenum, and, so far as present development shows, must be concentrated if worked for its copper content. A sample taken from a portion of the outcropping assayed: Gold, trace; silver, 0.6 oz.; copper, 1.1 per cent.

The development-work done on the westerly side of the *Copper King* mineral claim consists of a vertical shaft, closely timbered and nearly full of water, which the owners claim is 90 feet deep, and in which they also say ore is exposed to within 6 feet of the bottom. There is also an

incline shaft 20 feet deep sunk in the mineral-bearing zone, a short distance north-easterly from the vertical shaft. An incline slope, with a slope of 1 foot in 5 feet, was being driven in the bed of the gulch at the time of the writer's visit; this was at that time 22 feet long under cover, and was projected to intersect the vertical shaft near its bottom and furnish a haulage-way to transport ore instead of hoisting up the shaft, which latter would necessitate the installation of hoisting and pumping machinery.

The structure of the ore-bodies on this property is very irregular and complex, but, apparently, a sufficient tonnage of high-grade ore can be secured by careful mining and sorting to pay a large proportion of the expense necessary to thoroughly prospect and develop the zones, which carry low-grade copper ores.

Black Bluff Group.

This is a group of mineral claims situated on Dupuix creek, a small stream flowing from Antler lake about two miles west from the north end of Mamete lake, and which empties into that lake. The property was located in 1914 by J. C. McGregor, of Calgary, for his associates and himself, who were searching for molybdenite ore. Several shallow pits were sunk to prospect a sheared zone in granite, in which occurred a little molybdenite, but always associated with more or less copper mineral, which rendered the ore practically valueless as a source for molybdenum. Apparently the locators abandoned the mineral claims when this fact was determined, as no work has been done since 1914. A sample taken from a small dump assayed: Gold, trace; silver, 0.2 oz.; copper, 2.5 per cent.

SIMILKAMEEN MINING DIVISION.

REPORT OF HUGH HUNTER, GOLD COMMISSIONER.

I have the honour to forward the annual mining report on the Similkameen Mining Division for the year 1915.

There has been very little change in the district since my last report. On account of the dry season more placer-mining was done than for some previous years, and in consequence there was a larger yield of gold and platinum.

The British Columbia Copper Mining Company still continues diamond-drilling on its holdings on Copper mountain.

In Voigt camp some development has been done during the summer by the Pennsylvania Syndicate, which has an option on the property.

In Summit camp, head of Tulameen river, considerable prospecting has been done, showing up a body of ore (silver-lead) on the *Morning Star* and *Celtic Chief* mineral claims.

The Treasure Mountain Company did assessment work on its claims.

In other sections of the district assessment work has been performed.

OFFICE STATISTICS—SIMILKAMEEN MINING DIVISION.

Free miners' certificates	234
Free miners' certificates (special)	2
Location records	148
Certificates of work	262
Conveyances (mineral claims)	38
Records (placer)	13
Leave of absence	1
Leases	1
Certificates of improvement	8

SIMILKAMEEN MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

The Similkameen Mining Division comprises, practically, all the drainage area of the Tulameen river and the Similkameen above Nine-mile creek.

During the past summer this Mining Division has experienced the advantage of railway connection with the outside world, having had a tri-weekly train service to Princeton over the Great Northern and Kettle Valley Railways. The Kettle Valley route affords direct communication via Merritt with the main line of the Canadian Pacific Railway at Spence's Bridge, and via Penticton and Okanagan lake with the same main line at Sicamous; while the Great Northern route furnishes connection with its main line in the State of Washington.

The line of railway via the Tulameen and Coldwater valleys to the Coquihalla summit, and down that valley to the town of Hope, on the main line of the Canadian Pacific Railway, ninety-one miles east from Vancouver, was almost completed last summer, and a train service over it is assured in 1916. This last-named connection will reduce the distance from Princeton to the Pacific Coast more than 100 miles than by the most direct railway route open at present.

Since placer-mining has ceased to be the chief and most profitable mining industry of the district, the progress in mining has necessarily been practically at a standstill, except at the *Nickel Plate* gold-mine at Hedley, because the copper ores, although in great quantity, are of too low grade to produce satisfactory commercial results unless afforded cheap transportation facilities, and, of course, this condition applies equally, if not more forcibly, with regard to the handling of coal.

The Provincial Mineralogist in 1901, as well as every mining engineer who has visited the district, recognized the handicap the Similkameen district was placed at; at the same time all have also given the district the credit due for the many natural resources it possesses.

During the past summer, despite the depressed business conditions due to the war, the fact was noticeable that owners of several Crown-granted mining properties, who had held the same for years, were engaged in cleaning out old workings and putting them in shape so that an examination could be made. The presence of some mining engineers and promoters from the United States was noticed; in fact, there were several indications of a revival in the mining industry of the district.

The history, geology, and other characteristics of the Similkameen Mining Division have been frequently commented on in various official reports. The most important of these are to be found in the Minister of Mines' Report for 1901 by the Provincial Mineralogist; in the Preliminary Report of the Canadian Geological Survey for 1907 by Charles Camsell; and in the Minister of Mines' Report for 1913 by the Assistant Provincial Mineralogist. For that reason the writer in the following report has confined himself almost exclusively to descriptions of new work done since the reports mentioned were published, as it is unnecessary to repeat what has already been recorded and published.

The town of Princeton is the natural distributing-point for the various near-by mining camps, of which it occupies approximately a central position, with Copper mountain, Voigt camp, and Kennedy mountain to the south, Whipsaw creek to the south-west, Granite creek to the north-west, Five-mile and Siwash creeks to the north-east, and Holmes and Owl mountains to the east. The completed portion of the automobile-road to Kennedy mountain will afford cheaper transportation for the copper ores in that locality.

The cement-works which were fully described by the Assistant Provincial Mineralogist in the Report of the Minister of Mines for 1913, have been closed down temporarily owing to financial difficulties, but it is reported that the plant would soon be operating again.

ROCHE RIVER CAMP.

The section bordering on the junction of the Similkameen and Pasayten rivers has always been named the Roche River camp, although really situated on the Similkameen river nearly ten miles below the recognized mouth of Roche river. Considerable prospecting was done in 1900 and for a few years later, but its inaccessibility has retarded its progress, and during the past season the camp was deserted the greater portion of the time.

With regard to the ore-deposits in the Roche River district, which were not examined by the writer for the reason already given, Camsell says in his report, published in 1907, as follows:—

"The ore-bodies are of two classes: (1) Small gold-bearing fissure-veins; (2) larger bedded veins, copper-bearing. The first are usually quartz veins from 3 inches to 4 feet in width, cutting across the strike of the schists, and dipping at angles from 60 to 90 degrees. They carry, besides gold, bornite, tetrahedrite, chalcopyrite, and pyrite.

"The second class contain larger ore-bodies lying parallel to the strike of the schists. These may be either quartz or mineralized bands in the schists. They carry some gold and the copper and iron sulphides, and the highest values are in copper.

"The greatest amount of work has been done on the *Red Star* and *Anaconda* claims. On these there is a belt of soft talc and chloritic schists about 400 feet wide, striking 125 degrees (S. 55° E.) and dipping vertically and lying between mica-schists. It appears to be traversed by a fault-plane, along which bunches and lenses of white feldspar and quartz have been found, and which were first worked for their gold content. On development the vein ran into talc-schist, which proved to be highly mineralized with copper carbonates, melaconite, and cuprite, and which was farther on replaced by bornite and chalcopyrite. Along with these were pyrite and arsenopyrite, siderite, and some blende. A shaft has been sunk in the tunnel to a depth of 60 feet, but this had to be abandoned on account of the noxious gases. Some native copper occurs as sheets in little slips and fault-planes in the schist."

KENNEDY MOUNTAIN.

Travelling northerly from the junction of the Similkameen and Pasayten rivers, the trail does not follow the bank of the Similkameen river after crossing Copper creek, as from that point, almost the entire distance to Princeton, that river flows through a series of deep gorges or canyons, and the several tributaries emptying into it have cut very deep channels with precipitous banks, so that the trail is located some distance back and crosses Sunday, Saturday, and Friday creeks near their sources. Three miles beyond the crossing of Friday creek the trail again approaches the west bank of the river, and crosses Kennedy mountain on its first bench at an elevation of about 400 feet above the Similkameen river, and about half a mile back from it.

The Hope-Princeton automobile-road has been built from Princeton to this point, where a magnificent road-bed has been excavated in solid rock along the steep bank of the Similkameen for a distance of about five miles to the crossing of Whipsaw creek, ten miles south from Princeton.

No prospecting or recent location of mineral claims has been reported between the Roche River camp and the southern base of Kennedy mountain; but on that mountain there are about twenty-five mineral-claim locations, several of which have been Crown-granted, and the regular assessment-work is annually being done on others, but, owing to inaccessibility, no extensive development-work has yet been undertaken, and but few of the owners of claims reside in the camp.

Geologically, Kennedy mountain is a continuation of Copper mountain, but geographically they are separated by the Similkameen river. In the Report of the Minister of Mines for 1901 the Provincial Mineralogist describes several of the mineral claims, but since that time there have been many changes in ownership, and on some claims there has been considerably more work performed.

In 1906 Charles Camsell, of the Canadian Geological Survey, examined the geology of Kennedy and Copper mountains in detail, and his report was published in 1907. He classifies the country-rock in both mountains as a monzonite, very similar to the mozonite of the Rossland district. This he says has intruded into and almost entirely digested the older overlying sediments, limestone, argillites, and quartzites, so that these only now appear as inclusions or remnants in the igneous rocks.

Fraser Group.

This group of mineral claims consists of the following Crown-granted claims: *Fraser*, *Fraser Fraction*, *Hamilton*, and *Brooklyn*; also the following named claims not yet Crown-granted: *Brooklyn Fraction*, *Don*, *Star*, *Bruce*, *Perley*, *Apex*, and *Ajax*. The owners are the McRae Bros., who reside on the property, which is situated near the southern end of Kennedy mountain, about thirteen miles southerly from Princeton.

The southern end of the completed portion of the Hope-Princeton auto-road traverses the *Brooklyn Fraction*, *Fraser*, *Don*, and *Star* mineral claims, and a wagon-road from Princeton traverses the *Brooklyn Fraction*, *Fraser Fraction*, *Hamilton*, *Bruce*, and *Perley* mineral claims.

The most recent work performed on this property has been done on the *Fraser* mineral claim, the boundaries of which extend from near the bed of the Similkameen river up the steep western bank and on to the bench back from the top of the river-bank to an elevation of about 800 feet above the river.

A mineralized fractured zone occurs in the mozonite country-rock on this claim that is easily traceable from the river to the top of the bank, about 300 feet higher by vertical measurement. In this fractured zone there is a well-defined fissure about 5 feet in width filled with chalcopyrite, iron pyrite, pyrrhotite, bornite, and calcite, in a gangue of brecciated country-rock with several inches of talcose gouge separating each wall from the mineralized vein-matter. Beyond the confines of the vein proper the country-rock contains particles of copper minerals irregularly disseminated through it, which in places extends to an aggregate width of about 25 feet. The line of strike and dip of the vein are conformable with the strike and dip of the fractured zone, the former being N. 60° E. (mag.) and latter vertical.

Three adits have been driven into the mineralized zone along the strike of the fissure-planes, one above the other; the No. 1 or lowest is situated 75 feet above the bed of the Similkameen, the No. 2 is 75 feet above No. 1, and the No. 3 is 150 feet above the No. 2. The No. 1 adit is said to be 50 feet in length, but on account of the caved condition could not be examined; the No. 2 adit is 75 feet in length, and the No. 3 is 65 feet in length.

In addition to this work, a shaft has been sunk to a depth of 60 feet on the *Fraser Fraction* mineral claim adjoining the *Fraser* mineral claim, at an elevation of 1,200 feet above the river or 3,700 feet above the sea-level, and about three-quarters of a mile south-westerly from the work on the *Fraser* mineral claim above described.

This shaft is in line with the adits, and the owners of the claim say that the same conditions with regard to mineralization were found in sinking as exist in the adits. As the shaft was timbered, and these had rotted so that the walls had caved, it was not possible to make any examination.

A grab sample taken from the dump at the portal of No. 3 adit assayed: Gold, 0.02 oz.; silver, 1 oz.; copper, 2.8 per cent. A sample taken from the No. 2 adit, representative of the mineralization exposed by that work, but not to be considered as an average, assayed: Gold, trace; silver, 0.9 oz.; copper, 2.4 per cent. The owners claimed that the ore carried platinum, consequently the two samples were tested for that metal, but with negative results.

As none of the owners of other mineral claims situated on Kennedy mountain could be found in the vicinity, the writer rode on to Princeton, from which town he visited the surrounding camps.

Princeton Coal and Land Co.

This company is under the general management of Ernest Waterman, with Francis Glover as superintendent of the colliery. This colliery was examined by the Provincial Mineralogist in 1901, whose report is contained in the Minister of Mines' Report for that year. In 1906 the coal areas were examined by Charles Camsell, of the Canadian Geological Survey, whose report was published in 1907. In 1913 J. D. Galloway, the Assistant Provincial Mineralogist, refers to the colliery in the Minister of Mines' Report for that year.

At the time that the Provincial Mineralogist made his examination in 1901, the owners of the coal lands were merely prospecting and had not driven working openings. At the time Charles Camsell made his examination in 1906, the prospecting-work had been carried farther and some drill-holes put down; the record of one hole drilled 280 feet deep near the bridge across the Similkameen river from Princeton being given in his report, as follows:—

	Ft.	in.
"Gravel	14	0
Shale	21	6
Coal	4	6
Sandstone	0	5½
Coal	6	7½
Clay	1	10
Carried forward	48	11

	Ft.	in.
Brought forward	48	11
Coal	18	5½
Shale	3	1
Carbonaceous shale	4	6
Clay	0	5
Carbonaceous shale	0	8
Sandstone	1	7
Fireclay	2	1
Coal	0	2
Shaly coal	1	1
Shale	1	0
Coal	1	8
Clay	1	4
Coal	1	6
Shaly coal	1	2
Coal	1	6
Clay shale, etc.	26	4½
Sandstone	31	0
Clay shale, etc.	79	6
Sandstone	44	6
Clay shale, etc.	8	6
Aggregate of clean coal 34 feet 5 inches."	279	0

At the time the Assistant Provincial Mineralogist visited the property in 1913 it was on a producing basis, and he refers in his report to the Main slope as being 1,100 feet in length and the output of the mine being from 150 to 180 tons per diem.

In the reports of the Chief Inspector of Mines for the years 1913 and 1914 the underground workings and mining machinery equipment are fully described in detail. The occurrence of fire in the mine during the latter part of 1914 is also referred to in the report for that year, as follows: "During the latter part of the year trouble has been experienced with an outbreak of fire in the old workings. Owing to the place being inaccessible, and also to surface breaks, considerable difficulty has been experienced in sealing this area off, and lately efforts have been made to either flood it or flume in non-combustible material so as to effectively seal the district off."

During the visit of the writer last summer he examined the mine-workings of the colliery in company with Francis Glover, the mine manager, at the request of Ernest Waterman, the general manager of the company, to both of whom he desires to express his thanks for courtesies extended to him.

The Main slope was followed to the bottom at 1,100 feet from the surface, on an incline of 11 degrees towards S. 31° W. Below this point a squeeze occurs in the coal-seam in this portion of the field. The clean coal above that point averages about 24 feet in thickness, of which the upper 8 feet only is mined. From the bottom of the slope the No. 4 East Main level drift was traversed for a distance of 1,800 feet, and a fine opportunity was afforded to examine the coal-seam on that level towards the east; also to examine the seam down a new slope, which has been sunk 400 feet below the No. 4 East Main level from a point about 200 feet east from the Main slope, and also east from a fault which has caused the squeeze below the 1,100-foot station in the Main slope. It was the intention of the management when this slope was started to ultimately connect it with the Main slope, but after the occurrence of the fire it was determined to close the old mine entirely, and, by leaving a barrier of solid coal 150 feet in width, ensure, as far as possible, against danger from the fire spreading into new workings projected to the east of the old. The area of the old mine within this barrier is approximately 1,640 feet on the strike by 1,560 feet on the dip, or 58.7 acres.

The eastern boundary of this barrier of solid coal is 1,600 feet east from the Main slope on the No. 4 East Main level drift, which has been driven through the barrier for a roadway in order to temporarily carry air into the new mine and facilitate the work of driving a new slope from that level upwards to the surface. This work was progressing at the time of the writer's

examination, and the upraise, at an angle of 11 degrees, was about 100 feet in length, where it connected with the No. 4 East Main counter-level. This was followed to the No. 5 incline in the old workings, which was traversed for 300 feet to the top level in the old workings.

As soon as the new slope, which will be about 800 feet in length, has been driven through to the surface and new air-courses opened, the roadways through the barrier on the No. 4 East Main level and No. 4 East Main counter-level will be stopped with concrete stoppings, and all connections with the old mine will thereby be closed.

The top level was followed to the No. 1 incline, where the concrete stoppings that had been erected to shut off the burning area on the east side of the Main slope were examined, and found to be so substantially built as to prevent the spread of the fire on the east side of the Main slope. The same precautionary measures have been adopted on the west side of the Main slope where the fire originated. The dimensions of the areas sealed up by the concrete stoppings, and directly affected by the fire, are: On the east side of the Main slope 300 x 400 feet, and on the west side 200 x 400 feet.

After examining the concrete stoppings the writer was guided to the surface. The ventilation throughout the mine was found to be excellent, and all timbering and roadways were in good condition.

The coal is a good lignitic coal, and when properly cleaned is of excellent quality, especially for domestic purposes.

Owing to inadequate transportation facilities in the past, the market for this coal has been restricted, but with the recent opening of the Kettle Valley Railway to Penticton and Spences Bridge via Merritt, and the Great Northern to Oroville, in the State of Washington, also the completion of the Kettle Valley Railway direct to Hope, the market for this coal will undoubtedly be very greatly enlarged.

The area underlain by lignitic coal-measures in the Similkameen Mining Division, according to the report and as mapped by Charles Camsell, extends from Ashnola, about seven miles south from Princeton, to about two miles above the mouth of Summers creek, or about nine miles north from Princeton, and has an average width of approximately seven miles east and west.

So far as prospecting with a diamond-drill has been carried on, the results have shown that the thickest lignite-seams are in the vicinity of the town of Princeton, and that most, if not all, of the workable seams are within 300 feet of the surface. Most of the drilling has been done at or near the bank of the Similkameen river, and only one near the western edge of the basin, while no drilling has been done north from the river.

The drill-hole bored near the western edge of the basin, where the sediments dip under the volcanics and not far from where there is an outcrop of coal 4 feet thick, is 863 feet in depth. In that borehole seventeen seams of coal were cut through, with an aggregate thickness of 50½ feet, of which the thickest seam was 9 feet.

The deepest hole bored in the entire basin is that known as Blakemore's No. 2, which was sunk to a depth of 1,000 feet at a point on the Similkameen river about two miles above Princeton. The record of this hole, showing the thickness and the depth at which each coal-seam was cut, is given in Camsell's report, as follows:—

Depth.	Thickness of Coal-seam.
At 95 feet	1 inch.
95 „ 4 inches	1 „
395 „ 8 „	2 inches.
404 „ 0 „	2 „
427 „ 2 „	8 „
475 „ 6 „	6 „
479 „ 0 „	4 „
508 „ 9 „	3 „
579 „ 4 „	2 „
579 „ 8 „	2 „
676 „ 8 „	10 feet 7 „
694 „ 6 „	1 inch.
699 „ 3 „	1 foot 3 inches.
793 „ 2 „	1 „
Total thickness of coal in 1,000 feet	15 feet.

Camsell also refers to the possibilities of other areas of these coal-measures being discovered outcropping in places between Summers creek and Nicola lake, situated about forty-four miles in a direct line north from Summers creek.

COPPER MOUNTAIN.

British Columbia Copper Co.

This company has been the only active operator on Copper mountain since the examination made by the Assistant Provincial Mineralogist in 1913, who made a very comprehensive report of conditions generally on Copper mountain, and especially of the development-work being carried on by the British Columbia Copper Company. This was published in the Minister of Mines' Report for 1913, and in it was included extracts describing the geology in detail from the report of Charles Camsell made in 1906, and published by the Canadian Geological Survey in 1907.

Since that time the British Columbia Copper Company has continued the work of prospecting with diamond-drills, and the latest report made by that company, under date of November 15th, 1915, states that there has been proven on the properties controlled by the company, by drill borings, systematic trenching, shafts, and adits, 8,900,000 tons of copper ore averaging 1.75 per cent. copper, together with 2,000,000 tons of the same value of partially proven ore, or a total of 10,900,000 tons averaging 1.75 per cent. in copper and an estimated low value in gold and silver.

In July last, when the writer had an interview with Oscar Lachmund, the general manager of the company, he was informed by that gentleman that glass models were being made which would show the vertical sections of all of the drill-holes bored to date, also that conferences were being held with the officials of the Kettle Valley Railway Company relative to the construction of a branch line to Copper mountain, and that the question of freight rates was under discussion at that time, as the British Columbia Copper Company was inclined to furnish its own transportation unless a cheap rate was guaranteed by the railway company for carrying ore.

On the strength of the quantity of ore developed it is reported that the directors recommend the installation of an oil-flotation concentrating plant with a daily capacity of 2,000 tons of ore. At this rate of extraction the property would have a life of at least fifteen years, even though no further ore reserves were developed.

The total number of feet of diamond-drilling up to November 1st, 1915, is reported at 78,000 feet, in addition to which 30,000 feet of trenching have been made.

The company controls 735 acres of mineral claims on Copper mountain, and the development-work during the past season has been under the superintendence of T. E. Norcross, M.E.

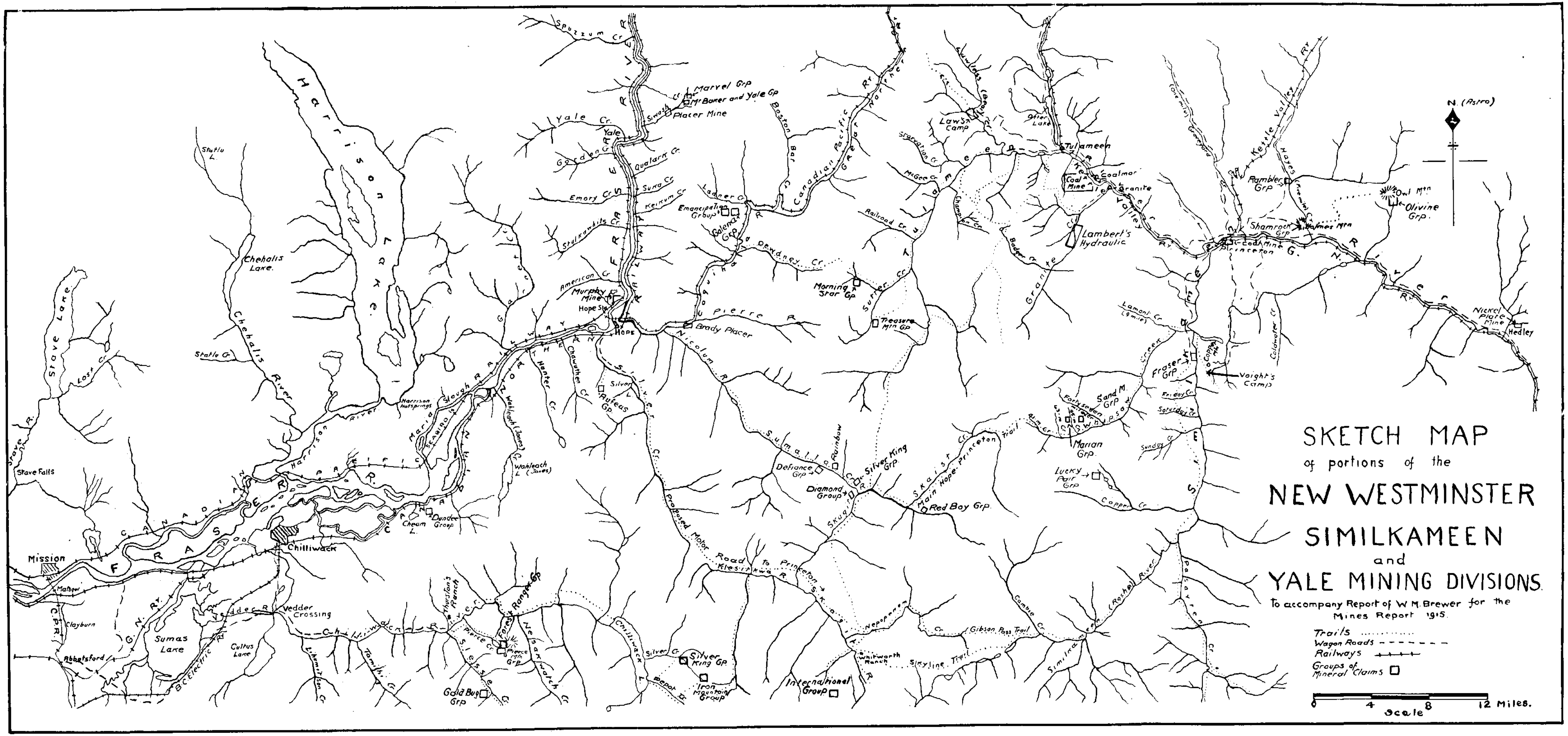
Voigt Camp.

Affairs at this camp were very quiet during the past summer, as Emil Voigt was absent in the East endeavouring to perfect negotiations that had been under way for several months, but up to the time when the writer left the district nothing definite had resulted.

FIVE-MILE CREEK.

This creek flows from a chain of lakes situated about thirty miles in a north-easterly direction from the town of Princeton, and empties into the Similkameen river five miles below that town. For some considerable distance at least, the course of the creek appears to follow the line of contact between a schistose argillite rock on the west side of the creek and a great mass of granite on the east side. The argillite belongs to a band of highly altered and metamorphosed limestones, quartzites, and argillites that crosses the Similkameen river near Allison, about three miles below Princeton, and is referred to by Charles Camsell, in his report on the geology of the Similkameen district, as "lying between and under younger volcanic rocks on the west and a great mass of granite on the east."

Some ten years ago there were a number of mineral claims staked along the west side of Five-mile creek, within about five miles in an air-line from the mouth; several of these have been Crown-granted, but have had no serious development-work done on them, because the owners could neither work them nor sell them until cheap transportation was assured. During the past summer some of these mineral claims attracted attention, and some of the owners have been doing systematic development-work, especially on Holmes mountain, eight miles east from Princeton. This portion of the mining district was visited by the writer and thoroughly examined.


SKETCH MAP
of portions of the
NEW WESTMINSTER
SIMILKAMEEN
and
YALE MINING DIVISIONS
To accompany Report of W. M. Brewer for the
Mines Report 1915.
Trails
Wagon Roads
Railways
Groups of Mineral Claims
0 4 8 12 Miles.
Scale
N. (Astro)
Harrison Lake
Stave Lake
Chehalis Lake
Chehalis River
Fraser River
Mission
Chilliwack
Abbotsford
Sumas Lake
Cultus Lake
Vedder Crossing
Hope
Yale
Tulameen
Coalmont
Granite
Princeton
Hedley
Marvel Grp
Mt Baker and Yale Gp
Placer Mine
Emancipation Group
Galena Grp
Murphy Mine
Brady Placer
Morning Star Gp
Treasure Mtn Gp
Lambert's Hydraulic
Rambler Grp
Olivine Grp
Owl Mtn
Nickel Plate Mine
Voight's Camp
Fraser Grp
Sand M. Grp
Marian Grp
Lucky Pair Grp
Silver King Grp
Defiance Grp
Diamond Group
Red Bay Grp
Rufeas Gp
Dundee Group
Forest Ranger Gp
Pierce Mtn Grp
Gold Bug Grp
Silver King Gp
Iron Mountain Group
International Group
Whitworth Ranch
Proposed Motor Road to Princeton
Main Hope-Princeton Trail
Skyline Trail
Gibson Pass Trail

HOLMES MOUNTAIN.

The geology of Holmes mountain is not described in Camsell's report, as the eastern boundary of the area he examined did not reach to Five-mile creek, nor do any of the other authors of reports, either on the geology or the mining industry of the Similkameen Mining Division, refer to this particular section.

Camsell's only reference to this portion of the Mining Division is as follows: "In the country lying between One-mile and Five-mile creeks, and on the slope of Five-mile creek, several claims have been located, but only the western portion of this area came within the district examined. The *United Empire* group, consisting of nine claims, is on Allison mountain, and occurs in the same series of metamorphosed sediments as occupies Kennedy mountain. The whole hill is covered with wash, and the rock, wherever exposed, is decomposed to a much greater extent than in any other part of the country, due, perhaps, to a covering of volcanic flows during the glacial period, which prevented this decomposed rock from being removed by the scouring action of the glacier. At the base of the hill is a thick deposit of clay and detritus washed down from the hill and heavily charged with copper carbonate. This has probably been derived from the leaching-out of a copper-bearing quartz vein higher up the hill carrying the sulphides of copper. Evidence in support of this is drawn from a shaft 40 feet deep, sunk about half-way up the hill, at the bottom of which blocks of quartz carrying chalcopyrite occur in the decomposed rock. It is probable that there is a vein of quartz carrying copper at this place, but not enough work has been done to demonstrate the size of the vein or the strike. Surface indications, however, point to its having an east-and-west strike across the strike of the country-rock, and in conformity with the strike of the fracture-planes on Copper mountain." Allison mountain is situated about three miles north-east from Princeton, and as no work has been done recently on the group of claims referred to by Camsell, the writer did not make any examination of it.

Shamrock Group.

This group of mineral claims comprise the following: *Right of Way*, *Shamrock*, *Ben Hur*, *Blue Ridge*, *Bornite*, *Falls View*, *Dixie*, and *Bellemite*, situated on the summit, and extending for about 1,000 feet down the southern and about 1,500 feet down the eastern slope of Holmes mountain. The property overlooks the Similkameen river to the south and Five-mile creek to the east. It is owned by Uhler & Cox, who reside on pre-emptions situated on the surface of the *Dixie* and other mineral claims, and whose post-office address is Princeton.

That portion of the Similkameen river that flows past the southern slope of Holmes mountain trends from west to east. The valley here is a gently rolling, almost flat bottom, nearly one mile wide for a distance of over two miles in length and to a point east from the mouth of Five-mile creek. This bottom forms one of the oldest ranches in the district, known as Holmes Flat, and is at present owned by W. H. Armstrong, of Vancouver. The flat at the mouth of Five-mile creek is quite extensive and has been acquired and also occupied as a ranch, but is too gravelly for a farm, and would make a much better site for either a concentrating or smelting plant.

The dividing line between the Similkameen and Kamloops Land Districts passes across the southern portion of the group of claims; this has been surveyed and is marked from east to west by a wide cleared line. The property is connected with the town of Princeton by a good wagon-road, and is also connected with the tracks of the Great Northern Railway and the main Princeton-Hedley wagon-road by a good switchback pack-trail down the steep southern slope of Holmes mountain.

There are excellent opportunities to develop water-powers on either the Similkameen river or Five-mile creek, and surveys have been made from the mine-workings on Holmes mountain to both of the valleys for aerial tramways. These surveys have established the distance from the south-west corner of the *Right of Way* claim to the Similkameen river, on Holmes Flat, as 7,500 feet, and from the south-west corner of the *Shamrock* claim to the mouth of Five-mile creek as 9,000 feet. The grade by either route is good for an aerial tramway, and cost for installation should be reasonable.

The summit of Holmes mountain reaches an elevation of about 3,000 feet above the valley of the Similkameen river; it covers a plateau about a mile square in area that is well watered by streams fed from good springs. The plateau is, for the most part, an open pasture where

the growth of bunch-grass is extremely luxuriant, and there is an ample supply of good timber for mining purposes and fuel on the surface of those claims that are located on the slopes towards both the Similkameen river and Five-mile creek.

Near the summit of the south slope of the mountain there are several precipitous rocky bluffs, where the general geology is well exposed, but the summit itself is so covered with glacial wash and grass that there is little opportunity to study the geology in detail, or to prospect for extensions of the ore-bodies exposed on the mountain-sides, except by very deep trenching.

Judging from the rock-exposures on the southern and eastern slopes of Holmes mountain, the geological structure of the mountain itself is a series of masses of granodiorite cut by intrusive dykes of an igneous rock resembling diabase.

To the west from the south-western boundary of the *Dixie* the country-rock is metamorphosed argillite; to the east from this formation occurs a mass of granodiorite (locally called porphyry) which is intruded by a wide dyke of igneous rock very much altered and fractured, resembling diabase, followed by more granodiorite; then another wide intrusive dyke of igneous rock occurs near the north-east side line of the *Shamrock* mineral claim, overlooking the mouth of Five-mile creek and about 3,200 feet in a south-easterly direction from the cabin on the *Dixie* claim.

The so-called diabase dykes, which trend in a nearly astronomical north-south direction, are from 25 to 100 feet wide, and carry more or less copper mineral in the fracture-planes as well as in the solid rock, but the heaviest mineralization is noticable at and near the contacts between the diabase and granodiorite. In the fracture-planes the minerals are chalcopyrite, bornite, and iron pyrite in a gangue of brecciated rock and quartz.

The mineralization on the surface is made up chiefly of copper carbonates, and the stain in some places, especially on a prominent precipitous bluff or cliff on the *Shamrock* claim, covers a width of approximately 50 feet on the steep face of the cliff. No work has yet been done at this point, and the face was too precipitous to permit of sampling, but about 100 feet east from the face of the cliff a shaft has been sunk to a depth of 10 feet on an outcropping made up of copper carbonates, chalcopyrite, iron pyrite, and occasional particles of bornite in a gangue of quartz and brecciated country-rock. Whether this outcropping bears any relationship to the cliff is an undetermined question, but apparently there is a mass of granodiorite intervening between the two showings. This granodiorite is exposed about 200 feet south-westerly from the face of the cliff, but on the surface there are no exposures of "rock in-place" between the cliff and the shaft.

The most work performed has been done in the *Blue Ridge* mineral claim, which adjoins the *Shamrock* on the north-west. This work consists of an adit driven in a diabase dyke for a distance of 120 feet along the strike or trend of the dyke in a northerly direction, with a crosscut 75 feet in length branching off from the adit at a point 90 feet from the portal. This work shows no well-defined vein-structure, but rather a mineralized zone along the fracture-planes, and also extending into the diabase dyke. The most prominent fracture, with which is associated considerable shearing movement, is 18 inches wide, and is filled with copper carbonates, chalcopyrite, and iron pyrite in a gangue of brecciated dyke rock cemented together with calcite and quartz. In this so-called vein the mineralization is more pronounced than elsewhere, and a sample taken, representing ore graded by hand-sorting, but not to be considered as an average of the entire ore-body, assayed: Gold, trace; silver, 0.8 oz.; copper, 7.2 per cent.

The crosscut showed that, for considerable width away from the fracture, the diabase carried some mineral which is disseminated through the rock, and made up chiefly of particles of chalcopyrite and iron pyrite, but, so far as could be seen in the crosscut, hardly sufficient to warrant being classed as ore, although possibly, if mined on a large scale and satisfactorily concentrated, the material across the entire 75 feet might pay to work.

This dyke in which the above-mentioned adit has been driven appears to lie parallel to the cliff before mentioned on the *Shamrock* mineral claim and separated from it by a wide mass of granodiorite.

On the *Dixie* mineral claim, situated north-westerly from and adjoining the *Blue Ridge* mineral claim, an adit has been driven 50 feet in length, in addition to the open-cut approach. This adit has also been driven in the fractured portion of a diabase dyke, in which the main fracture is about 18 inches wide and filled with brecciated country-rock mineralized with copper carbonates, as well as some chalcopyrite, iron pyrite, and occasionally particles of bornite. The

adit has been driven towards the north along the line of strike of the fracture, which is persistent through the length of the adit, and shows in the face. There is also some mineralization disseminated through the diabase near the main fracture. There does not appear to be any ore of a shipping grade exposed by the work performed, but it is possible that a considerable proportion of the diabase rock might pay to mine and concentrate.

In another adit on the *Dixie* mineral claim, driven in a parallel dyke to the east of the one described for a length of 30 feet, considerable stain from copper carbonates occurs in the rock, but the writer did not see any solid ore exposed. The course of this adit is also in a northerly direction.

All of the adits described expose very similar characteristics with regard to mineralization, and the lines of strike of the zones of fracturing trend approximately in the same direction, while the mineralization is confined to the series of diabase dykes and does not occur in the granodiorite. Unless a thoroughly systematic and extensive method of sampling is adopted, no reliable results can be arrived at with regard to the values carried by the dyke rock; consequently, as the writer had no facilities for sampling on the large scale necessary, and as selected or grab samples would necessarily be unreliable, no samples of the mineralized diabase were taken. Judging from the general appearance of the geological formation and mineralization, one is reminded of the conditions at Copper mountain, situated in an air-line about twelve miles distant in a south-westerly direction. To thoroughly prospect the property diamond-drilling should be resorted to, and the extent of the mineralized zones, as well as the values carried by the material, proven.

The *Bornite* mineral claim, another of the group, is situated on Holmes mountain, on the western slope of Five-mile creek, and east of and adjoining the *Falls View* and *Ben Hur* mineral claims, which adjoin the *Dixie* and *Blue Ridge* mineral claims on the east. At a point vertically about 400 feet down the steep slope from the summit of the mountain, there is an outcrop 4 feet wide of chalcopyrite and gossan. This has been prospected with two open-cuts and a short adit. In the upper open-cut, which is 18 feet in length and 25 feet deep at the face, the mineral is exposed at the face scattered through an igneous rock resembling diorite, but the lower open-cut, 12 feet long, leading to an adit 10 feet under cover, has not been driven sufficiently far to expose the mineralized rock. The line of strike of this occurrence is apparently N. 40° W. (mag.) and dip about 80 degrees towards the south-west (mag.), but from the present exposures it is quite difficult to determine these facts, or form any definite opinion regarding the possibilities, and, owing to the dense growth of underbrush and depth of alluvial wash, equally difficult to prospect.

Rambler Group.

This group of mineral claims contains the *Freddy B.* and *Rambler*, and is owned by Luke Gibson, of Hope. The property, which is Crown-granted, is situated on the west bank of Five-mile creek, about five miles above the mouth. The country-rock is schistose argillite metamorphosed, decomposed, and heavily stained with iron oxides; also containing innumerable narrow fractures or fissures filled with malachite, azurite, and some chalcopyrite. The line of strike of the schistosity of the country-rock is N. 15° W. (mag.) and the angle of the dip about 80 degrees towards the east (mag.). The mineralization extends for upwards of 50 feet in width, as exposed in an adit driven into the steep bank of Five-mile creek, which at this point flows nearly parallel to the line of strike of the schistosity of the argillites, which has the same trend as the fissures.

On the opposite side of the creek the geological formation is granitic, and the creek, at this point at least, marks the line of contact between the granite on its east and the metamorphosed sediments on its west side.

All of the work, which is represented by two adits, was done on the *Freddy B.* mineral claim eight or nine years ago, when a Crown grant was obtained, and afterwards work was suspended awaiting the construction of railroads into the district to furnish cheap transportation. The upper adit is 55 feet in length, and is driven through a low-grade mineralized zone the entire distance, crosscutting it at right angles. The mineralization consists of the copper minerals before mentioned, filling innumerable fissures in the schistose country-rock, but such minerals are not sufficiently concentrated to warrant mining operations being carried on, unless it is demonstrated by proper tests that some method of concentration can be satisfactorily employed. In the lower crosscut adit, located about 30 feet below and about 100 feet northerly from the upper adit, the writer was informed by the owner of the property that considerable solid ore

was exposed in the zone, but this adit, which is said to be 110 feet in length, could not be examined, because some big logs had fallen across the portal and had caved the roof and sides of the adit at the portal, and for about 20 feet back from the mouth, so that no entrance could be made.

The property appears to possess sufficient merit to warrant being thoroughly and systematically prospected by diamond-drill boring, as to-day the Kettle Valley Railway is only about two miles distant, and the transportation problem has thus been solved.

OWL MOUNTAIN.

This mountain reaches an elevation of about 4,000 feet above the Similkameen river, and is situated about eight miles easterly from the mouth of Five-mile creek and about three miles and a half north from the track of the Great Northern Railway. The survey-line between the Similkameen and Kamloops Land Districts traverses the base of the mountain from west to east.

This section was the scene of a big timber fire in 1914, since which time several prospectors have been making a determined search after mineral, and several claims were located in 1914 and 1915 on the south-west slope of the mountain.

Owl mountain is reached from the main Princeton-Hedley wagon-road by a switchback pack-trail that branches off from the wagon-road near the east end of the bridge across Five-mile creek near its mouth.

As already mentioned in this report, Five-mile creek marks the line of demarcation, or contact, between the granodiorite and other igneous rocks that compose Holmes mountain, and a vast mass of granite that occupies several miles in width on the east side of Five-mile creek.

Near the summit of Owl mountain, on the south-west slope, there occurs a triangular-shaped mass of igneous rock resembling diabase that has apparently intruded into the granite, and both rocks show that they are very much altered, sheared, and fractured near the contacts. The north-west, south-east, and south-west boundaries of the diabase rock can be traced without any difficulty, but, owing to dense growth of underbrush to the north-east from the limits of the timber fire, the contact in that direction has not yet been found.

Olivine Group.

The *Olivine, Red Cloud, Panama, Pacific, Summit,* and *Colon* mineral claims form the *Olivine* group, owned by Uhler & Cox, whose post-office address is Princeton. The property is situated in the Similkameen Mining Division on the south-west slope of Owl mountain, about 500 feet below the summit.

The claims were staked in the spring of 1915, and since then the owners have sunk a shaft on the *Red Cloud* claim to a depth of 28 feet, another shaft on the *Olivine* claim 10 feet deep, and made two large open-cuts, also on the *Olivine* claim. This work has all been done in a fractured zone in the diabase that shows mineralization, which, where it is weathered on the surface, is very much decomposed, has a yellow colour, and in appearance bears a similarity to decomposed manganese ore; but below the weathered zone the minerals contained in the gangue rock appear to be confined to iron pyrite, magnetite, marcasite, and pyrrhotite, with marcasite predominating, in a gangue made up of silicified country-rock.

The shaft on the *Red Cloud* mineral claim has been sunk on a fractured zone 5 feet in width, filled with the iron minerals referred to, in a gangue of brecciated, silicified country-rock between fairly well-defined diabase walls. The owners worked along under the impression that the white iron pyrite, or marcasite, was arsenopyrite, and that such would carry fair gold values, as in the *Nickle Plate* mine, but a sample taken from near the bottom of the shaft assayed: Gold, trace; silver, trace; copper, *nil.*

WHIPSAW CREEK.

Whipsaw creek is one of the longest tributaries of the Similkameen river; it rises near the Hope-Princeton trail at the summit of the Hope range of mountains, about midway between the towns of Hope and Princeton, where the elevation of the pass is 6,000 feet above sea-level, and after uniting with Nine-mile creek, empties into the Similkameen river near Ashnola, nine miles south from Princeton. The proposed automobile-road, surveyed from Princeton to Hope, and of which fifteen miles has been built south from Princeton, crosses both Whipsaw and Nine-mile creeks above their junction, where good substantial bridges have been erected.

Having been informed that there were several mineral claims near the head of Whipsaw creek that had not been examined by any representative of the Bureau of Mines, the writer rode to the locality, travelling from Princeton to the bridge across Nine-mile creek by the road, and thence by the main Princeton-Hope horse-trail up the north side of Whipsaw creek to Forty-seven-mile creek, a tributary of Whipsaw that empties into the last mentioned at a point forty-seven miles from Hope and eighteen miles from Princeton.

The lower three miles or so of the bed of Whipsaw creek is approximately the line of demarcation between the lignite coal formation, consisting of clay shales and sandstones, with lignite seams, on the north side of the stream, and on the south side volcanic rocks of Tertiary age, andesite and basalt flows, as classified by Chas. Camsell. Near the Forty-seven-mile Creek crossing there is a decided change in the formation, a belt of mica, talc, chloritic, and hornblendic schists being exposed, dipping under volcanic rocks. Apparently this belt of schists is an extension of the belt of similar rocks exposed near the junction of the Similkameen and Pasayten rivers, situated about twelve miles distant in a south-easterly direction. The line of strike of the schists is N. 30° W. (mag.) and the angle of the dip, while it varies somewhat in places, is usually about 45 degrees towards N. 60° E. (mag.).

The change from the lignite to the volcanic formation is not very well defined, so far as could be observed from the trail, but it is probably at a point about two miles up Whipsaw creek from the bridge near where the course of the stream changes from north-east to nearly due north.

The writer could not learn of any discoveries of mineral having been made in the belt of volcanics on either side of Whipsaw creek below its junction with Forty-seven-mile creek, but above that point there are three or four localities near the summit where mineral claims have been staked, and, despite the lack of any transportation except by pack-horses, on some of these quite considerable prospecting-work has been done, especially on three groups that were examined and which are later described.

Marian Group.

This property consists of six mineral claims—the *Marian Nos. 1, 2, 3, 4, Defence*, and *Defiance*, owned by Sam Spencer, of Princeton. The group is situated at an elevation of 5,700 feet above sea-level in the mountains between Forty-five-mile and Forty-three-mile creeks. The location-lines extend from south-east towards the north-west, one claim, or 1,500 feet wide, in the order in which they are named in this report, except that the *Marian No. 4* claim adjoins the *Marian No. 3* on the west.

The country-rock is a soft mica, hornblende, talc schist, and crystalline limestone, the latter occurring on the east side of the schist where it outcrops as detached masses in contact with the schist. The mineralization does not appear to occur in association with any well-defined vein-structure, but rather as a replacement deposit in the country-rock at the contact referred to, but being more pronounced in the limestone when that is present.

The first place examined was near the south-east end line, and close to the north-east boundary of the *Marian No. 1* mineral claim. At this point development-work has been done, consisting of a crosscut adit 45 feet in length under cover, with an open-cut approach 15 feet in length, and a drift adit 25 feet in length under cover, with an open-cut approach 15 feet in length. These adits connect with one another on the same level, about 22 feet below the surface outcrop. The reason for this duplication of work is because the survey-line of the adjoining mineral claim, the *Three Forks*, is located through the centre of the drift-adit and the corner post established near the face. As neither the owner of the *Three Forks* mineral claim nor any representative were in the camp, this claim was not examined, because no guide could at the time be obtained who knew where any work or mineral outcroppings could be found.

The mineralization consists of zinc-blende, iron pyrite, chalcopyrite, occasional flakes of molybdenite, and quantities of crystals of calcite in a gangue composed principally of crystalline limestone. In fact, most of the mineralized material at this point is so closely associated with the rock-matter as to suggest a concentrating proposition, although a fair proportion can be mined and sorted out as ore, as is shown both in the workings and on the dumps; the latter containing some 25 or 30 tons of sorted ore, a grab sample from which assayed: Gold, 0.13 oz.; silver, 6.1 oz.; copper, 1.8 per cent.; zinc, 15.8 per cent.; lead, trace.

The line of strike of the mineralized zone is N. 45° W. (mag.), and the width of ore and concentrating material as shown in the adits varies from 4 to 8 feet, with the mineralization more pronounced in the floor of the workings than in the roof.

At a point 750 feet northerly from the location post of the *Marian No. 2* claim, located to the north-west of and adjoining the *Marian No. 1* claim, there is an outcropping about 10 feet wide made up of quartz mineralized with iron pyrite. This occurs in mica-schist country-rock, and has apparently no commercial significance. A prospect-hole 5 feet long by 10 feet wide has been sunk on this outcrop to a depth of 6 feet.

About 1,300 feet north-westerly from the adits already described, and 350 feet higher elevation, a shaft has been sunk to a depth of 22 feet. In this a vein is exposed, about 8 feet wide, between mica-schist foot-wall and granite hanging-wall, with the vein-filler mineralized with zinc-blende, iron pyrite, calcite, occasional flakes of molybdenite and epidote in a quartz gangue. The line of strike is apparently N. 40° W. (mag.) and the dip at an angle of 45 degrees towards the south-west (mag.).

Whether there is any relationship between this vein and the ore-body exposed in the adits already referred to is a problem that no attempt has been made to solve. The fact that at the shaft no crystalline limestone is found, and that the ore in the adits is so closely associated with such rock, is rather significant; but, as already stated, the limestone occurs in detached masses rather than as a continuous belt, and while there is no evidence of any limestone at or near the shaft, there is quite an extensive outcrop of it distant about 250 feet in a south-easterly direction. There the limestone has the same line of strike as the vein exposed in the shaft, but the dip is not sufficiently exposed to be determined.

On the *Defiance* mineral claim, one of the *Marian* group, situated in a north-westerly direction and about 6,000 feet distant from the initial post of the *Marian No. 1* mineral claim, there is a mineralized outcrop of considerable width and length in mica-schist country-rock.

No work has been done at this point, but a typical sample was taken which assayed: Gold, trace; silver, 1.4 oz.; copper, *nil;* zinc, 1.1 per cent.; consequently, unless a pay-streak carrying higher values can be found, such mineralization cannot be considered of commercial value.

S. and M. Group.

This property consists of the *S. and M., M. and S., Black Pine, Pine Knoll,* and *Nelson* mineral claims, owned by Sam and Marian Spencer, of Princeton.

The group is situated at an elevation of 4,950 feet above sea-level on the north side of Whipsaw creek, one mile east from its junction with Forty-five-mile creek.

On this property there occurs a belt of micaceous, talcose schist, very much fissured with narrow veins that are filled with decomposed material looking like lead carbonate, cemented with calcite, and solid kidneys mineralized with zinc-blende, galena, and iron pyrite. The line of strike of this mineralized zone is about N. 80° E. (mag.), with the veinlets dipping at varying angles, but no permanent dip is determinable, because the work exposing the veins is hardly sufficiently deep to cut the solid rock. The permanent hanging-wall of the mineralized zone is apparently a porphyritic dyke that outcrops to the east of the belt of schist, but has not been exposed in the underground workings.

There are three adits on the property, situated very near to each other on the mountain-side at an elevation of about 4,900 feet above sea-level.

The No. 1 adit was so badly caved that an entrance could not be made. This adit, the owners of the property said, was 75 feet in length and driven through surface wash.

The No. 2 adit is closely timbered for most of its length, which is about 66 feet. The general course of this adit, starting from the portal, is N. 60° W. (mag.) for a distance of about 50 feet; thence N. 10° W. (mag.) for 15 feet to the face. The first-mentioned course crosscuts the formation diagonally, while the last-mentioned course crosscuts it at right angles.

Only a partial examination of the walls of this adit could be made, because of the timber obstruction; from that it was seen that several narrow fissures, or so-called veins, had been intersected by the course of the adit; the widest of these fissures is about 12 inches. Apparently there is a possibility that a concentration test would demonstrate that there is sufficient ore in the formation crosscut by the adit to warrant the adoption of a system for thoroughly prospecting the property at deeper levels to determine whether or not the fissuring extends to considerable depth and carries mineral of commercial grade. This adit was not sampled, because it was not possible to systematically sample the material intersected by it unless considerable time was devoted to the work, and a larger sample taken than the writer could pack on horseback, in order that a proper concentration test could be made.

The No. 3 adit is situated in a south-easterly direction from the No. 2 adit, and about 40 feet lower elevation. This adit has been driven a total of 153 feet in length in a general N. 20°

W. (mag.) course, in addition to the open-cut approach, about 15 feet long. It crosscuts several fractures or narrow fissures dipping at varying angles towards S. 70° E. (mag.) and having their lines of strike nearly parallel to each other, trending towards N. 20° E. (mag.). These fissures are filled with a decomposed material similar to the filling in the veinlets in the No. 2 adit already described. For a considerable proportion of the length of this adit it is driven through gravel and surface wash, with less than 20 feet of backs above the level of its floor, but near the face there are 50 feet of backs and the solid rock is exposed; it is very much broken up and fractured, with the narrow fissures filled with talcose material, apparently crushed schist, some of it mineralized with particles of galena and iron pyrites. A sample of solid ore taken from a small dump at the portal of the No. 3 adit assayed: Gold, 0.3 oz.; silver, 24.9 oz.; copper, 2.5 per cent.; lead, 8 per cent.; zinc, 12.5 per cent.

The solid ore occurs as nodules and small kidneys in the decomposed vein-filler, but the percentage of it contained in the veinlets is undeterminable except by a concentrating test. Until further and deeper prospecting has been carried on it is impossible to express an unqualified opinion as to the value of the property, other than that it has possibilities, and is a good enough prospect to warrant further prospecting by systematic and deeper development-work. It has the appearance of possibly developing into a concentrating proposition of commercial value, and, so far as timber and water are concerned, there is an ample supply of both within easy access from the workings on either the *S. and M.* or *Marian* groups of mineral claims.

Lucky Pair. This mineral claim is owned by William Knight and Charles Day, of Princeton. It is situated on the south side of Whipsaw creek, about two miles in a southerly direction from its junction with Forty-seven-mile creek, and is connected with the main Princeton-Hope trail near the junction by a good pack-trail.

The country-rock is apparently an extension of the belt of mica, hornblendic talc, and chloritic schists occurring on the *Marian* group, and possibly of the belt mentioned earlier in this report in connection with the Roche River camp, near the junction of the Similkameen and Pasayten rivers, which has its line of strike about N. 55° W. (mag.) and dips vertically.

A mineralized outcropping is exposed on the steep slope of a gulch, and about 150 feet below it an adit has been driven 216 feet in length, as a drift along the line of strike of a well-defined fissure about 2 feet wide, filled with quartz, calcite, and talc in which occur nodules of iron pyrites, zinc-blende, and galena. Both walls of this vein are mica-schist for about 200 feet from the portal of the adit, beyond which point the country-rock on the south side of the vein has changed to a black graphitic slate. The line of strike of the fissure varies slightly from the general strike of the mica-schist, the former in places being N. 70° W. (mag.), but the dip is vertical, conforming with the dip of the schistosity of the country-rock.

An average sample of the entire vein-filler taken across 18 inches at the face of the drift, the width of the vein at that point, assayed: Gold, 0.2 oz.; silver, 0.6 oz.; copper, *nil;* lead, trace; zinc, 3.0 per cent.

The drift branches off at a point 30 feet from the portal of the adit, which beyond the forks is driven in a westerly (mag.) direction for about 200 feet, and crosscuts the schist country-rock diagonally. For about 100 feet under cover from the portal, both the drift and crosscut are closely timbered, so that no critical examination or sampling of that portion of the vein was possible.

On the dump there was a quantity of sorted ore that had the appearance of carrying fair values, but no sample was taken because it was impossible to form any judgment as to the proportion of mineral to rock vein-filler which had been mined previous to sorting.

In addition to the underground work described in this report, a large ore-bin with sorting-tables, roofed over with a substantial snow-shed, and a good cabin have been built, and the whole of the work shows that better than the average skilled miner and mechanic had been engaged in its performance.

Since the writer visited this property, William Knight, one of the owners, a miner and pioneer prospector of the district, has died.

GRANITE CREEK.

On August 14th the writer rode from Princeton to Granite creek, where he examined the placer- and hydraulic-mining propositions described later. The placer mines on Granite creek were examined by Dr. G. M. Dawson in 1888, and his notes published in the annual report of

the Canadian Geological Survey for that year. In 1900 Professor F. J. Kemp made an investigation of the geology and platinum-bearing placers of Granite creek, and his report was published as a special bulletin by the United States Geological Survey. In 1901 the Provincial Mineralogist examined the Tulameen district, including Granite creek, his report being published in the Minister of Mines' Report for that year. In 1909 and 1910 Charles Camsell, of the Canadian Geological Survey, made a detailed examination of the geology of the Tulameen district, including a portion of Granite creek, the results of which, with maps, were published by the Survey as Memoir No. 26. In 1913 the district was visited by the Assistant Provincial Mineralogist, whose notes were published in the Minister of Mines' Report for that year.

In consideration of the publication of these earlier reports, the writer confined his examination to the work done on Granite creek since 1913, the most important of which has been performed by Lambert & Stewart about five miles above the mouth of the creek.

Lambert & Stewart's Hydraulic Mine.

This property comprises one mile and a half of creek leases, situated on Granite creek above the North fork, and just below the junction of the main creek with Newton creek. For the past seven years C. E. Lambert, who placer-mined on the creek in 1885 and 1886, also in Atlin from 1898 until about 1907, has been superintending the work on these leases owned by Stewart and himself. The ground included in the leases referred to is situated in a portion of the creek just above a box canyon and has never been worked, or even prospected, until Lambert & Stewart began operations about 1908; for the reason that apparently a very extensive rock-slide had at some distant day in the past dammed up the creek at the lower end of the leases and caused a lake to form above the slide. This presented such an obstacle as to be considered insurmountable by the old-time placer-miners, for the reason that they estimated no bed-rock could be reached by the ordinary methods usually followed. The present owners decided to drive a tunnel through the slide at such a low level as would drain the lake, and at the same time serve for carrying off the tailings from a bed-rock flume which they constructed above the upper end of the tunnel.

Before attempting this expensive piece of work the owners sank a shaft 15 feet square at the upper end of the slide, and struck bed-rock at a depth of 12 feet, where the gravel yielded $12 to the cubic yard in rough, coarse placer gold.

The drain-tunnel through the slide is 300 feet in length; a dam was constructed and 800 feet of flume, 3 feet wide, built of lumber, for diverting the water from the bed of the creek. After this preparatory work had been finished the bed-rock flume was installed, 200 feet in length; but this portion of the flume is built several feet above the bed-rock; in fact, no particular effort was made to reach bed-rock with that portion of the flume, because the rock formation on both sides of the creek is a hard, smooth diorite, evidently an intrusive mass in the argillites and not considered as likely to form a favourable bed-rock for catching gold. About 3 feet above the head of the bed-rock flume, as it appeared when the writer visited the work, the formation changes to a soft argillite, and it is in this portion of the lease where the owners expect to obtain good "pay."

Since the date of this visit it is reported that a short time previous to closing down for the season the head of the bed-rock flume had been advanced and the soft bed-rock reached, resulting in a clean-up of about $2,000 in a short time. This result apparently confirms the opinion of the owners as to the richness of that portion of the creek, provided bed-rock could be exposed.

The operators have had no large boulders to contend with; the only serious difficulty they have had to overcome has been with regard to the erratic supply of water, which is too little for producing good results during most of the season, but during the spring freshets, resulting from melting snow and rain, which cause abnormally high water in the creek, the quantity is too large to permit of work being carried on, besides the danger of damage to the flumes.

Despite the fact that the placer-ground on Granite creek has been considered to have been worked out some years ago, there are still several miners working in various portions of the creek every year; and during 1915 there were eight or ten placer-miners working, who earned fair wages, as the writer was informed by E. Cook, who runs the general store and hotel, and is also postmaster at Granite.

LODE-MINING.

Up to the present time no lode-mining has been attempted in the district directly tributary to Granite creek, notwithstanding that on W. H. Wheeler's placer claim, situated about four

miles above the town, some narrow stringers of high-grade gold-bearing quartz are reported to occur in the argillite country-rock, and the further fact that nuggets of coarse gold have frequently been found on this and other claims along Granite creek, with particles of quartz matrix adhering to them, denoting local origin.

Wheeler Placer Claim.

This placer claim was worked in 1915 by the owner, W. H. Wheeler, whose operations consisted chiefly of drifting in an ancient channel of Granite creek, from which he reported satisfactory results. At this claim the creek cuts through a belt of argillites which is very heavily stained by iron oxides, and is seamed with innumerable gash-veins filled with quartz also heavily impregnated with iron pyrite and discoloured from oxidation of the pyrite.

There was a small quantity of platinum found with the placer gold that was mined during the past season, most of which was purchased by E. Cook, already referred to, who informed the writer that the yield so far reported was a fair average of the annual production during recent years; but the clean-up made by Lambert & Stewart at the end of the season probably increased the yield for the year.

Professor Kemp, in his report published by the United States Geological Survey, states, with regard to the occurrence of platinum in the Similkameen district, that he found platinum to occur in quantities varying from traces to nearly 2 oz. to the ton in serpentine bands in altered peridotite, and that it was also detected in dykes of pyroxenite, and possibly as a secondary mineral in an altered granite.

Gypsum-deposits.

The gypsum-deposits near the Tulameen river, above and below the mouth of Granite creek, were examined, but no work has been done recently; consequently, it is unnecessary to describe these in this report, as such would only be a repetition of the remarks made in the reports by Camsell and the Assistant Provincial Mineralogist.

TULAMEEN RIVER.

The various camps in this vicinity were fully described by the Assistant Provincial Mineralogist in the Minister of Mines' Report for 1913, and also by Charles Camsell, of the Canadian Geological Survey, in Memoir No. 26, published by the Survey in 1913, entitled "The Geology and Mineral Deposits: Tulameen District, B.C."

In view of this fact the writer confined his investigations to an examination of development-work performed since 1913 on Sutter creek, at the head of the Tulameen river; but paid a short visit to Coalmont, where the syndicate owning the Coalmont Collieries has its headquarters.

Coalmont Collieries.

This coalfield is very fully described by Camsell in the memoir referred to, and extracts from his reports are also incorporated in the report by the Assistant Provincial Mineralogist. Since these were published there has been practically no extension of the mine-workings. A. N. Coutrell, the manager for the syndicate, stated to the writer that A. McEvoy, the president, was visiting New York and other Eastern cities for the purpose of securing capital to permit of a resumption of work and the installation of a system of transportation from the coal-mine to the railway at Coalmont.

PLACER-MINING.

Placer-mining has been carried on along the Tulameen river more or less spasmodically during recent years, and several leases have been granted for dredging and hydraulic-mining operations. During the past season no really serious development-work or active mining operations on any large scale were in evidence. There were, though, a larger number of individual placer-miners than usual working at several historic bars along the river, especially along the upper portion above the town of Tulameen, because the extremely low stage of water enabled them to mine in the bed of the stream, without constructing wing-dams, much farther from either bank than has been the case for years. These miners reported that they were all earning fair wages, and some of the more fortunate obtained fair-sized nuggets of both gold and platinum.

On the arrival of the writer on August 15th at the town of Tulameen, he met Andy Jensen, who informed him that recently considerable underground work had been done on the *Morning Star* and other mineral claims near the Tulameen summit which had not been examined by any representative of the Bureau of Mines. As this work had been performed since the visit of the

Assistant Provincial Mineralogist in 1913, an arrangement was made with Jensen to accompany the writer to the head of Sutter creek for the purpose of making an examination of the results of the recent work.

A start was made on the morning of August 16th on horseback, and the camp, about twenty-one miles distant from the town of Tulameen, was reached the same afternoon.

SUTTER CREEK.

Sutter creek is one of the tributaries of the Tulameen river, and helps to form the head-waters of the North fork of that river, which it joins at a point distant about eighteen miles in a south-westerly direction from the town of Tulameen. The trail by which it is reached follows up the Tulameen river. This trail as far as Kelly creek, a distance of about fourteen miles, has been greatly improved during the summer of 1915 by grading it along the steep side-hill along the north-westerly bank of the river, instead of by the old route which crossed the summits of the divides that lie between Eagle, Siwash, and Kelly creeks, tributaries of the main Tulameen river. The construction of a substantially built bridge across the deep canyon cut by the waters of Siwash creek is a very marked improvement, as it shortens the distance very considerably, besides cutting out some very bad grades that occur in this section of the old route. As the appropriation was exhausted, work was suspended at Kelly creek.

An extensive forest fire that burned from just beyond that point to near the head of Sutter creek, a distance of about seven miles, had caused that portion of the trail to be in a bad condition, and the contrast between this portion of the route and that portion below Kelly creek was very marked. The source of Sutter creek is near the summit of the Tulameen range of mountains which forms the watershed between the Similkameen and Yale Mining Divisions.

Morning Star. This is an old Crown-granted mineral claim owned by the Estate of Dan Ross, an old-timer in the camp, and had been bonded by Andy Jensen, who had a force of miners working on the property in 1914 and 1915, and had driven 246 feet of crosscuts and drifts, starting about 60 feet vertically below some old working performed by Ross, the original owner, previous to his application for a Crown grant.

The camp buildings are located in a basin surrounded by precipitous cliffs, near the summit of one of which, about half a mile distant from the camp, there occurs the outcropping of a gash-vein exposed for about 15 feet in length, and from a few inches to about 18 inches in width, filled with galena, zinc-blende, calcite, and quartz. The line of strike of this vein is N. 75° E. (mag.) and the dip at an angle of 45 degrees towards the south-east. A typical sample of the solid ore chipped from the vein assayed: Gold, 0.03 oz.; silver, 55 oz.; lead, 24.2 per cent.; zinc, 13 per cent.

The country-rock in which this outcropping occurs is apparently a very much altered igneous rock, containing such a large percentage of green chlorite as to give it the appearance of greenstone. In the vicinity of the vein later referred to as No. 1, this rock is fissured and fractured to a considerable extent; most of the narrow crevices are filled entirely with calcite, while the wider ones carry more or less galena, zinc-blende, calcite, and iron pyrite in a quartz gangue. The outcrop of the so-called gash-vein just described is an illustration of one of the wider fissures.

Another vein, later referred to as No. 2, outcrops about 75 feet distant in a south-westerly direction from the outcropping that was sampled, the assay of which has been already referred to. This last-mentioned vein has its line of strike N. 45° E. (mag.) and dip at an angle of about 80 degrees towards the south-east (mag.). If these veins maintain persistency along their lines of strike, they should intersect each other at some point not very far from the outcropping of the No. 1 vein, but no evidence of this was noticed.

The No. 2 vein at the point where it outcrops is about 2 feet wide, filled at that point mainly with quartz and calcite, but having some mineral scattered through the gangue rock. There has been a short adit driven under this outcrop and the vein crosscut by it. No sample was taken of the vein-filler in the adit, because the mineralization appeared insufficient where the vein was crosscut to show values of commercial importance, and no drifting had been done along the line of strike.

The main work on this property is that performed by Jensen during 1914 and 1915. This consists of a crosscut adit driven 75 feet in length, from which a drift about 108 feet in length

has been driven; also another crosscut 38 feet in length made from the face of the drift; and a winze sunk 10 feet deep at the end of the second crosscut. He also cruised and cut out a winter sleigh-road between the mine and Holmes's ranch, situated at the end of the wagon-road, six miles from Tulameen village. This work was done to facilitate the transportation of ore from the mine to the railway. The route, though, is not available for a summer road, because it crosses too many marshes that are impassable during that season.

The crosscut adit referred to is located at about 60 feet lower elevation than the open-cut, and trenching on the outcrop of the No. 1 vein, and nearly directly under that outcropping, where the sample already mentioned was taken. The adit is driven in a south-easterly direction with the expectation of crosscutting the No. 1 vein on its dip. At a point 45 feet from the portal a narrow fissure was intersected, but no attention was paid to this at the time, and the work of driving the crosscut was continued for a further distance of 30 feet; but as no other fissure was encountered the miners started to drift on the fissure already crosscut. This drift was driven in a S. 75° W. (mag.) direction for a distance of 108 feet, but the results were unsatisfactory, because, except for about 10 feet of this distance, the fissure is very narrow and carries no mineral. The 10-foot section, where the fissure is 2 feet wide, is mineralized to some extent with particles of galena, zinc-blende, iron pyrite, and marcasite in a gangue composed of soft talcose material and silicified, brecciated, altered country-rock. Beyond this point the fissure pinches out in the roof of the drift entirely, but shows in the floor with indications that it may be found wider below the floor. Regardless of these conditions, the drift was driven for about 30 feet farther in solid country-rock.

At the face of the drift a crosscut was made towards the north-west for the purpose of prospecting the ground, and after driving about 13 feet a well-defined fissured zone was exposed. The crosscut was continued through this for 25 feet farther, and showed that the zone is about 25 feet wide, and made up of three mineralized fissures, each about 2 feet wide, separated by bands of altered greenstone. The vein farthest from the drift appeared to give the most promise, and contained the most mineral, chiefly zinc-blende, with some kidneys of galena and iron pyrites in a gangue made up principally of brecciated country-rock. The greenstone walls are not very well defined, but sufficiently so to segregate the vein-filler from the wall-rock. A winze was sunk on this vein to a depth of 10 feet, and an average sample taken across 2 feet at the bottom of the winze assayed: Gold, trace; silver, 8 oz.; copper, 2 per cent.; zinc, 20.2 per cent.

From a rough survey made by the writer with a Brunton compass, it would appear as though the fissure on which the long drift has been driven may be a continuation of the No. 1 vein at depth, but that it has pinched on the level where it is exposed by the crosscut, as well as (except in the 10-foot section) in the drift, and that beyond that point the miners lost it, but by crosscutting to the north-west had again exposed it at a point where it has widened out. Further prospecting along the strike may possibly lead to opening up a lens in the vein sufficiently wide and filled with mineral of commercial grade, if a satisfactory method of concentration is applied.

Treasure Mountain Mining Co.

The writer had arranged to visit this company's property, situated on Treasure mountain about four miles and a half in a direct line westerly from the *Morning Star* mineral claim, as he had been informed in Tulameen village that Messrs. Dornberg and Edwardes, of Spokane, representing the company, were also visiting the property to inspect work recently done; but during the evening of August 16th two miners came to Jensen's camp from the Treasure Mountain camp, and brought the information that the representatives from Spokane had closed down all work, locked up the camp, and fastened up the portal leading to the underground workings. Consequently, as it appeared that no examination could be made, the writer abandoned his proposed visit, and, as there was no other work recently done in the neighbourhood, returned direct to Tulameen village.

Here he met Messrs. Dornberg and Edwardes, who informed him that work had been closed down because it was considered inadvisable to continue hand-work, and that until the wagon-road was constructed beyond Holmes's ranch, the present terminus, they could not transport machinery to Treasure mountain. They also informed the writer that since the visit of the Assistant Provincial Mineralogist the main crosscut adit had been extended to a length of about 550 feet, where a vein was crosscut, and a drift had been driven a distance of 108 feet along the line of strike of the vein; that a crosscut 12 feet long had also been driven from the drift.

They stated that zinc-blende, with galena, occurred along the drift as kidneys and bunches of solid ore, and that the short crosscut was all in ledge-matter which contained a large proportion of similar ore of shipping grade. From their statements the writer formed the opinion that, while some of the ore on the property would pay to ship direct, yet a very large proportion would require to be concentrated.

The lower or main crosscut adit is said to be 480 feet in vertical depth below the upper adit, described by the Assistant Provincial Mineralogist in the Minister of Mines' Report for 1913, and 600 feet deeper on the incline of the dip of the vein.

VERNON MINING DIVISION.

REPORT BY L. NORRIS, GOLD COMMISSIONER.

I have the honour to submit my annual report on mining operations in the Vernon Mining Division for the year ending December 31st, 1915.

The revival of interest in the mines near Monashee mountain which was noticeable during 1914 was not sustained during 1915, probably owing to war conditions.

The owners of the *Minerva* group, near Monashee, Messrs. McDaniels, Woods, and Paul, have, however, accomplished something. They drove 50 feet of a tunnel and ran their 2-stamp mill long enough to crush 70 tons of ore, which yielded $17.50 a ton of free gold, besides giving 5,700 lb. of concentrates worth $366 a ton net. The run was very satisfactory. This group, which embraces the *Minerva*, *Zilpah*, *Black Bess*, and *Tough Nut*, is evidently a valuable property.

In 1914 the Vernon Hydraulic Mining Company secured four hydraulic leases of 80 acres each on Siwash creek, on the west side of Okanagan lake, about twenty miles from Vernon by wagon-road. In the spring of 1915 a good substantial plant was put in and the first run was made in May and June. Previous to the installation of this plant the bed-rock uncovered by the run in May and June had been to a considerable extent worked out by tunnelling. The amount of gold obtained from the sluice-boxes, together with the amount previously extracted, it is claimed, shows the ground so worked out to have yielded just about 15 cents a cubic yard. This is considered to be a very good showing, as the ground is not difficult to work. It is easy of access, a wagon-road running right on to the claim. R. H. Hanaur, of Spokane, Wash., is the manager of the company. There is every reason to think that work will be pushed energetically next year.

OFFICE STATISTICS—VERNON MINING DIVISION.

Free miners' certificates	139
Mineral claims recorded	25
Placer claims recorded	12
Hydraulic leases	4
Certificates of work	28
Transfers recorded	2
Crown grants issued	4

VERNON MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

On October 7th the writer reached the town of Vernon for the purpose of examining the *Monashee* mine, situated forty-seven miles east from Vernon, also some hydraulic-mining operations on Siwash, Whiteman, and Boulean creeks, that flow into Okanagan lake on the west side nearly opposite to Okanagan Landing.

Monashee.

This property was not visited, because all work had been suspended by the Fire Valley Gold Mining Company, and the manager, Dr. A. H. Elftman, had left for Minnesota, leaving no one in the camp during his absence. Earlier in the summer this company had been doing extensive development-work by driving a long adit to intersect the ore-body on the *Rossland* mineral claim at a depth of 1,000 feet below the surface.

From the most reliable information obtainable, the writer learned that no other work was in progress in the camp; consequently he deemed it inadvisable to incur the expense and occupy the time necessary to make an examination, especially considering the lateness in the season and probabilities of snow-storms at the high elevation of the mineral claims.

PLACER-MINING.

During 1915 the Union Hydraulic Mining Company, of Spokane, operated on Siwash creek, and claims to have obtained about $3,000 up to July last, when operations were suspended because of lack of water. At the time of the writer's visit to Vernon the camp was idle and untenanted, so that unless prepared to make tests by working the gravel, which was impossible, no satisfactory examination could be made; consequently the writer did not expend the time and money that would have been necessary. The company stated that it was preparing to install machinery when compelled to close down.

On Whiteman and Boulean creeks three hydraulic leases have been recorded, owned by the Green Bros. and Frank Mitchell, of Vernon, and Frank Hagenbuch, of Calgary. The owners propose installing machinery and constructing a ditch and pipe-line to bring water a distance of about one mile and a quarter. During last summer it is claimed that the owners expended $2,000 in preparatory work.

YALE MINING DIVISION.

REPORT OF L. A. DODD, MINING RECORDER.

I have the honour to submit the annual mining report and office statistics for the year ending December 31st, 1915.

PLACER-MINING.

Beyond some development-work by Cherry & Brady on their lease on the Coquihalla river and by W. E. Adams on his Siwash Creek leases, very little has been done in this class of mining. The Chinamen have been very industrious on the various bars of the Fraser river, and store-keepers report gold to the value of $5,970 as having been purchased during the year.

I am informed that wherever the Canadian Northern Pacific Railway during construction made a gravel cut, the action of the water in its higher stages on the gravel thrown over the river-bank has caused a concentrate which pays good wages, with a rocker, during low water.

QUARTZ-MINING.

With the exception of the two localities hereinafter referred to, the Division was very thoroughly inspected by W. M. Brewer, M.E., for the Bureau of Mines, whose report will no doubt appear concurrently with this. It would therefore be unnecessary to make any comment on the properties visited by Mr. Brewer.

In September, 1914, five claims were located some fifteen miles up Quoieek creek by Keefers Indians. A half-interest in the group has been acquired by W. S. Clark, of Keefers. Some little development-work was done during the past season and 3 tons of ore brought out. This was shipped to Seattle for treatment and returned $92.50 a ton in antimony.

During the summer a discovery of a promising copper-deposit was made by Hope prospectors some ten miles south of St. Elmo and three or four miles from Jones lake. Examination of the original locations caused considerably more than local excitement, and quite a large number of locations were recorded. Owing to the altitude very little work could be accomplished, and, though the properties were examined by outside parties, it was impossible to get very much done before the snow fell. The ore-body appears to be very extensive, though no effort has yet been made to prove its depth. A pleasing feature is its proximity to transportation. A trail has been built to the locations.

OFFICE STATISTICS—YALE MINING DIVISION.

Free miners' certificates issued	210
Locations recorded	169
Certificates of work issued	51
Bills of sale, powers of attorney, etc., recorded	40
Filings	12
Creek, hydraulic, and dredging leases granted	4

Revenue.

Free miners' certificates	$ 945 00
Mining receipts, general	1,863 45
Other sources	905 20
	$3,713 65

YALE MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

HOPE.

The town of Hope is situated on the east side of the Fraser river, distant ninety-one miles from Vancouver. Until the present year the only railway facilities have been via the Canadian Pacific, which company has maintained a station on the west side of the river, and connections have been made with the town by means of a gasolene-launch and scow, but last summer a double-decked steel and concrete railroad and wagon bridge was constructed to furnish direct connections between the Canadian Pacific and the Kettle Valley Railways, the last named having been recently built from Hope, up the Coquitlam River valley, and across the Hope mountains to Merritt, in the Nicola valley.

The Canadian Northern Pacific Railway Company has recently completed its main line from Vancouver along the south-east side of the Fraser river, and established a station and side-tracks at Hope, so that in future this pioneer settlement will be well furnished with transportation facilities.

From a mining point of view this portion of the Fraser valley is particularly interesting, not only because it was brought into prominence in 1858 through the discovery of rich placer-diggings on Hills bar, but as early as 1871 the *Eureka* group of mineral claims was located and later Crown-granted. This group is at a very high elevation about six miles south from the town. No work has been done on the property since the early seventies, and the writer was informed by a prospector who had attempted to visit it that slides had rendered the workings inaccessible, so no examination was made. In the Report of the Provincial Minister of Mines for 1874 there is the following reference, which is here inserted for the information of prospectors:—

Eureka.

"The first lead, called the *Eureka* mine, crops out about 5,000 feet above the river-level, is well defined, from 4 to 7 feet in thickness, and has been traced 3,000 feet. A tunnel has been driven into this lead for 190 feet. The ore is described as argentiferous grey-copper, and assayed from $20 to $1,050 worth of silver to the ton. During the time the above lead was being worked, another about 300 feet distant was discovered; this is of a far more valuable character, and is called the *Van Bremer* mine. The ore is described as chloride of silver, and has yielded, under assay, from $25 to $2,403 of silver per ton of rock. A quantity of ore from the outcrop sold at San Francisco at $420 a ton. The lead is distinctly traceable for half a mile."

The same property is also mentioned by the late Dr. George M. Dawson in the report of the Canadian Geological Survey for 1876-7, as follows: "Specimens assayed by Dr. Harrington and Dr. Hunt gave, respectively, 271.48 oz. and 347.08 oz. of silver to the ton of 2,000 lb. Lead, copper, antimony, iron, arsenic, and sulphur are also present. As stated in the Minister of Mines' Report, the ore in this locality has been sold at a remunerative price in the rough

state, as extracted from the mine, and carried to the river by the present rude appliances. Certain unfortunate difficulties with regard to the ownership of the property now only appear to prevent the successful working of this deposit."

From the best information the writer has been able to obtain, no attempt has been made since Dr. Dawson's report was published in 1876-7 to reopen the workings, but it is possible that with the excellent transportation facilities now furnished some action may be taken to that end.

Aufeas Gold Mining Co.

The property owned by this company is situated in the mountains at the head of Wardle creek, a tributary flowing into Silver creek from the south, and about six miles distant from the town of Hope in a south-westerly direction. The officers of the company are H. B. Dardier, president, and A. E. Rabb, secretary, both residents of Hope. During the disastrous fire at Hope in the spring of 1915, all maps and other papers belonging to the company were destroyed when Mr. Rabb's office was burned.

The writer visited the property on July 10th and found a well-defined contact-vein, filled with arsenical pyrite, outcropping at an elevation of about 1,500 feet above sea-level. This is designated as the No. 1 vein in future reference in this report. The line of strike of this vein is N. 55° E. (mag.) and it dips at an angle of 40 degrees towards the south-east. The vein is exposed on the outcrop continuously for a distance of 200 feet, its width varying from 6 to 18 inches. The hanging-wall is granite and the foot-wall a narrow diorite dyke intrusive in the granite, which is again exposed below the dyke, and is the prevailing country-rock in the neighbourhood.

A sample taken across 6 inches of solid arsenopyrite, and representing an average of the vein at the particular point sampled, assayed: Gold, 1.05 oz.; silver, 0.6 oz.; copper, *nil.*

A second vein (designated as the No. 2 vein later in this report) outcrops at about 100 feet lower elevation. This No. 2 vein occurs between granite walls, and although only a few inches in width is well defined, filled with arsenopyrite and iron pyrite, with gouge on both walls. The vein-filling contains much more quartz than the No. 1 vein, but was not sampled because where exposed the vein is too narrow to be successfully mined, unless the ledge-matter was of remarkable richness, of which there were no indications, or unless the width increased materially as development progressed. This latter condition might possibly occur at depth where the two veins may unite, if they maintain continuity and if the diorite dyke that intrudes into the granite between the veins cuts out, and provided each of the veins maintained their dips, because the No. 2 vein dips at an angle of 23 degrees towards the south-east (mag.), while the No. 1 vein, at somewhat higher elevation, dips at an angle of 40 degrees in the same direction. The line of strike of the No. 2 vein is N. 55° E. (mag.), or parallel with the strike of No. 1 vein.

At a slightly lower elevation than the outcropping of the No. 2 vein a crosscut adit has been driven in granite. At a point about 50 feet in from the portal a vein is crosscut, with granite for both walls, having its line of strike N. 60° E. (mag.) and dip at an angle of 43 degrees towards the south-east (mag.). The mineral contents of this vein are arsenopyrite and iron pyrite in a quartz gangue very similar to the outcropping of the No. 1 vein. This is assumed by the miners to be the No. 1 vein. Such can hardly be possible, though, because the slope of the mountain is at a very high angle to the north-west, unless the footwall as well as the strike and dip have changed between the outcrop and the adit.

The writer concluded, after observing the above-mentioned condition, that the assumption arrived at by the owners was incorrect, and that the crosscut had not been driven far enough to intersect the No. 1 vein. Apparently there occurs in the mountain a series of three veins at least, with the one that is crosscut in the adit, at the point 50 feet in from the portal, not outcropping on the surface. At any rate, there were no indications of any other outcroppings except those of the No. 1 and No. 2 veins already mentioned.

The No. 2 vein has been crosscut in this adit at a point 6 feet from the portal. Short drifts have been run in both directions from the adit on the line of strike of the vein crosscut at 50 feet in from the portal. The drift towards the north-east is 6 feet in length, and towards the south-west is 10 feet in length.

Samples were taken at the faces of each of these drifts across the ore-body there exposed. In the first-named drift the arsenopyrite and iron pyrite is 8 inches wide, and the sample assayed: Gold, 0.24 oz.; silver, 0.2 oz.; copper, *nil.*

A lower crosscut adit has been driven for a distance of about 470 feet, starting at somewhat more than 100 feet lower elevation than the upper adit. This has been driven in granite, except at two points mentioned later, where veins were crosscut.

At a point 190 feet in from the portal a vein corresponding in strike and dip with the No. 2 vein has been crosscut, and at a point 386 feet in from the portal another vein has been crosscut; this has the same general strike and dip as the No. 1 vein.

A drift 60 feet in length has been driven towards S. 55° W. (mag.) from the adit on the vein crosscut at 190 feet from the portal; in this drift bunches, or kidneys, of quartz containing some iron pyrite and arsenopyrite occur, similar to the filler in the No. 2 vein.

A second drift, about 400 feet in length, has been driven towards S. 60° W. (mag.) from the adit at a point 386 feet from the portal, along the hanging-wall of the second vein crosscut. There has also been a drift driven towards N. 60° E. for a distance of about 40 feet along the foot-wall of this vein.

In both of these drifts quartz containing some iron pyrite and arsenopyrite is exposed, but the vein-filler is narrow; the walls, though, are well defined, with narrow seams of gouge of talcose nature occurring along both walls. At the face of the north-east drift the vein carries apparently a good grade of ore for 12 inches in width. Near the face of the south-west drift there are several seams of a black-coloured soft material, each seam being several inches in width. This material has been reported to carry values, but a sample taken by the writer assayed only traces in gold and silver, with no copper.

From a point in the long drift about 100 feet towards the south-west from the main adit, a crosscut has been driven for a distance of 58 feet in a north-west (mag.) direction, in which is exposed several narrow veins filled with quartz containing arsenopyrite and iron pyrite, and the granite rock between these narrow veins is so much altered and crushed as to resemble soft talcose gouge. Apparently the entire width of 58 feet might pay to concentrate, and if such treatment proved successful the mine could be operated as a low-grade proposition.

Some months prior to the writer's visit active operations were in progress, and a light aerial tramway about 1,800 feet in length was installed. This extended from the portal of the lower adit to the Silver Creek wagon-road, and was used to transport sacked ore, but later all operations were suspended and the property placed in charge of a caretaker.

COQUIHALLA RIVER.

Leaving Hope on Sunday, July 11th, the writer, in company with Joseph Gibson, a pioneer of the district, for a guide, rode up the Coquihalla River wagon-road to the vicinity of the mouth of Ladner creek, one of the largest tributaries of the river flowing in from the west. From Hope to the mouth of Ladner creek the Coquihalla river is a large rapid stream, with a fairly wide, heavily timbered valley.

The track of the Kettle Valley Railway parallels the course of the Coquihalla river the entire distance from the town of Hope to Ladner creek, crossing the river from the south to the north side near its confluence with the Nicolum river, a short distance from the town. The railway is built along the valley of the Coquihalla for about ten miles, but beyond that point the valley is quite narrow in places, and in order to obtain a minimum grade to cross the summit at the head of the river, the track is laid along the steep river-bank on the mountain-side, gradually ascending until at the crossing of Ladner creek the steel and concrete railway-bridge is 276 feet above the bed of the creek, or 1,500 feet above sea-level, and at the summit, about sixteen miles distant, the elevation is about 3,200 feet above sea-level.

Above the confluence of the Coquihalla river and Ladner creek the valley of the Coquihalla is very narrow, and the width of the river at a normal stage of water decreases considerably, while the fall increases as the grade of the river-bed ascends from about 1,300 feet elevation above sea-level at the mouth of Ladner creek to about 3,200 feet at the summit, sixteen miles beyond. For a considerable distance on the upper portion of the river it flows through a deep canyon in a bed encumbered with masses of rock, and the steady roar of the flowing waters can be heard for a long distance. Above the mouth of Ladner creek the mountains on both sides of the river rise abruptly to a great height.

Granite is the prevailing country-rock for a distance of about five miles from Hope, but on the north side of the river near the 6-mile post on the railway there is a change to argillites,

Chilliwack Lake, with Skagit Range in Distance.

Hydraulic Mine, Siwash Creek, near Vernon.

slates, and schists, usually metamorphosed, heavily iron-stained, with the laminations very much contorted and fissured. This formation has its line of strike towards the north-west, and dips at high angles towards the south-west, and is continuous to the mouth of Boston Bar creek, about one mile and a half above the mouth of Ladner creek.

Brady Placer Mine.

At a point about eleven miles from Hope, and nearly opposite to the mouth of Pierre creek, a tributary of the Coquihalla river flowing in from the east, the writer met John Brady and L. W. Cherry, placer-miners, who were working on a bar, and showed specimens of coarse gold they said they had secured by sluicing gravel taken from shafts and from the bank of the river during the past sixteen months.

John Brady informed the writer that he and his partner had applied for a lease along half a mile of the Coquihalla river, and had already constructed a wing-dam and flume 100 feet in length, but that, in spite of sinking three shafts in an endeavour to reach bed-rock, they had been unsuccessful because of inability to handle the water without a steam-pump. The deepest of these shafts is sunk 30 feet.

During the progress of this work he stated that some gold had been secured in the strata of gravel passed through in sinking, but that between the strata of gravel there occurred strata of sand and clay which were barren.

Several attempts to reach bed-rock on the bars along the river and on Ladner and Pierre creeks have been made, but up to the present time all have failed because of the quantity of water. On Ladner creek, Michael Merrick, in 1914, sunk a shaft 26 feet deep and attempted to handle the water with a hand-pump of insufficient capacity.

Emancipation Group.

This property consists of eight mineral claims situated sixteen miles north-east from Hope, on the line of the Kettle Valley Railway, on a mountain known locally as Emancipation peak, the summit of which reaches an elevation of at least 6,000 feet above sea-level. The claims are located as the *Big Four*, *Instructor*, *Victory*, *Packard*, *Emancipation*, *Liberator*, *Rochester*, and *Director*. The owners are Michael Merrick and Herbert Beech, of Hope.

The *Big Four* claim is staked in the narrow valley of the Coquihalla, which river flows across the claim from the north-east to the south-west corners; the other claims in the group, with the exception of the *Director* claim, are staked up the eastern slope of the mountain, in the order in which they are named above, almost in a straight line from south-east to north-west (mag.), with the end lines adjoining. The *Director* claim is staked on the west side of and adjoining the *Victory* and *Instructor*. The tracks of the Kettle Valley Railway traverse the *Instructor* claim from south-west to north-east at an elevation of 1,462 feet above sea-level.

On the mountain-side there is a very heavy growth of timber, as well as of dense underbrush, while a considerable thickness of moss covers the surface in places, so that prospecting is rendered very difficult, especially at the lower elevations.

The prevailing country-rock is slaty argillite, with beds of siliceous limestone sometimes as thick as 10 or 12 feet and bedded comformably with the argillite. The strike of the country-rock is north-west (mag.) and dip varying from 60 to 70 degrees towards the south-west.

On the *Instructor* mineral claim, at the foot of the mountain, a bed of siliceous limestone with lenses of quartz containing some arsenical iron has been prospected somewhat, but with negative results so far as showing any value.

From the *Instructor* claim a good trail was followed by the writer, accompanied by the owners of the property, up the mountain, across portions of the *Victory* and *Packard* claims on to the *Emancipation*, where, at a point about 200 feet north-westerly from the initial post, at an elevation of about 1,400 feet above the level of the Coquihalla valley, there occurs a wide body of hard flinty quartz, with brecciated country-rock intermixed. The outcroppings of this body are about 50 feet wide, with slaty argillite for a foot, and a highly siliceous limy rock for a hanging-wall. The line of strike is north-west (mag.) and dip 40 degrees towards the south-west.

An open-cut some 10 feet long has been made next to the hanging-wall, as an approach to an adit which had been started and driven 4 feet under cover. This work exposes a seam of quartz averaging about 12 inches in width, separated from the hanging-wall by a few inches of gouge, in which particles of free gold could easily be detected by the naked eye.

The face of this work was sampled by the writer across 38 inches, which included the 12 inches of high-grade quartz, together with 26 inches of the brecciated country-rock which contains much quartz. This sample assayed: Gold, 3.1 oz.; silver, 1.3 oz.; copper, *nil.*

Another sample taken from a dump of a few tons of ore that had been mined from the open-cut approach to the adit, already mentioned, assayed: Gold, 1.9 oz.; silver, 0.5 oz.; copper, *nil.* A selected specimen taken from the same dump was not assayed because it contained many particles of native gold visible to the naked eye.

Little work had been done to prospect the wider portion of the body of quartz towards the foot-wall at this point; in fact, the discovery of the rich stringer had been made only a short time previous to the writer's visit, and as soon as it was found that this high-grade quartz was apparently persistent, the men working had stopped driving the adit, and started to build a cabin near to their work, and thereby save the time and labour required to go to and from the camp established in the valley below.

From later observations by the writer, it would appear as though the wide body of quartz and brecciated country-rock just referred to filled a wide fissure in the country-rock at the contact of the argillite with the siliceous rock, and maintained its continuity along the strike towards the north-west (mag.) for some considerable distance; it is exposed in open-cuts made every few feet up the mountain to a point on the same mineral claim, but about 500 feet higher elevation than where the samples mentioned were taken, and about 700 feet by horizontal measurement. These cuts have invariably been made on the foot-wall side of the quartz body, and represent work done before the high-grade quartz stringer next to the hanging-wall had been discovered. In none of the cuts is the full width of the body of quartz disclosed, nor has any work other than shallow prospecting been done until the higher elevation mentioned is reached.

During 1914, when Merrick and his partners were prospecting therein an attempt to open up a body of concentrating ore indicated on the exposed surface of the quartz bluff, about 70 feet of open-cut and underground work combined was done. When they realized how low grade were the values carried at this point—i.e., only about $3 in gold to the ton—they started work tracing the vein down the mountain-side by making the open-cuts already described, hoping to find better values, and finally struck the high-grade stringer, the assays from samples of which have already been given.

The line of strike of the wide quartz-filled vein from the upper workings along the foot-wall as exposed in the various open-cuts corresponds with that along the hanging-wall where the samples were taken, or north-west (mag.) generally, but varies a few degrees at some places, while the dip of the foot-wall, which is at an angle of 70 degrees towards the south-west (mag.), also corresponds. These facts would appear to indicate persistency and maintenance of such continuity as would warrant the statement that the various showings exposed in the open-cuts belonged to the same ledge, although it has not been stripped and exposed with absolute continuity between the lower and upper workings.

The upper outcroppings are about 50 feet wide. The portion of this quartz which carries arsenical and iron pyrites is reported to contain fair assay values, but other portions appear to carry little, if any, value, as the quartz shows no sulphides and is flinty and glassy. The entire body, however, on account of its apparent extent, its close proximity to an ample water-supply for both concentrating and power purposes, and its ideal location with regard to railway transportation, has possibilities indicating probable commercial value.

It was hardly practicable to systematically sample the upper workings, and, as any haphazard sampling would have been unreliable, no samples were taken.

Galena Group. This property consists of the *January*, *Sunshine*, and *Galena Crown* mineral claims, owned by Michael Merrick, of Hope, and partners. The group is situated about 700 feet east of the *Rochester* mineral claim of the *Emancipation* group. No examination was made of this group because, from the description by the owner, there had been very little work done.

DEWDNEY CREEK.

Below the mouth of Ladner creek the Coquihalla river flows nearly due south for about two miles, then makes a bend towards the south-west. Near the bend a fairly large tributary called Dewdney creek flows in from the east. This creek heads in a high range of mountains known as the Tulameen range, distant about ten miles from the mouth of the creek.

Several years ago a pack-trail was constructed up Dewdney creek to the summit, across that and down Sutter creek to the Tulameen river; thence down that river to its confluence with the Similkameen river near Princeton, a distance of about fifty-five miles. This trail has, however, been used very little during recent years, because the main Hope-Princeton trail via the Skagit range has the easiest grades, and for most of the distance is sufficiently wide for wagon-haulage.

No discoveries of any mineral deposists have been reported along Dewdney creek except in the mountains near its head, where some mineral claims were staked about 1911 by George Cook, Ernest Rice, and others. As these properties were examined in 1913 by J. D. Galloway, the Assistant Provincial Mineralogist, and reported on in the Minister of Mines' Report for that year, and as the conditions had not materially changed since, no attempt was made to visit the camp.

COQUIHALLA SUMMIT.

The summit at the head of the Coquihalla river is situated about sixteen miles north-easterly from the mouth of Ladner creek. Some mineral claims have been staked in the mountains in this neighbourhood, and at no great distance from the line of the Kettle Valley Railway, but, as none of the locators were either in camp or around Hope to show the writer over the properties, no attempt was made to visit the section.

The best information obtainable was to the effect that specimens of galena ore had been brought in from time to time by prospectors, but lack of transportation facilities had retarded development. Now that the completion of the Kettle Valley Railway has removed that handicap, it is the general opinion that the prospectors who have already located mineral claims near the summit would return to work their properties, and that others would be attracted into the district to search for other occurrences of mineral.

Murphy Mine.

This property is situated one mile and a half east from Hope Station, on the Canadian Pacific Railway, and on the opposite side of the Fraser river. The present owner of the property is W. J. Wadleigh, who resides on the Murphy homestead at Union Bar, about half a mile distant from the mine on the Fraser river.

Nearly sixty years ago the Murphy Bros. located, owned, and worked Union Bar as a placer mine, and at the same time prospected for quartz in the low mountains west from the present line of the Canadian Pacific Railway, and located the mineral claims that have ever since been known as the Murphy mine. This was visited by the writer, in company with the owner, W. J. Wadleigh, and as thorough an examination as possible was made.

At a point about 600 feet west from the Canadian Pacific Railway track, at an elevation of about 300 feet above the track, in a shallow gulch, there occurs the contact between slaty argillite and an eruptive, intrusive mass of diorite. A wide fissure at this contact is filled with iron pyrite, pyrrhotite, chalcopyrite, and some galena, disseminated through a quartzose gangue. In some portions the ledge-matter is 10 or 11 feet wide, and is exposed in old workings for a length of about 300 feet.

The line of strike of this ledge at the southerly end is N. 50° W. (mag.), with the dip vertical, but towards the north it appears as though either some fault movement had deflected the ledge, or else that a cross-fissure occurs, because at that end the line of strike is N. 5° W. (mag.), with the dip at an angle of 55 degrees towards the west (mag.); a close examination caused the writer to conclude that the variation in the direction of the line of strike is apparently due to faulting caused by the intrusive, eruptive mass.

The earliest work was done in 1858, when the Murphy Bros. sank what is known as the Greenwood shaft near the southernmost exposure of the ledge. This could not be examined as it was full of water, but the depth is reported to be 24 feet. Adjoining this shaft on the south a large open-cut has been made, 50 feet long and 30 feet wide by 12 feet deep, which was also full of water.

It is claimed that ore taken from these workings carried such good silver and lead values that it was sacked and shipped to Swansea, Wales, for treatment.

In these workings the line of strike of the diorite which forms the hanging-wall is N. 50° W. (mag.) and dip vertical; this wall is the slickensided plane of a prominent bluff, at the foot of which the Greenwood shaft has been sunk.

From the Greenwood shaft the ledge is exposed by two long open-cut drifts and several shallow crosscut open-cuts nearly the entire distance to the Beamer shaft, located about 300 feet to the north. The Beamer shaft was sunk some years ago, and was full of water at the time of the writer's examination.

The only portions of the workings where mineral was exposed "in place" were in two long open-cut drifts and on the surface of the bluff above the Greenwood shaft on the hanging-wall. In all of these places the ledge appeared to be made up of low-grade ore which might be made available for shipping by concentration. A grab sample taken from the dump of one long open-cut drift assayed: Gold, trace; silver, 0.4 oz.; copper, 1.6 per cent.

The most extensive work on this property is a crosscut adit driven under the railway-grade for the purpose of intersecting the ledge, already described, at a depth of about 300 feet. This adit could not be examined, because from the portal for an unknown distance a cave has filled the adit with surface soil and gravel. Mr. Wadleigh informed the writer that this work was done between 1859 and 1879, previous to the building of the Canadian Pacific Railway, and for that reason a concrete-lined approach was built by the railway company under the track to the portal of the adit, which, he said, had been driven for a total length of 800 feet; also that a ledge had been intersected which was presumed to be the same as that on which the work had been done at the higher elevation, already described.

YALE.

The next point visited was the historic town of Yale, on the west side of the Fraser river, nearly opposite to Hills Bar, which is credited with a large production of placer gold from 1858 to 1875, from within an area of less than half a mile square. (Report of Minister of Mines of British Columbia, 1875, page 17.)

Siwash Creek Hydraulic Mines.

Siwash creek flows from east to west, and empties into the Fraser river on the east side about two miles above Yale. The Fraser river is crossed by means of a cage on a cable-ferry located about a mile above the town. From the landing a good trail has been constructed to the hydraulic mines operated by the Siwash Creek Mines Company, Limited, under the superintendence of W. E. Adams, where six men were working all last summer.

This property is situated at an elevation of 900 feet above the Fraser river, and at a distance of one mile from the river if the bed of Siwash creek could be travelled, but three miles by the present trail.

The operating company owns three miles of leases which extend from the camp up the creek. All the work so far has been done on the lower lease, where the writer was informed a force of men has been working during the past four seasons. This work has been of a preparatory nature, and owing to local conditions was necessary before placer-mining operations could be systematically and extensively carried on.

Siwash Creek canyon, which is situated just below the western line of this property, is a narrow deep gorge with a precipitous fall at the upper end, where the elevation is more than 600 feet above the Fraser river, one mile distant; consequently, there is ample dumpage for tailings from mining operations carried on up the creek.

At the lower end of the lease, situated farthest down the creek, an immense deposit of boulders and large gravel has accumulated from the effects of a cloud-burst which caused a big slide higher up the creek, and, consequently, as this debris has formed a dam, which prevented the tailings from being carried down the canyon at the lower end of the ground being worked, some method had to be devised to remove this impediment. Tunnelling under was considered the best way, and two drain-tunnels, each 250 feet in length, were driven before the problem was satisfactorily solved. This method provided the necessary dump, but contrary to the expectations of the management, no bed-rock was exposed at the upper end of the drain-tunnel. A bed-rock flume was next constructed, with the lower end connecting with the drain-tunnel; this flume is about 300 feet in length, equipped with wooden-block riffles, and is built of heavy plank sawed on the property.

When this flume was constructed the work was done with the expectation of exposing bed-rock, the depth to which was assumed from the fact that rim-rock had been exposed near the down-stream end of the lease, where it was dipping at an angle of 40 degrees towards the south-west, but up to the time of making the examination on which this report is based, all

efforts to expose bed-rock in this section of the creek have failed, but it is expected that within a comparatively short distance it will be exposed at the up-stream end of the flume as construction progresses.

Most of the gold that has been secured is found in a stratum of gravel which overlays a bed of clay. This has been assumed to be a false bed-rock, because the former manager, A. C. Stewart, of Seattle, states that he found gravel carrying gold under the clay.

The channel of Siwash creek along the portion referred to in this report practically crosscuts the formation. At the western end of the property the prevailing rock is gneiss, with the plane of its schistosity dipping vertically and having its line of strike N. 30° W. (mag.). Near the head of the bed-rock flume occurs the contact between this gneiss and slaty argillite very heavily stained with iron-rust, and containing many gash-veins filled with quartz. The line of strike of the bedding-planes of this rock is N. 80° W. (mag.) and dip at an angle of about 60 degrees towards the north (mag.).

All the indications, at least along the section of the creek examined, point to the deposition of a portion of the placer gold found to be of local origin, due to the degradation of the argillite rock and quartz stringers.

In addition to the work already described herein, the company has installed a sawmill which has a capacity to cut 3,000 feet of lumber a day, and also a pipe-line between 500 and 600 feet in length which was intended to carry water for hydraulic mining. After this pipe-line had been laid by a former manager, it was decided by the present management not to utilize it, partly because the water in the creek flows with sufficient pressure to ground-sluice all gravel through the bed-rock flume and drain-tunnels without the aid of a giant, also because by ground-sluicing the work is continuous during the night without the aid of manual labour, which obviates the expense of a night shift of miners.

The manager informed the writer that he would, at an early date, construct a dam and drain ditch in order to be able to control and divert the water during cleaning-up operations. This, owing to the narrow width of the channel and great quantity of water, has been an obstacle that has in the past prevented any clean-up of the bed-rock flume, and consequently it is impossible to determine how much gold has been secured. The manager stated that as work has progressed he has found some small nuggets in the gravel being sluiced, but that until permanent bed-rock was reached it was not expected to secure any considerable quantity of placer gold.

Mount Baker and Yale Mining Co.

This company owns eight Crown-granted mineral claims situated on the North fork of Siwash creek. The officers of the company are: President, Wm. Legoe, of Bellingham, Wash.; and secretary, C. G. White, of Yale, B.C. This property has apparently had quite a checkered history, and is an illustration of the folly of installing milling equipment for treating ore before sufficient preliminary work has been done to determine the extent and grade of the mineralized deposit. Some years back a 10-stamp mill of the Davis pattern was erected, which was supplemented with two Wilfley concentrating-tables. Some high-grade surface gold-bearing quartz was treated, but as work progressed in the mine it was found that the grade of the ore decreased to such a point that the plant could not be operated profitably, so it was closed down, and was in the same condition last summer during the writer's visit to Siwash creek. In addition to the mill and equipment, there was installed an electric-light plant and sawmill, also well-built cabins for a mining camp.

During 1913 an English syndicate optioned the property, and made a serious and *bona-fide* attempt to ascertain the value and extent of the mineralization, and whether development would demonstrate that operations could be carried on successfully on a commercial scale. This option was not exercised for the reason that, although a little rich specimen ore was found, the main body, which is said to be 125 feet in width, did not carry the minimum value that had been required by the syndicate.

The property has been idle since this option was released, and when the writer visited Siwash creek there was no one interested in it who could be secured to show him around it; consequently no examination was made, but the foregoing information was obtained from as reliable a source as could be found.

Martel Gold Mining Co.

This company owns two Crown-granted mineral claims, locally called the *Ward* group, and a fractional claim on the North fork of Siwash creek. The officers of the company are: President, Lewis Stenger, of Bellingham, Wash.; and secretary, Walter Slade, of the same place. The conditions surrounding this property are very similar to those found on the Mount Baker and Yale Company's property, so far as concerns the installation of stamp-mill, concentrating-tables, electric-light plant, saw-mill, and cabins. This property was also idle last summer, and was not examined for the same reason as is given herein with regard to the Mount Baker and Yale Company's holdings.

During 1911 the property was examined by A. M. Bateman, of the Canadian Geological Survey, who says in his summary report, published by the Survey for that year, as follows: "The ore is associated with quartz-syenite porphyry dykes which intrude slates. The dykes vary in width from 1 foot to 50 feet, and constitute in the vicinity of the workings about 50 per cent. of the rock exposed. They are irregular in outline and have forced apart and enclosed masses of slate. Five of these dykes are cut in the lower tunnel, two of which are sheared parallel to the schistosity of the slates, while the others are normal. The slates are hard, dark-coloured, and fissile, and dip at high angles. The gold occurs in the quartz and porphyry in a finely divided state, generally coated with a film of iron oxide. Pyrite is scattered through the gangue, and occasional globules of quicksilver have been reported."

Other lode mineral claims situated on Siwash creek, such as the *Roddick*, the discovery lode claim of the district, the *Reciprocity* claim, and the *Dolly Varden* group, were also not examined by the writer, because they were idle; there was no representative on the ground, nor could a guide be procured who was conversant with the properties. From Bateman's report, already referred to, these properties have produced some rich specimens of gold-bearing quartz occurring in small irregular pockets and stringers in porphyry dykes, and the work consists chiefly of open-cuts.

Canadian Northern Pacific Railway.

The completion of this railway has afforded the camps situated on the east side of the Fraser river excellent direct railroad transportation facilities, which have heretofore been lacking. Prospectors who have desired to explore the mountainous section bounded on the west by the Fraser river and on the east by the Coldwater river have heretofore been heavily handicapped. In the first place, there has been the difficulty experienced in crossing the Fraser river, as there are no bridges or ferries above Hope; consequently every one has had to depend either on the cage and cable crossing above Yale or hire Indians and canoes. In the next place, there have not been any trails made into that section, except one or two short ones used by the Indians when picking berries or hunting, and one trail from Boston Bar, on the Fraser river, about four miles below North Bend railway-station, on the Canadian Pacific Railway, to the old town of Nicola, on Nicola lake. This trail was travelled by Dr. Dawson in 1877, and the route is described in his report published by the Canadian Geological Survey for that year.

During the construction of the Canadian Northern Pacific and Kettle Valley Railways, several prospectors turned their attention to this practically unexplored region, and a good many mineral claims have been staked, but up to last summer no discoveries of importance had been reported, but so far prospecting has been confined to the outside fringe, and in such places as supplies packed on men's backs could be delivered with the minimum of labour.

Most of the mountains are rugged and precipitous; the growth of timber is heavy, the prevailing varieties being fir, spruce, and cedar. The growth of underbrush is also very dense, and a thick covering of moss over the surface in the valleys and on the mountain-sides hides the rock formation.

The most important watercourse of this section is Anderson creek, which rises in the high mountains south-east from Spuzzum, and after flowing towards the north for several miles turns towards the west and empties into the Fraser river at Boston Bar.

GOLD AND HIDDEN CREEKS.

As several mineral claims had been located on both Gold and Hidden creeks, on the opposite side of the Fraser river from Spuzzum, a station on the Canadian Pacific Railway eleven miles north from Yale, and much local interest was apparent in that district, the writer visited that section in company with a prospector named Wm. Tompkins, the locator of some of the claims.

The Fraser river was crossed in a canoe a short distance above Spuzzum, and, after climbing to the second bench above the river and walking three miles in an easterly direction, the cabin of a prospector named McDonald was reached. This is located at the head of a small creek, known locally as Gold creek, and at an elevation of about 1,600 feet above the Fraser river.

Pride of B.C. Group.

This group consists of six mineral claims located by A. A. McDonald and brother. The prevailing country-rock is a slaty argillite in which occur gash-veins filled with quartz. This is hard and glassy in appearance, showing but little, if any, indication of carrying any mineral. Some outcroppings of this character occur at the surface on a bench about 60 feet higher than the cabin.

A crosscut adit has been driven 80 feet in length, apparently with the intention of cross-cutting the quartz outcroppings mentioned at a depth of about 50 feet. An examination of this work showed that, so far as the crosscutting had progressed, no mineralized rock had been exposed. In the adit there was exposed a very narrow fissure filled with barren-looking quartz, which was crosscut at a point 60 feet from the portal.

A second adit had been started in a big rock-slide about 250 feet northerly from that just mentioned. This was 18 feet in length and was close timbered, as solid rock had not been reached.

Hazel.

This mineral claim joins the *Pride of B.C.* group on the east, and is also owned by A. A. McDonald and brother; it was staked because of an outcropping of banded, rusty-looking quartz 15 feet in length and about 12 inches in width which occurs in a porphyritic rock. The only work that had been done up to the time of the writer's visit was a shallow open-cut.

Lake View Group.

Travelling in an easterly course from the last-mentioned property for a distance of about eight miles, the headwaters of Hidden creek was reached. This creek is a tributary of Eight-mile creek, which empties into the Fraser river some little distance below Spuzzum Railway Station. The elevation is about 2,800 feet above the Fraser river.

The *Lake View* group of mineral claims is owned by Wm. Tompkins, of Hope, and consists of the *Lake View, No. 1, Ophir,* and *Gold Coin* claims, staked from west to east across Hidden creek. The prevailing country-rock is slaty argillite, into which some syenite porphyritic dykes have intruded.

On the *Lake View* claim one of these dykes occurs into which gash-veins extend. These are filled with hard, white, vitreous quartz. The lines of strike of these veins are towards the east (mag.), almost parallel to each other, and the dip at angles varying from 80 to 85 degrees towards the north (mag.).

Work has been done on the *Lake View* and *Gold Coin* claims, consisting of an adit on the former 29 feet in length, and an open-cut on the latter at a point about 300 feet higher elevation than the adit and to the west from the *Lake View* claim.

An average sample taken from the adit near the face, across 7 feet of porphyry and quartz, assayed: Gold, 0.02 oz.; silver, trace; copper, *nil.* A sorted sample also taken from the south side of the adit across 12 feet assayed: Gold, 0.06 oz.; silver, 0.4 oz.; copper, *nil.* A sample taken from the open-cut on the *Gold Coin* claim assayed: Gold, trace; silver, trace; copper, *nil.*

In Bateman's report, already referred to, his description of this group of mineral claims is very similar to that of the writer's herein, but there was then much less work done, and the samples he took (the assays of which are quoted) were nearer the surface, which probably accounts for the higher values he reports, as follows:—

	Value in Gold a Ton.
"No. 1. Sample of quartz and porphyry collected from the dump	$ 4 76
"No. 2. Representative sample of all quartz stringers exposed in upper cut	14 28
"No. 3 Sample of porphyry remote from quartz stringers	20"

HOPE TO PRINCETON.

On July 20th, 1915, the writer, accompanied by Joseph Gibson, of Chilliwack, for guide, left Hope on horseback to ride to the headwaters of the Skagit river, and thence across the Skagit range of mountains to the Similkameen Mining Division.

The route travelled from Hope was via the Dewdney trail, an excellent horse-trail built on a wagon-road grade, up the Nicolum river to the Beaver Lake meadows, at the head of one of the forks of the Nicolum, situated about twelve miles distant from Hope, to the 23-Mile camp, situated on the Sumallo river; here there are several prospects, the most promising of which were examined on July 21st and 22nd, and are described later in this report.

There is another route from Hope up Silver creek, leading to the Skagit river and thence to Princeton; this has been surveyed for an automobile-road, but is not yet open for travel, except for about ten miles from Hope and fifteen miles from Princeton. The distance by this route from Hope to Princeton is about eighty miles, twenty-five miles of which have been built on an excellent grade at a cost of nearly $10,000 a mile.

The rock formations between Hope and 23-Mile camp seen from the trail travelled by the writer are the granitic rocks of the Coast Range batholith; argillites, more or less metamorphosed; and diorite. The first-named formation extends for a distance of about five miles from Hope, then the argillites prevail to a point about seventeen miles farther, where diorite is encountered, apparently as an intrusive mass in a belt of the Hozomeen series of rocks, consisting of cherty quartzite, greenstone, and limestone, as classified by R. A. Daly, of the Canadian Geological Survey.

TWENTY-THREE-MILE CAMP.

Defiance Group.

This group of mineral claims consists of the *Copper King*, *Velvet*, *Fairy Prince*, *Fairy Queen*, and *Elite*, owned by W. H. Robinson and James Pennie, of Hope. The property is situated in the 23-Mile camp, on the south-west side of and 500 feet above the Sumallo river. Very extensive outcroppings of pyrrhotite occur at the contact between a diabase dyke and limestone. The first-named rock forms the eastern boundary and the latter the western boundary of a prominent bluff of pyrrhotite that is from 12 to 30 feet wide and can be traced for 150 feet along the strike. So far as could be seen in the surface exposure, the pyrrhotite carries no other mineral, and no samples were taken. No work has been done, as the claims have only been recently staked.

Rainbow.

This mineral claim, which was originally included in an adjoining property named the *Horseshoe* group, is owned by W. H. Robinson and James Pennie, of Hope. It is situated in the 23-Mile camp, on the north-east side of the Sumallo river, with the highest workings on the claim located about 500 feet above the river.

On a steep mountain-side overlooking the river there is a belt of rock resembling quartzite, but in which occurs considerable epidote. This quartzite is fissured, and there are several narrow veins which are filled more or less with mineral, chiefly with arsenical pyrites. The lines of strike and angles of dip of these various veinlets, which are enclosed by well-defined walls, are nearly parallel. The former are usually in a N. 30° E. (mag.) direction, but vary sometimes as much as 10 degrees, and the latter are from 70 to 75 degrees towards the north-west (mag.). In width these fissures vary from a few inches to 5 feet, but where this maximum width is reached the mineral occurs in the fissure in irregular kidneys, instead of in a solid continuous body, as is the case where the fissures are narrow.

The workings on this claim consist of an open-cut about 30 feet long on the outcrop; an adit 43 feet long situated 30 feet below the open-cut, with which it is connected by an upraise; a second open-cut 25 feet long, made for an approach to a lower adit, situated about 100 feet below the upper adit, but about 100 feet south of it.

A sample taken from the upper adit across solid mineral a few inches wide assayed: Gold, 0.08 oz.; silver, 20.8 oz.; copper, 1.5 per cent.; zinc, 3.4 per cent. A sample taken from the lower open-cut across 3 inches, the full width of the mineral at the point sampled, assayed: Gold, 0.08 oz.; silver, 3.4 oz.; copper, trace; zinc, 1.5 per cent.

During the summer of 1914 the owners of the *Rainbow* mineral claim optioned it with the other claim comprising the original *Horseshoe* group to the Canada-States Mining Development Corporation, Limited, of which H. B. Brown is managing director. Most of the work described in this report was done under that management, and, in addition, a light home-made aerial tramway 1,000 feet in length was erected, as well as several buildings for a mining camp, but work was suspended and the option cancelled previous to last summer, but not until after 20

tons of ore had been mined, transported to Hope on pack-horses, and shipped to the Trail smelter for treatment; the results from this shipment could not be ascertained, as Brown had left Hope and had not informed any one regarding the returns.

The Provincial Government supplemented a fund raised by the business-men of Hope, which was used to build a sleigh-road for the transportation of ore to Hope during the winter, and camps for men and horses were erected en route, but the company suspended operations after the shipment referred to, and the *Rainbow* mineral claim reverted to the original owners.

Silver Queen Group.

This group of mineral claims consists of the *Silver Queen* and *Silver King*, owned by W. H. Robinson and James Pennie, of Hope. The property is situated on the north-east side of the Sumallo river near its confluence with the Skagit river, and about two miles in an easterly direction from the *Rainbow* mineral claim just described.

A deep gorge that traverses the *Silver Queen* claim from east to west down the mountain-side exposes a body of mineral at a point about 1,000 feet distant from the north end line of the claim. The outcropping where the gorge has cut through it is about 2 feet wide, consisting of nodules and narrow stringers of galena and iron pyrites in a quartz gangue between well-defined walls, with a few inches of gouge separating the mineral from each wall.

The wall-rock is a monzonite which very closely resembles granodiorite. This country-rock occurs as a stock, which is intrusive in the volcanics, referred to by Daly as the Skagit volcanic formation, consisting of andesite flows and pyroclastic deposits. The dimensions of this stock have not been determined, but apparently are limited in extent.

On the northern side of the gorge an adit has been driven for 30 feet along the strike of the vein, which is filled with the same ledge-matter as is exposed in the outcrop. The line of strike of this vein is slightly east of north, while the angle of the dip varies slightly, but is usually about 45 degrees towards the west. The width of solid galena ore in the ledge-matter varies from 2 to 10 inches.

A sample taken from the solid ore where it was 3 inches wide assayed: Gold, 0.04 oz.; silver, 198 oz.; copper, 0.8 per cent.; lead, 15 per cent.; zinc, 14.9 per cent. A sample taken across 2 feet, the full width of the ledge-matter at the face of the adit, and which represents an average, assayed: Gold, trace; silver, 1.2 oz.; copper, *nil*. This sample was taken in order to ascertain whether the vein-filler, if mined as a whole, would pay to concentrate, or whether in mining attention should be given exclusively to saving the solid ore by hand-sorting.

On the southern side of the gorge, opposite the adit referred to, there is apparently an extension of the vein exposed in the adit, but no work had been done at this point; the mineralization is chiefly iron oxides and pyrites in a rotten quartz gangue, between well-defined walls of monzonite rock. The line of strike of this vein, so far as can be determined from the exposure, does not conform with that exposed in the adit, as it is S. 30° W. and dips at an angle of 75 degrees towards the north-west.

Along the mountain-side, both north and south from the gorge, several narrow fissures occur in the monzonite country-rock; these are filled with iron pyrites and marcasite, and none of these appear to be of sufficient extent or to carry values to encourage any work being done on them.

Diamond Group.

This group comprises eight mineral claims, as follows: *Diamond No. 1*, *Diamond No. 2*, *Gold Top*, *Silver Top*, *Copper Pan*, *Eagle*, *No. 23*, and *No. 37*, owned by Frank Fritz, Alex McDonald, M. C. Dignon, T. O'Malley, of Hope, and George Clarke, of Vancouver. This property is situated on the Skagit river about a mile below its junction with the Sumallo river. The location-lines of the *Diamond No. 1* and *No. 2* claims cross the Skagit river from north-east to south-west, where the end line of the *Diamond No. 2* claim adjoins the eastern boundary of the *Gold Top* and *Silver Top* claims at a point about 300 feet higher elevation than the valley of the Skagit; the location-lines of the last-mentioned claims extend along the side of the mountain from south to north, with the *Gold Top* claim adjoining, and south of the *Silver Top* claim; to the west of these claims and adjoining their western boundary are located the *Eagle* and *Copper Pan* claims; to the north-west of the *Copper Pan* claim and overlapping the north-west corner of that claim is located the *No. 23* claim, and the *No. 37* claim is located west of and adjoining the *No. 23* claim. The western boundary of the last-named claim extends to the summit of the mountain at an elevation of about 1,600 feet above the valley, or 3,600 feet above sea-level.

Judging from the extent of copper ore exposed in the various workings, this property is by far the most promising of any in the 23-Mile camp, but cannot become a shipper until railroad transportation reaches it, because the average grade of the ore is not high enough to pay for shipping by any other system; in fact, the bulk of the ore would need concentrating, but there is some high grade near the summit.

The most extensive natural exposures of mineral occur on the side of the mountain overlooking the Skagit river, on the northern portion of the *Gold Top* claim and southern portion of the *Silver Top*, but the highest-grade ore so far found occurs on the *No. 37* claim, near the summit of the mountain. A sample of the solid chalcopyrite ore, typical of but not to be considered an average of the ore-body from that claim taken from near the surface, assayed: Gold, 0.08 oz.; silver, 1.8 oz.; copper, 18 per cent.; zinc, 6 per cent.

This occurrence of copper ore is found near the contact of a rock resembling diorite and crystalline limestone, a belt of the latter rock being found on the extreme summit and sides of several peaks in the range of mountains lying to the west of the Skagit river and south of 23-Mile camp, but its extent has never been determined. The limestone belongs to the Hozomeen series of rocks, which consists of quartzite, limestone, argillites, and much volcanic material, so named by Dr. R. A. Daly in his report on the geology of the North American Cordillera at the 49th parallel.

Some open-cuts have been made on *No. 37* claim in the outcroppings exposed, consisting of chalcopyrite, pyrrhotite, arsenopyrite, and iron pyrite in a siliceous limestone gangue, but the work has not been sufficient to warrant the expression of an opinion as to the probable extent and average grade of the ore, except so far as saying that indications show such promise that the performance of further development-work on these showings is very advisable and fully merited.

The outcroppings on the *Gold Top* and *Silver Top* claims occur along the mountain-side at an elevation of about 360 feet above the level of the Skagit river, or about 2,400 feet above sea-level. The country-rock in which these outcroppings occur is an impure limestone in which are found epidote, garnet, and hornblende. This formation is very much altered in places owing to many intrusions of andesite dykes.

The main zone of mineralization can be traced along its strike towards the north-west for a distance of about 200 feet; its width is variable, from a few feet to 30 feet. The dip is apparently vertical, but this is only an approximate conjecture, because the boundary-wall on the south-west or foot-wall side has been eroded away, and that on the north-east or hanging-wall side has not been exposed to a sufficient depth to determine the angle of dip.

The rock formation on the north-east wall of the ore-deposit is an andesite dyke that has intruded into the impure limestone, and the line of strike of the ore-body is from north-west to south-east and parallel to that of the dyke, which is parallel to the side of the mountain.

The ore exposed in several large open-cuts made into the side of the mountain consists of a mixture of pyrrhotite, arsenopyrite, iron pyrite, and chalcopyrite in a gangue of quartz, epidote, and garnetite.

If the work which has been distributed amongst so many open-cuts had been more concentrated, much information as to extent in depth and character of the ore-deposits would be apparent, that under present conditions is merely conjectural. Three samples taken by the writer typical of the ore, but not to be considered as representing an average, assayed: (1.) Gold, trace; silver, 2.8 oz.; copper, 2.4 per cent. (2.) Gold, 0.02 oz.; silver, 17.6 oz.; copper, 0.7 per cent. (3.) Gold, trace; silver, 2.6 oz.; copper, 2.6 per cent.

In the report of the Canadian Geological Survey for 1911 Charles Camsell gives a brief description of this property, which he concludes as follows: "Specially selected samples, one of clean arsenopyrite and the other of mixed chalcopyrite and pyrrhotite, were taken for assay to determine where the gold and silver values lay. The results show that the arsenopyrite only carries a trace of gold, while the chalcopyrite and pyrrhotite yielded 0.06 oz. in gold and 34.10 oz. in silver."

Red Boy Group.

This group of mineral claims contains the *Red Boy No. 1*, *Red Boy No. 2*, *Red Boy No. 3*, and *Red Boy No. 4* claims, owned by Larson & Rady, of Hope. The property is situated on the Skaist river near its confluence with the Sumallo river, and near the fork of the Hope-Princeton and Skagit River trails. The two

streams mentioned, below their junction, form the Skagit river, which flows in a southerly direction, crosses the International Boundary-line, and empties into Puget sound.

The country-rock in this section is described by Camsell in the report of the Canadian Geological Survey for 1911 as belonging to the Pasayten formation, containing siliceous and feldspathic sandstones, coarse conglomerates, black and grey argillites, and at the base, a thick flow of volcanic rock of andesitic composition.

From the very narrow valley a mountain rises, with precipitous slope facing south-west; the summit of this mountain reaches an elevation of more than 4,000 feet above sea-level, and for nearly 1,000 feet above the valley the side is almost vertical. At the base, and nearly on the same level as the river-bed, the volcanic rock of which the mountain is composed is considerably fissured, very much altered, and contains bunches of chalcopyrite in the country-rock itself, distant from the fissuring, but whether in sufficient quantity to possess commercial value is not apparent from the work so far performed.

A short adit has been driven in a N. 30° E. (mag.) direction along the strike of the most persistent of these fissures, which is only a few inches wide. This adit was only 16 feet in length when examined by the writer; the fissure was filled with mineral consisting of galena, iron pyrite, chalcopyrite, and pyrrhotite in a quartz gangue. This mineralization extended into the country-rock on both sides of the fissure, the width of enriched rock being quite variable, with the strongest mineralization occurring in and near a cross-fissure, the line of strike of which is north (mag.) and the dip at an angle of 35 degrees towards the east.

A sample taken to represent an average of the mineral exposed in the short drift-adit assayed: Gold, 0.02 oz.; silver, 6.6 oz.; copper, 1.2 per cent.

At a point about 1,500 feet higher elevation than the adit referred to, another adit has been driven 30 feet in length, which it is assumed exposes the same fissure as the lower adit has been driven on.

After having examined the *Red Boy* group just described, the writer left the main Hope-Princeton trail, and followed the old Skagit-Lightning Creek trail, down the east side of the Skagit river, past the deserted Steamboat Mountain townsites, and across the base of Little Steamboat mountain to Whitworth's ranch, a well-known old settlement situated three miles north from the International Boundary-line, and about fifteen miles down the Skagit river. This trail, although it was cut out several years ago, was rarely used previous to the Steamboat Mountain excitement in 1910, when it was considerably improved, and made the main pack-trail from Hope, but since the collapse of that excitement the trail has been practically abandoned.

The Skagit river north from Little Steamboat mountain flows through a very narrow valley and between steep banks, but after passing the base of that mountain the river occupies a broad U-shaped valley averaging about one mile in width. The northern portion of this wide valley is a gravelly jack-pine flat, but near the mouth of the Nepopekum creek, about two miles north from Whitworth's ranch, the growth of timber is much heavier, with cedar, fir, and spruce trees well adapted for lumber, and the soil well adapted for cultivating timothy and clover, as is shown at both the Whitworth and Gordon ranches.

At the Whitworth ranch, the writer, with Joe Gibson as guide, turned towards the south-east on to a branch trail which crosses the Skagit river below the mouth of Galena creek, a torrential stream flowing from the south-east that heads above timber-line in the main Skagit range of mountains, the summit of which in this section reaches an elevation of about 7,000 feet.

After climbing to an elevation of 6,600 feet, at a point about 3,000 feet north from the International Boundary-line, the *International* mineral claim was reached, and camp was pitched at the head of Galena creek on the side of a glacial lake in a basin surrounded by precipitous peaks.

International Group.

This group consists of two mineral claims named the *International* and *Grand View*, owned by Joe Gibson, of Chilliwack. Both of these claims are Crown-granted, and were the first mineral claims located in this section of the Skagit range, having been staked in 1906. The southern end line of the *International* mineral claim adjoins the International Boundary-line, and the *Grand View* is staked north of and adjoining the first-named claim.

At an elevation of 6,500 feet a strong fissure between well-defined walls is exposed in a deep gorge in the bed of Galena creek in an andesitic, brecciated country-rock bounded on the west by a prominent precipitous bluff made up of agglomerate. Apparently the same fissure can be

traced for more than 1,000 feet in a S. 10° E. direction, where it is well exposed at the summit of the mountain, but much of the intervening distance is covered by slide-rock, and the small glacial lake of about 2 acres in area already referred to.

In the opposite direction, along the line of strike of the fissure below the gorge at the head of Galena creek, the depression is filled with slide-rock to such a depth as to cover up entirely all "rock in-place" for a distance of 700 feet, or to the margin of a large lake some 200 feet below where the vein is exposed in the deep gorge; as no work has been done in this direction from the gorge, any conclusions are merely speculative.

This fissure, which is 4 feet wide, is filled with banded vein-matter consisting of successive layers of quartz, galena, and chalcopyrite, with the country-rock on each side of the actual fissure so very much altered as to resemble serpentine; the mineralization extends for a width of about 6 feet on either side of the vein proper, which has a vertical dip.

A sample taken across 4 feet, representing an average of the vein-matter, assayed: Gold, 0.12 oz.; silver, 11.9 oz.; copper, 1 per cent.; lead, 1 per cent.; zinc, 1.2 per cent. Another sample of the solid galena ore in the vein assayed: Gold, 0.06 oz.; silver, 20 oz.; copper, 4 per cent.; lead, 59.8 per cent.; zinc, 0.5 per cent.

The work on this property has been done on the dividing line between the two claims along the location line. This work is in the deep gorge already mentioned, and consists of a shaft reported to be about 20 feet deep, but which had been nearly filled up by a rock-slide, and of several open-cuts, in all of which the conditions with regard to mineralization were practically similar to those where the samples referred to were taken.

The property, despite its inaccessibility so far as railway transportation is concerned, is attractive when considered on the basis of a concentrating proposition, for which it appears to be admirably adapted.

The water-supply for operating a concentrator is apparently ample, both for power and ore-washing purposes, and this is available at a most convenient point with regard to the location of permanent mine-workings, provided development-work demonstrated that the mineralized vein was persistent along its strike and at depth.

SKY LINE TRAIL.

After the writer returned to the Whitworth ranch on the east side of the Skagit river, it was decided to ride to the Similkameen river by way of an old unused trail locally known as the Sky Line trail, instead of returning to the junction of the Skaist and Sumallo rivers, and travelling over the main Hope-Princeton trail via Whipsaw creek, because the feed for horses was more plentiful by the route selected.

Leaving the Skagit valley about a mile east from Whitworth's ranch, the trail ascends Gordon mountain, one of the peaks of the Hozomeen range, and, within a distance of about four miles after leaving the valley, reaches the summit at an elevation of about 6,800 feet above sea-level and about 1,000 feet above timber-line.

The geological formation of this mountain belongs to Daly's Hozomeen series of cherty quartzites, argillite, limestone, and volcanic flows. The rocks seen along the trail are principally slaty argillites, with the bedding-planes very much distorted.

The summit of the range was traversed towards the east for about four miles, until Lightning creek could be seen several hundred feet below, with its waters flowing towards the south-west. From this point the trail descended a very steep mountain-side to a chain of small lakes on the divide between the heads of Lightning and Mamaluse creeks, the latter being a tributary of Cambie creek, and flowing in an easterly course for about two miles, where it empties into Cambie creek at the junction of the Sky Line trail with the Muddy or Gibson Pass trail, which latter is the route surveyed for the automobile-road between Hope and Princeton.

Camp was pitched on the edge of one of the chain of beaver lakes which are the headwaters of Mamaluse creek on Sunday night, July 25th, after having travelled almost continuously from 4.45 that morning from the Whitworth ranch.

On July 26th Mamaluse creek was followed down to its junction with Cambie creek, which was crossed on a good bridge, and followed down to the junction formed by the meeting of its waters with those of Roche river from the south-west, and of Chuwanton creek from the south-east. The elevation at this point is 3,458 feet above sea-level.

Below the confluence of these waters the stream so formed is really the Similkameen river, although it has been erroneously called the Roche river to a point about ten miles towards the north-east, where the elevation is 3,060 feet above sea-level, and it joins the Pasayten river.

The Similkameen river flows east for two miles, then in a general north-easterly course for about twelve miles in an air-line from the mouth of Cambie creek to the confluence of the Similkameen and Pasayten rivers; thence north for about twenty miles in an air-line, but nearly forty miles by trail, to the town of Princeton, where the Tulameen river joins it, and their united waters flow towards the south-east, crossing the International Boundary-line into the State of Washington, where they empty into the Columbia river.

The trail from Mamaluse creek to the mouth of Cambie creek is for the most part back from the creek, on jack-pine benches, as the valley proper is extremely narrow, but beyond the junction of Roche river with Cambie creek the valley widens out, and the trail crosses a wide flat in which are located two ranches owned by two prospectors named Bonnevier and Pouwells. Both of these prospectors own mineral claims situated in the mountains back from the river, but as neither of the owners could be found, and as the guide had never visited the location, the writer considered it inadvisable to stop over and attempt to find the claims, some of which were examined and reported on by the Provincial Mineralogist in the Minister of Mines' Report for 1901, and later by Charles Camsell in 1906, whose report was published by the Canadian Geological Survey in 1907.

There is but little opportunity to study the geology of this section along the trail travelled from Mamaluse creek to Cambie creek, and the only report describing it is the one by H. Bannerman, F. G. S., Geologist to the North American Boundary Commission, 1850 to 1861, published by the Canadian Geological Survey in 1884. In this he says: "As far as the mouth of Roche river, cherty or hornstone-like metamorphic beds, probably originally sandstones and conglomerates of a green colour, are seen. The same rocks are continuously exposed in the valley of the south Similkameen, with a southerly dip up to within five miles of the Pasayten River junction, where they are succeeded by a small mass of grey syenite which preserves its massive character for a mile and then becomes gneissic. The gneiss is flanked by soft talcose and micaceous slates at the junction of the two streams."

The change from Bannerman's massive syenite, which is classified by Camsell as granodiorite, to gneiss, followed by mica-schist, is well defined in the steep western bank of the Similkameen river near its junction with the Pasayten.

ASHCROFT MINING DIVISION.

REPORT OF H. P. CHRISTIE, MINING RECORDER.

I have the honour to submit my annual report as Mining Recorder for the Ashcroft Mining Division for the year 1915.

The general situation remains unchanged from last year, although there has been some activity in the Highland valley and a few car-loads of ore shipped, showing excellent returns. There is a very general opinion that good copper-mines will be developed in time. In particular the *Glossie* group has shipped a car-load of ore; the *Chataway*, *Transvaal*, and *Sanson* groups have been undergoing steady development; and the *Snowstorm* group has shipped two car-loads of ore; all these properties showing up to advantage with increased development.

OFFICE STATISTICS—ASHCROFT MINING DIVISION.

Free miners' certificates issued	126
Certificates of work recorded	87
Conveyances recorded	15
Locations recorded	145

ASHCROFT MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

HIGHLAND VALLEY.

Highland valley is situated at an elevation of nearly 4,000 feet above sea-level, and represents the height of land between the heads of Pukaist creek that flows west and empties into the Thompson river; Three-mile creek, flowing north into Kamloops lake; and Witches brook, flowing east into Guichon creek about six miles north from Mamete lake; and is really a series of lakes, with beaver flats which form wild hay meadows intervening. The average width of this so-called valley is nearly one mile, and the length of the open meadow land and lakes is about fifteen miles from south-east to north-west.

On both the north-east and south-west the valley is bounded by ranges of hills reaching elevations from 5,000 to 7,000 feet above sea-level, with some of the peaks, such as Mount Glossie and Forge mountain to the north-east, and Gnawed mountain to the south forming the most prominent landmarks.

Although many mineral claims were staked in these ranges of hills during 1899 and 1900, but little development-work was done for several years owing to the lack of transportation facilities.

During the winter of 1914 and 1915 Stuart Henderson, of Victoria, commenced mining operations on a group of mineral claims located about 1900, and known as the *Snowstorm* group, and he made some shipments of high-grade bornite ore to the Tacoma smelter. This fact directed attention to the old camp during the season of 1915, which resulted in the bonding of two groups of mineral claims known as the *O.K.* and *Glossie* groups, on both of which development-work was carried on during the season.

As all ore shipped has to be hauled to Ashcroft, about twenty-nine miles, on sleighs during the winter and on wagons during the remainder of the year, it can be readily appreciated that, even with the high prices for copper prevailing during 1915, no ore carrying less than 10 per cent. in copper could be mined and treated on a commercial basis.

During the writer's visit to the Highland Valley camp he was under many obligations to the resident miners and operators for several courtesies extended to him, and for which he desires to record his thanks, especially to the following: Geo. H. Chataway, Robt. MacDonald, Joseph W. Burr, Gerle, and Dunlevy.

Several days were occupied in making examinations of the following described groups of mineral claims, most of which are referred to by the Provincial Mineralogist in the Minister of Mines' Report for 1907, during which season he visited the camp and examined the mineral claims on which work was being done, but since that time the development has been considerably extended on several properties.

The conclusions arrived at by the writer, after completing his examination of the Highland Valley camp, were that, while there is a considerable tonnage of high-grade bornite and chalcocite copper ore on several of the mineral claims, yet that the future growth and prosperity of the camp will eventually centre around the apparently extensive bodies of low-grade copper ore. To systematically and thoroughly prospect and develop these deposits diamond-drill boring would appear to offer more advantages than the slower and more expensive method of opening up the mineral-bearing zones by working openings.

The prevailing rocks in the lower levels in the Highland Valley camp are granitic intrusions, usually very hornblendic, sometimes porphyritic, and, in places, more or less gneissic and schistose. At the higher elevations, and notably near the summits of the mountain ranges, especially those to the north-east of the valley amygdaloidal trap-rocks, basalts, and trachytes are met with, apparently belonging to the Kamloops volcanic group, as classified by Chas. W. Drysdale, of the Canadian Geological Survey, who reported on the geology of the Thompson River valley below Kamloops lake in the Summary Report published in 1912 by the Geological Survey. The area included in this report did not take in Highland Valley camp, but reached the northern and eastern borders.

Snowstorm Group.

This group consists of five mineral claims owned by Stuart Henderson, of Victoria, and situated at the south-east end of the Highland Valley camp, at an elevation of about 1,000 feet above the valley, and a distance of about one mile and a half north from the headwaters of Witches brook.

The most prominent outcroppings of ore on the property occur on the *Snowstorm* mineral claim, one of the group, and near the centre of the claim. The geology is exposed in many bare rocky ridges and bluffs, the surfaces of which often show striation lines caused by glaciation. The country-rock is granitic and is described by the Provincial Mineralogist in his report for 1907 as "a dark, porphyritic, volcanic rock, through which are darker hornblendic seams, usually iron-stained on the surface; along the lines of these seams a movement seems to have taken place and a considerable amount of gouge-matter formed, a soft kaolin material, in which is found a considerable percentage of copper sulphides and carbonates." At that time there was comparatively very little work done, but at the time of the writer's visits on September 3rd and October 19th, 1915, he had a much better opportunity to study the ore-bodies, as there has been the following work performed since 1907: A total of about 125 feet of sinking and a total of about 150 feet of underground crosscut adits and drifts, in addition to open-cuts and trenches.

Nearly all the work mentioned has been done at the point already referred to, near the centre of the *Snowstorm* mineral claim, where outcroppings carrying bornite, chalcocite, and copper carbonates occur on a steep ridge about 50 feet higher than the bed of a gulch, of which the ridge forms the western wall.

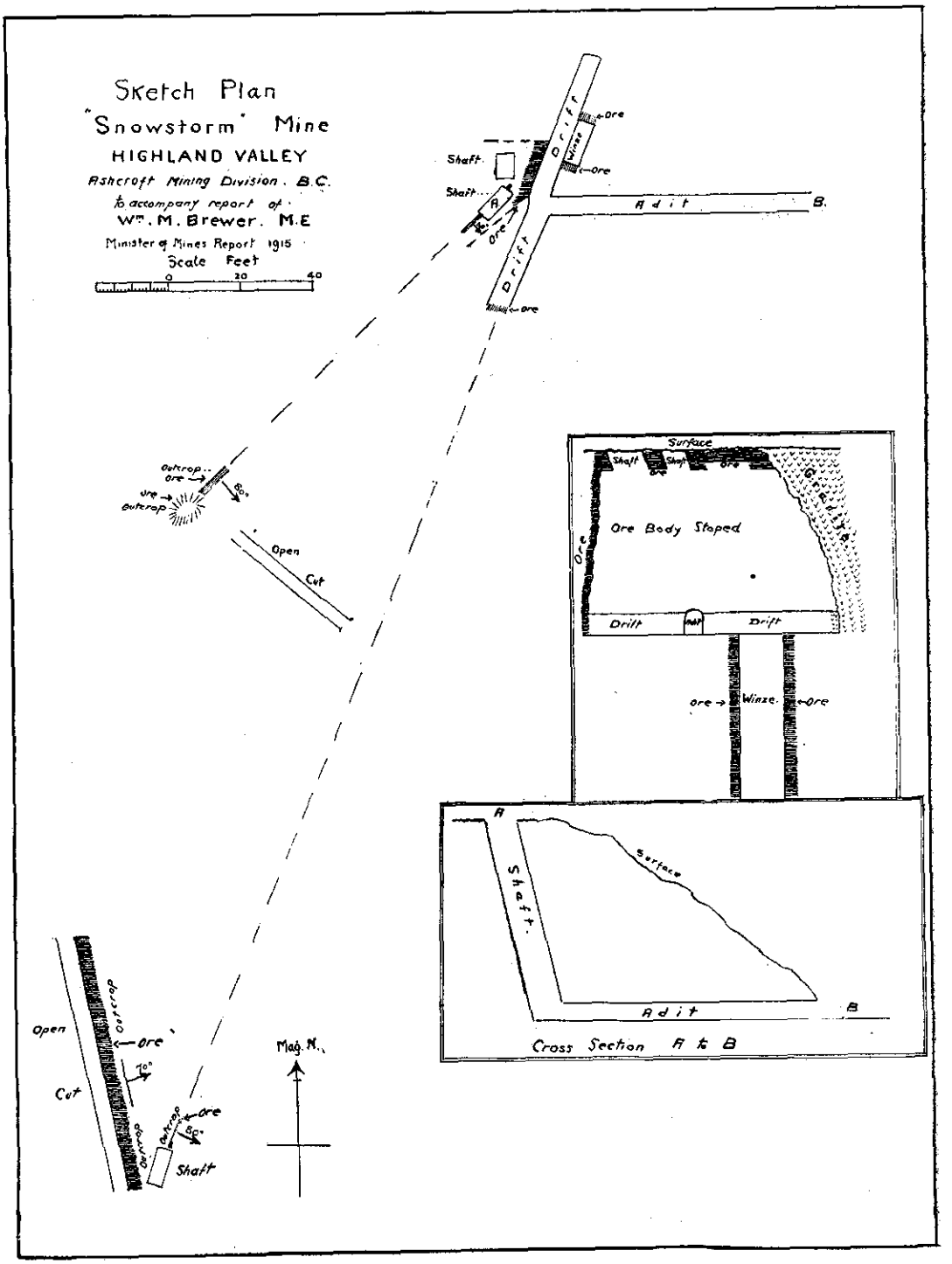
The first prospecting-work performed was making an open-cut across the outcropping from the south-east (mag.) to the north-west (mag.), in which was exposed a fissure-vein in the granitic country-rock, having its line of strike N. 45° E. (mag.) and dipping at an angle of about 80 degrees towards the south-east (mag.). The next work was sinking a shaft 10 feet deep near the face of the open-cut on the vein mentioned, but in this shaft the full width of the mineralized ledge-matter is not exposed on the hanging-wall side; on the foot-wall side, for a width varying from about 30 inches to 8 inches, that portion of the fissure is filled with copper ores, such as already mentioned, in a gangue composed chiefly of altered country-rock and some quartz. The lower 6 feet of this shaft is closely timbered.

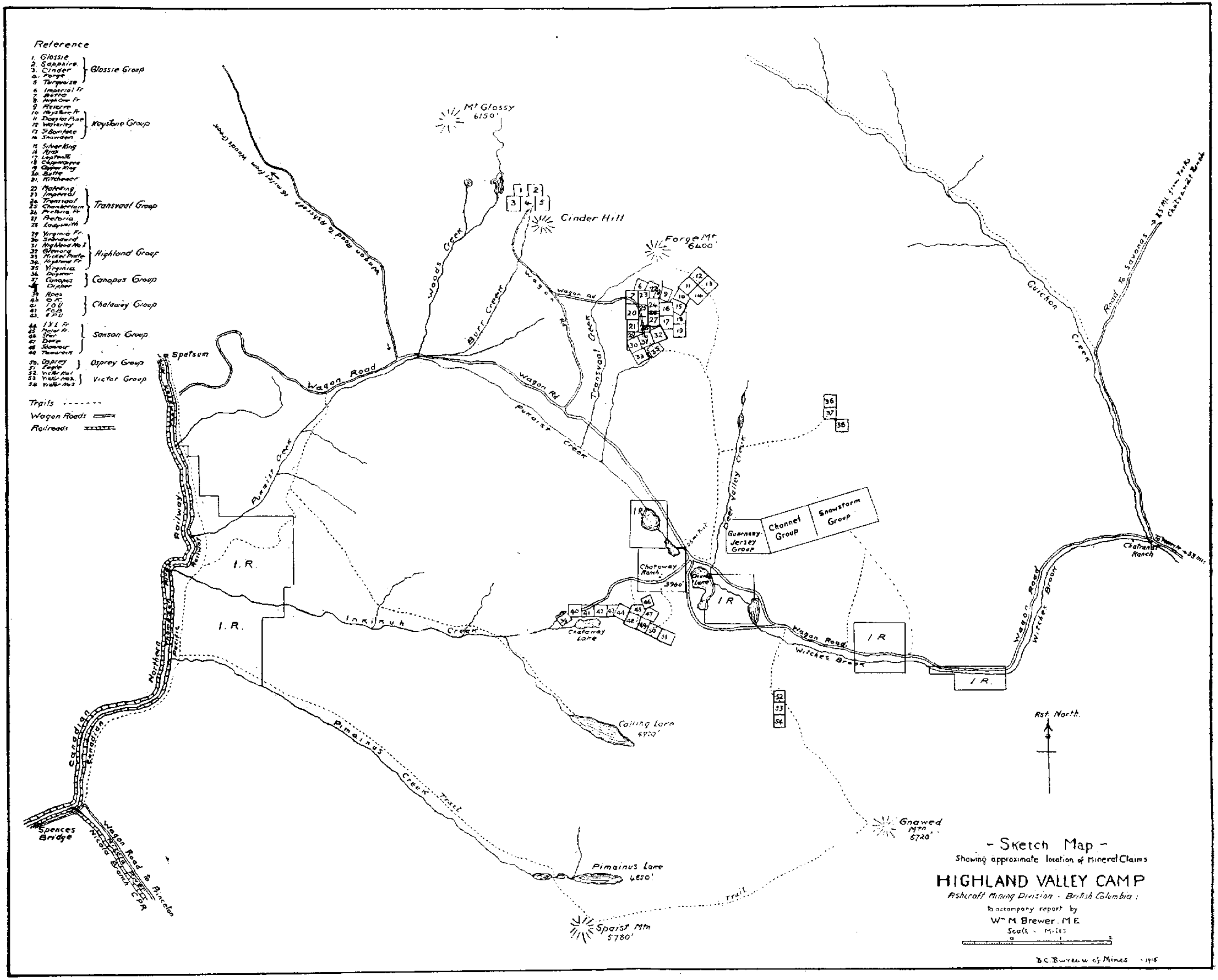
Later, another shaft, known as the Crouvette shaft, was sunk a short distance in a south-westerly direction from the open-cut and 10-foot shaft. The Crouvette shaft was sunk to a depth of 50 feet. At the bottom of this shaft two veins are exposed—one, the same as is exposed in the other openings, and the second one appears to cut off the other, because its line of strike is N. 20° E. (mag.) and dip at an angle of 78 degrees towards the south-east. The next work performed was driving a crosscut adit; this was driven in a westerly direction from the level of the bed of the gulch, and at the face, 72 feet from the portal, intersected the ore-body at the bottom of the Crouvette shaft, 50 feet below the outcrop. Drifts were then driven from the crosscut in both directions along the strike of the fissure N. 20° E. (mag.); the drift towards N. 20° E. (mag.) is 40 feet in length, and that towards S. 20° W. (mag.) is 35 feet in length, ore being exposed the entire distance, and also in the face of the south-west drift, but not in the face of the north-east drift.

The portion of the ore-body along the drifts that produced high-grade bornite and chalcocite ore varied in width from 30 inches to 8 inches, with 10 inches showing in the south-west face of the drift at the time of the writer's visit. This ore has practically all been mined from the floor of the drift up to near the surface, and produced 96 tons of hand-sorted ore, which was hauled to Ashcroft, and shipped from there to the Tacoma smelter in three shipments during the winter and spring of 1915. The smelter returns for these shipments were as follows:—

	Weight.	Gold.	Silver.	Copper.
	Tons.	Oz.	Oz.	Per Cent.
No. 1	32.183	3.22	218	31.64
No. 2	34.6425	2.42	224	30.78
No. 3	29.291	2.64	172	27.47

At a point about 10 feet from the crosscut in the drift driven towards the north-east a winze has been sunk to a depth of 50 feet below the floor of the drift, but as this was full of water the writer could not make any examination of it. He was, however, informed by the superintendent, Robt. MacDonald, that the ore-body maintained continuity to the bottom; that the solid high-grade ore varied in width from 18 inches to 6 inches, the latter being its width at the bottom of the winze; the fissure, however, was wider, the remainder of the vein-filler being made up of lower-grade ore.


Sketch Plan
"Snowstorm" Mine
HIGHLAND VALLEY
Ashcroft Mining Division. B.C.
To accompany report of
Wm. M. Brewer. M.E
Minister of Mines Report 1915
Scale Feet
0 20 40
Shaft
Shaft
Drift
Winze
Ore
Adit
B.
Drift
Ore
Outcrop
Ore
Ore
Outcrop
50°
Open
Cut
Surface
Shaft
Shaft
Ore
Ore Body Stoped
Ore
Drift
Drift
Ore
Winze
Ore
A
Shaft
Surface
Adit
B
Cross Section A & B
Open
Cut
Outcrop
Ore
70°
Outcrop
Outcrop
Ore
50°
Shaft
Mag. N.


Reference
1. Glossie
2. Sapphire
3. Cinder
4. Forge
5 Turquoise
Glossie Group
6 Imperial Fr
9 Reserve
11 Douglas Pine
12 Waverley
14 Snowden
Keystone Group
15 Silver King
16 Ajax
20. Butte
21. Kitchener
23 Imperial
24 Transvaal
25 Chamberlain
26 Pretoria Fr
27 Pretoria
28 Ladysmith
Transvaal Group
29 Virginia Fr.
30 Standard
31 Highland No 2
32 Glenora
33 Nickel Plate
34 Highland Fr
35 Virginia
Highland Group
37 Canopus
Canopus Group
39 Roes
40 O.K.
41 I O U
42 F.O.B.
Chalaway Group
44 I X L Fr
45 Motor Fr.
46 Star
47 Dome
49 Tamarack
Sanson Group
50. Osprey
51 Eagle
Osprey Group
Victor Group
Trails
Wagon Roads
Railroads
Mt Glossy 6150'
Cinder Hill
Forge Mt 6400'
Wagon Road to Ashcroft 18 miles from Woods Creek
Woods Creek
Burr Creek
Wagon Rd
Transvaal Creek
Wagon Road
Pukaist Creek
Le Spatsum
Railway
Northern
Pacific
Canadian
I.R.
Inkikuh Creek
Chataway Ranch
3960'
Chataway Lake
Deer Valley Creek
Guernsey Jersey Group
Channel Group
Snowstorm Group
Witches Brook
Guichon Creek
Road to Savonas
Chataranet Ranch
Calling Lake 4920'
Pimainus Creek Trail
Pimainus Lake 4850'
Spaist Mtn 5780'
Trail
Gnawed Mtn 5720'
Ast. North
Spences Bridge
Wagon Road to Princeton
Nicola Branch C.P.R.
- Sketch Map -
Showing approximate location of Mineral Claims
HIGHLAND VALLEY CAMP
Ashcroft Mining Division - British Columbia ;
to accompany report by
Wm M. Brewer. M.E.
Scale - Miles
0 1 2
B.C. Bureau of Mines - 1915

The underground workings described expose some very interesting, as well as complex, features with regard to the structure of the vein system in the mineralized zone; for instead of one fissure, as is exposed in the outcroppings, there are three quite well-defined veins along fault-planes, as well as some other faults in the country-rock along the planes of which no ore occurs. The main fault-plane is noticeable in the crosscut adit about 40 feet from the portal. The line of strike of this fault-plane being N. 60° W. (mag.), with its dip at an angle of 70 degrees towards the east, corresponds with a fault-plane near the face of the north-east drift which apparently cuts off the vein exposed in the surface workings at a point a few feet north-easterly from those workings.

Another apparent fault-plane that has produced a narrow, well-defined fissure-vein, filled with more or less copper ore, is noticeable in the face of the crosscut adit beyond the foot-wall of the ore-body where the main fissure has apparently cut it off, as the fault-plane does not cut through the foot-wall. The line of strike of this fissure is N. 25° W. (mag.) but no attempt had been made up to the time of the writer's visit to prospect this occurrence.

The third fissure was found by breaking through the foot-wall of the main ore-body on the west side of the north-east drift, opposite the winze; here a low-grade ore-body was found about 20 feet wide, having its line of strike towards S. 40° W. (mag.) on its southerly wall, and from east to west (mag.) on its northerly wall. These walls are both well defined, and, if they maintain their continuity, will represent the boundaries of an ore-body of increasing width; but probably the fissure referred to in the preceding paragraph has cut through it, in which event a body of apparently low-grade ore of triangular shape would result. Both of the walls have vertical dips. No attempt had been made to prospect this body of ore at the time of the last examination made by the writer on October 19th, as it had only been discovered a short time previously, and the mine was closed down early in October.

The mineralization in this last-mentioned body appears to occur as impregnations from infiltration or replacement, and is made up of particles of bornite, chalcocite, and copper-carbonate ore in a gangue composed chiefly of a very much altered granitic rock.

In connection with this last-mentioned ore-body an interesting fact is noticeable on the surface; this is that at a point about 125 feet in a south-westerly direction from the Crouvette shaft there is an outcrop stained from copper minerals, and having considerable epidote associated with the country-rock. A long, deep open-cut has been made, apparently with the intention of crosscutting the formation, but work on it was stopped before the face reached the point where mineral might be expected to occur. The ground between this open-cut and the Crouvette shaft is covered with such a heavy growth of underbrush and drift as to hide the rock formation and make prospecting difficult.

At a point about 275 feet in a S. 22° W. (mag.) direction from the Crouvette shaft, in granitic country-rock, the outcroppings of a ledge occur, carrying bornite and copper-carbonate ore in a gangue of altered country-rock. A shaft 15 feet deep, 7 feet long by 3 feet wide, has been sunk on this outcrop recently; this exposes a vein filled with copper ores that is 3 feet wide between the walls; the foot-wall of it is very well defined, but the hanging-wall is, in places, somewhat broken. Half a ton of high-grade bornite ore was shipped from the material excavated. The line of strike of this fissure is N. 20° E. (mag.) and the dip at an angle of 80 degrees towards the south-east. These directions, it will be noted, correspond with the line of strike and dip of the vein drifted on from the face of the crosscut adit under the Crouvette shaft. The characteristics of the mineralization are very similar in both occurrences, but whether there is any connection between them has not been determined by any work.

At a point a few feet south-westerly from that end of the shaft just described there is an open-cut along the line of strike of a cross-fissure or seam. This cut is old work and was done previous to the examination made by the Provincial Mineralogist in 1907, and is described in his report in the Minister of Mines' Report for that year, as follows:—

"The No. 1 cut is about 50 feet long, and 8 feet deep at the face, and has been run alongside one of these seams. A gouge material some 9 inches thick, exposed for a portion of the length of the cut, was sampled and gave: Copper, 21 per cent.; silver, 5.4 oz. to the ton, and a trace of gold."

At the time of the writer's examination this cut was nearly full of debris and could not be examined, but, judging from the dumps along the trench, there was quite a good proportion of ore in the material excavated during the progress of the work.

Channel Group. This group contains four mineral claims, staked from north to south, with the north boundary of the group about half a mile from the south-west boundary of the *Snowstorm mineral* claim. The property is owned by Stuart Henderson, of Victoria. This group is staked up the steep mountain-side that extends along the north-eastern boundary of Highland valley, the south line of the group being near the level of Highland valley, and the north line about 1,000 feet higher elevation.

So far as at present known, the only outcroppings of mineral on this group of claims occur on the second claim from the northern boundary of the group, where, in an open-cut 50 feet in length, a fissure 3 feet wide is exposed, with its line of strike N. 20° E. (mag.) and dip 45 degrees toward the north (mag.); in this the vein-filling or ledge-matter carries some bornite and copper carbonates in a gangue composed principally of quartz, with which is associated brecciated country-rock very much crushed and altered.

On the *Channel* group the country-rock is granitic, and resembles that on the *Snowstorm* mineral claim, except that it is less altered, finer grained, much less stained by iron oxides, and contains much less hornblende.

Guernsey-Jersey Group. This group contains four mineral claims, staked parallel to and adjoining the *Channel* group on the western boundary, and is owned by Stuart Henderson, of Victoria. One of the claims of this group was originally staked as the *Last Chance* claim in 1896 or 1897, and was then bonded to a French syndicate, but the bond was cancelled after the company had sunk a shaft, said to be 80 feet deep, but this was so very badly caved at the present time that no examination could be made. On the old dump there is a quantity of chalcopyrite and bornite ore, indicating that an ore-body had been exposed of more or less importance.

In 1907, at the time when the Provincial Mineralogist made an examination, the *Guernsey-Jersey* group was known as the *Ball* group, and as such is described in the Minister of Mines' Report for that year. In his report he refers to two shafts in addition to the old *Last Chance* shaft. One of these in 1907 was 6 feet deep, the other 12 feet deep.

Since that time these two shafts have been sunk deeper, and to-day each one is about 20 feet deep. Although located some distance from the old *Last Chance* shaft, these are approximately in line with that shaft, one being in a N. 20° E. (mag.) direction from it, and the other in a S. 20° W. (mag.) direction from it.

The conditions in these shafts below the depths reached in 1907, with regard to mineralization, are the same as described in the Provincial Mineralogist's report, as follows:—

"On the *Handball* a shaft had been sunk 6 feet showing a seam of about 15 inches, which assayed in copper. An open-cut 20 feet long was seen, but it had not cut solid formation. No. 1 shaft, which was sunk in 1905, was down 12 feet and exposed two seams each 12 inches thick, separated by a portion of barren and very much broken and decomposed ledge-matter. These seams assayed 5 per cent. copper, with traces of gold and silver only."

Canopus Group. This group contains the *Canopus*, *Dipper*, *Dog Star*, and *Pegasus* mineral claims. It is situated in a northerly direction and about five miles distant from the *Storm* group, but in the same range of hills, and at an elevation of 5,500 feet above sea-level, but on the west side of Deer Valley creek. This creek has cut its channel almost through the range from north to south, about two miles west from the *Storm* group; it flows into Fish lake, the largest of the chain of lakes in Highland valley, situated close to the summit of the divide between the head of Witches brook and Pukaist creek.

Originally this group of mineral claims was known as the *Albatross*, and was owned by Hosking, Knight, *et al.* As such it was visited in 1907, and referred to by the Provincial Mineralogist in the Minister of Mines' Report for that year, as follows: "No one was present on the property when visited, and the various showings had to be found by following foot-trails from the camping-ground, a method anything but satisfactory. The *Albatross* tunnel was found to be barricaded and locked, and judging by the size of the dump would be about 30 feet long, in a volcanic breccia, with fragments of granite carrying some copper pyrites and specular iron."

The writer was more fortunate last summer by being able to make a detailed examination, because he was guided over the group by George H. Chataway, who relocated it for George Ward, Dr. Sanson, and himself, of Ashcroft, as the *Canopus* after the original owners had allowed their record to lapse.

There is a well-defined contact on the *Canopus* claim of this group between granite and a dark-coloured eruptive rock resembling trachyte. The line of strike of this contact is about N. 50° W. (mag.), and for some distance nearly follows the course of a gulch which is about 200 feet wide. On the hillside which forms the northerly boundary of the gulch the country-rock is trachyte and breccia, while on the hillside that forms the southerly boundary the country-rock is granitic, and a zone between these for an undetermined width is made up principally of breccia and talcose material carrying some copper minerals, including bornite, chalcopyrite, and copper carbonates.

One adit, which is the tunnel referred to in the report by the Provincial Mineralogist, is about 40 feet long and has been driven as a diagonal crosscut across a portion of the mineralized zone. This exposes low-grade copper mineralization with micaceous iron and graphite its entire length. The dangerous condition of this adit prevented a systematic sampling of it, but at one point as near the face as could be reached a grab sample representing all the ledge-matter, talcose gangue, ore, etc., was taken, which assayed: Gold, trace; silver, trace; copper, 0.9 per cent. Similar mineralization is exposed in a big open-cut situated about 100 feet south-easterly from the adit mentioned.

At a point about 300 feet in a north-westerly direction from the adit described there is a long open-cut approach and an adit which has been driven 32 feet under cover; 25 feet of this length is close timbered, being driven through surface wash. This carries some copper minerals, but no micaceous iron or graphite; similar mineralization is seen in the solid rock from the end of the timbers to the face of the adit. The open-cut approach has been made through mineralized wash material, a selected sample from which, not an average of the open-cut, assayed: Gold, trace; silver, 0.4 oz.; copper, 4 per cent.

Two samples, representing a fair average of the ledge material through which the adit has been driven, assayed: (1.) Gold, trace; silver, trace; copper, 0.9 per cent. (2.) Gold, trace; silver, trace; copper, 0.5 per cent.

Highland Group. This group consists of the *Highland No. 2*, *Glenora*, *Standard*, *Virgima Fraction*, *Nickel Plate*, *Highland Fraction*, *Glenora Fraction*, and *Standard Fraction* mineral claims, situated at an elevation of 5,500 feet above sea-level, about one mile distant in an air-line in a north-westerly direction from the *Canopus* group. The property is owned by George Novak, of Rossland, and the estate of J. S. C. Fraser.

The *Highland* group of mineral claims is reached by a wagon-road direct from Ashcroft, about twenty-seven miles distant in a north-westerly direction; also by a good pack-trail cut in 1915 by the Dominion Forestry Inspectors from the 26-mile post on the Ashcroft-Highland Valley wagon-road. This property was examined by the Provincial Mineralogist in 1907, but since that time there has been considerable new development-work performed. On October 20th last, when the writer made an examination of this additional work, he found George Novak, one of the owners, with a force of miners working on the property.

The most favourable mineral-bearing outcroppings occupy a prominent ridge made up of a very dark-coloured, almost black, trap-rock, in which occur sheared zones, much fissured and fractured, with some of the main fissures cutting the shearing-planes almost at right angles. These are filled chiefly with brecciated country-rock impregnated with varying quantities of copper minerals, principally chalcopyrite.

On the *Highland No. 2* mineral claim there are three well-defined fissures exposed in the workings, as follows: No. 1 has its line of strike N. 10° E. (mag.) and dip at an angle of 65 degrees towards the east; No. 2 has its line of strike N. 65° E. (mag.) and dip at an angle of 72 degrees towards the south-east; No. 3 has its line of strike and dip parallel to the strike and dip of No. 2. The No. 1 fissure is exposed by a series of deep open-cuts for a distance along its line of strike of about 400 feet. The No. 2 and No. 3 fissures are also exposed by open-cuts, but neither of these is exposed for as long a distance as the No. 1.

A short distance southerly from the No. 1 lead a vertical shaft has been sunk to a depth of 65 feet in the trap country-rock, except at a point about 40 feet from the surface, where a vein is exposed that may prove to be the No. 1 lead, or may possibly be determined to be a fourth fissure not noticeable on the surface.

In the Provincial Mineralogist's report made in 1907 he refers to this shaft as being about 25 feet deep, but which was full of water during his visit. Last summer it had been pumped out previous to the writer's visit, and was being sunk deeper, with the intention of crosscutting

from a deeper level to intersect, if possible, the Nos. 2 and 3 leads. An assay of a sample taken by the Provincial Mineralogist in 1907 from the dump at the collar of the shaft is referred to in his report as showing 4 per cent. copper.

The No. 2 fissure is about 6 feet wide where it has been exposed by a long open-cut following the course of the line of strike; the walls are fairly well defined and show the shearing-planes in the country-rock striking at right angles to the line of strike of the fissure. The ledge-matter for a width of over 4 feet is chiefly brecciated country-rock impregnated with copper minerals, but the remainder of the vein, a width of about 15 inches, is filled with fairly solid chalcopyrite ore. The No. 3 fissure is about 12 inches wide, filled with low-grade copper minerals in a gangue of brecciated country-rock.

In an easterly direction about 100 feet distant from the vertical shaft along a low ridge there occurs a second mineralized zone, three separate mineralized outcroppings, along nearly parallel lines in a magnetic north direction. Several open-cuts have been made on these some years back, but they were all more or less filled with debris. The mineralization is in the form of small quantities of copper minerals disseminated through the trap country-rock for varying widths. There is no defined vein-structure in this zone, but sufficient evidence of mineralization to warrant further prospecting.

On the *Glenora* claim, one of the group, which adjoins the *Highland No. 2* on the east, an adit has been driven for a distance of about 100 feet in trap-rock carrying small quantities of copper minerals disseminated through it. A sample taken from the dump, representing about an average of the material showing mineralization, assayed: Gold, trace; silver, trace; copper, 0.6 per cent.

No other samples were taken by the writer from other workings on this property, because in the time at his disposal it was not practicable to sample in a thoroughly systematic manner, and any other sampling would be misleading. The property, especially that portion in the vicinity of the vertical shaft, shows sufficient evidences of the occurrence of ore-bodies of enough promise to warrant more thorough prospecting; but undoubtedly the average grade of the ore is low. The property is a concentrating proposition, and if sufficiently extensive ore-bodies are developed, probably a method of concentration can be adopted.

Transvaal Group. As this property, which is Crown-granted, has been idle since it was examined by the Provincial Mineralogist in 1907, it was not visited by the writer in 1915, but the report included in the Minister of Mines' Report for 1907 is copied, as follows:—

"The best-known group in Highland Valley camp is the *Transvaal* group, since that property, while under bond to the Trail smelter, was quite extensively developed. The group consists of six claims—the *Transvaal*, *Imperial*, *Chamberlain*, *Ladysmith*, *Pretoria*, and *Mafeking* mineral claims—and is owned by William Knight, J. Hoskings, and George Novak. The shaft, in July, 1907, was found to be filled with water to within 25 feet of the collar, so that none of the underground workings could be inspected, but they are evidently extensive, to judge from the size of the dump. The shaft has two compartments, and is reported to have been sunk 200 feet, with, at the 100-foot level, a drift to the west of 160 feet in length, and another to the east of 180 feet, and from the latter a 40-foot crosscut was driven. At the 200-foot level a drift was made to the east for about 75 feet. The shaft is surmounted by a shaft-house, in which a hoisting-engine had been installed, which has since been removed. A few feet to the north-east from the shaft are some large open pits, in which were to be seen a certain amount of blue carbonate of copper, occurring as irregular patches in a black amygdaloidal trap-dyke. The mineral, as shown in these cuts, is not present in sufficient quantity to constitute an ore, although appearing greater than it really is, owing to the contrast of the blue carbonate against the black enclosing rock. The underground workings mentioned had been undertaken to prove this surface showing at a depth, and, judging from the character of the dump and the fact that no ore had been shipped, no ore-body of importance was encountered in the workings.

"Some 1,500 feet from the shaft to the north-east there is a tunnel about 200 feet long, evidently driven to show up a surface showing of copper in a similar trap-rock, but, as far as could be seen, no sufficient amount of ore was met with in the tunnel."

Glossie Group. This group contains the *Forge*, *Glossie*, *Cinder*, *Sapphire*, and *Turquoise* Crown-granted mineral claims, owned by Joseph W. Burr, of Ashcroft. At the time of the writer's visits to this property on September 11th and 14th,

and October 21st last, it was under bond to Carlson, Dunlevy, and Gerle, of Vancouver, but in January, 1916, the information was received from Joseph W. Burr that the bond was cancelled and the property had reverted to the original owner.

The group is situated at an elevation of 5,200 feet above sea-level, and at the north-western end of the Highland Valley mineral belt on Burr creek, a tributary of Pukaist creek that flows into the latter in the Highland valley near the 22-mile post on the main Ashcroft-Highland Valley wagon-road. The peaks known as Glossie, elevation 6,150 feet; Forge, elevation 6,400 feet; and Cinder, about 5,800 feet elevation, are the highest peaks in the range bordering along the north-east of Highland valley, and these mountains are all within a short distance of the *Glossie* group. The camp is built on the *Forge* mineral claim, and is about four miles distant in an air-line and north-westerly direction from the *Transvaal* group, already described. The property is reached by a wagon-road that branches from the Ashcroft-Highland Valley main road between the 19- and 20-mile posts, from which point the distance to the *Glossie* camp is about four miles.

The prevailing country-rock on this property in the vicinity of the ore-bodies is hornblendic granite, which is capped at the higher altitudes to the north-east by basalt, trachyte, volcanic breccia, and tuff.

On the *Forge* mineral claim along a low ridge there occur several outcroppings of copper minerals, chiefly carbonates with some bornite, and occasional particles of copper-glance, associated with calcite, brecciated crushed granite, and quartz. These outcroppings vary in width from 3 to 12 feet. The three most important occur along a line from N. 70° W. (mag.) to S. 70° E. (mag.) and outcrop at intervals within a total distance of about 650 feet, but continuity between these outcroppings has not been determined. At one point a shaft known as the *Forge* shaft, 8 feet wide by 6 feet long inside the timbers, had been sunk 12 feet deep between September 12th and 14th, and had been continued to a depth of 40 feet by October 21st, since which date it is reported to have been sunk to a depth of 100 feet.

In this shaft there was exposed a well-defined fissure-vein, about 10 feet wide between walls, of a hornblendic granitic rock, with its line of strike N. 70° W. (mag.) and dip almost vertical. Two samples, representing a fair average of the entire vein-filler, were taken by the writer across 8 feet 2 inches of the vein at a depth of 12 feet, but as the hanging-wall was not exposed in the shaft below the collar this did not represent the full width of vein. This width was sampled in two sections—one measuring 4 feet 2 inches wide from the foot-wall, including all of the vein-filler; the other 4 feet wide from adjoining the first sample towards the hanging-wall, which also included all of the vein-filler. The first of these assayed: Gold, trace; silver, 1 oz.; copper, 4.2 per cent.; the second assayed: Gold, 0.04 oz.; silver, 25 oz.; copper, 2.4 per cent.

It was the intention of the writer to take average samples from the bottom of the shaft at 40 feet depth during his visit in October, but at that time this was impossible, because the shaft was close timbered and there was about 6 feet of water in it; the hand-pump was out of order, and an attempt to bale the water out proved abortive during the limited time at the writer's disposal, because of the inflow.

About 250 feet easterly from the shaft an open-cut has been made 50 feet in length, cross-cutting into the ridge already mentioned; the face of the cut is about 8 feet deep. At the date of the last visit a shaft had been started at this point, which is reported to have since been sunk 40 feet. This work exposed an ore-body 5 feet in width between well-defined granitic walls. This body has its line of strike N. 80° W. (mag.) and dip at an angle of 73° towards the north, which directions practically correspond with those of the strike and dip of the vein exposed in the *Forge* shaft. The mineralization at this showing is very similar to that at the *Forge* shaft, and the ledge-matter appeared to carry about the same average values.

At a point about 700 feet easterly from the *Forge* shaft in a long open-cut a cross-vein is exposed about 3 feet wide on the surface, with its line of strike N. 20° W. (mag.) and dip at an angle of 60° towards the east (mag.). This cut was made as a drift along the vein, which it exposes for about 30 feet in length, but at that point a fault occurs, which has thrown the vein about 10 feet towards the east. The open-cut has been continued for a length of 20 feet along the vein beyond the fault, where the direction of its line of strike is similar to that on the opposite side of the fault, but the vein itself is narrower, and at the face of the cut, which is about 10 feet deep, it only measured 1 foot in width. An average sample of the vein-filler

across the face, 1 foot wide, assayed: Gold, trace; silver, trace; copper, 2 per cent. The mineralization in this vein is chiefly copper carbonates and bornite in a gangue made up of black limestone and some quartzose rock.

About 1,000 feet easterly from the *Forge* shaft, at the head of a branch of Burr creek, close to the Wilkinson cabin, a shallow open-cut has been made on an outcrop of copper carbonates and iron ore, but this work has not been carried far enough to determine any material facts relative to the occurrence.

In a westerly direction from the *Forge* shaft, and about 400 feet distant, an open-cut and shallow prospect-hole exposes a vein 8 feet wide between granitic walls filled with mineralized, decomposed granitic rock. The apparent line of strike of this vein is N. 70° W. (mag.) and dip at an angle of about 80 degrees towards the north; these directions correspond with those of the strike and dip of the vein at the *Forge* shaft, but no connection between the two occurrences had been determined when the examination by the writer was made. The characteristics of the mineralization at the last-mentioned open-cut also correspond with those in the vein at the *Forge* shaft, and apparently the values are about similar.

On the *Glossie* claim of this group, which adjoins the *Forge* claim on its northern boundary, and at a distance of about half a mile by trail in a north-westerly direction, there is an old shaft that was sunk some years ago, and is reported to be 35 feet deep, but was filled with water, besides being close timbered, so could not be inspected. This was sunk on a mineralized outcropping in granitic rock, and, judging from the dump, considerable mineral was encountered during the work. The mineralization consists of some bornite, chalcopyrite, copper-glance, a large percentage of micaceous iron ore, as well as some graphite, calcite, and epidote, in a gangue made up of a little quartz, and the remainder altered, crushed granitic rock. This mineralized zone occurs on both sides of a deep gulch, and appears to have its line of strike nearly east and west, conforming with the course of the gulch, which is nearly 100 feet wide. The shaft is sunk on a ridge that forms the southern wall of the gulch. On the opposite side there are several similar outcroppings which have been to some extent opened up by shallow open-cuts.

Evidently the mineralized body as a whole is quite low grade, but might prove profitable to develop as a concentrating proposition, providing cheap transportation could be secured. With a wagon-haul of about twenty-three miles to Ashcroft, no low-grade copper proposition could be carried to a commercial success unless concentration can be successfully applied.

The holders of the bond shipped in November, 1915, to the Tacoma smelter 21.8 tons of carefully selected ore mined from the *Forge* shaft, the assay from which they reported as follows: Gold, 0.08 oz.; silver, 2.96 oz.; copper, 12.62 per cent.

The holders of the bond prosecuted work very energetically between September 11th, 1915, when they obtained possession, and October 21st, the date of the writer's last visit. In addition to the development-work on the property, they improved the wagon-road and erected the following log buildings: Cook-house, 20 x 30 feet; bunk-house, 18 x 60 feet, divided into three apartments; office, 16 x 20 feet; Wilkinson cabin enlarged to 18 x 36 feet; storehouse, 14 x 30 feet; root-house, 12 x 14 feet; shaft-house, 20 x 50 feet, equipped with two ore-sorting tables with a capacity of 15 tons.

Chataway Group.

Leaving the northerly side of Highland valley, a traverse was made by the writer to the southerly side, crossing at the hay-ranch owned by George Chataway, situated at an elevation of 3,960 feet above sea-level in the valley at the foot of Divide lake, at the head of Pukaist creek, and near the 26-mile post on the Ashcroft-Highland Valley wagon-road. From Chataway's ranch to the *Chataway* group of mineral claims is three miles and a half in a south-westerly direction by a good trail.

The *Chataway* group consists of the *O.K.*, *I.O.U.*, *Apex*, *F.O.B.*, and *E.P.U.* mineral claims, owned by George H. Chataway, Dr. Sanson, and George Ward, of Ashcroft, and under bond to Frederic Keffer and Henry Johns, of Spokane, Washington, who have organized the Highland Valley Mining and Development Company (Non-Personal Liability) under the laws of the State of Washington, U.S.A. At the time of the writer's examination on September 4th last the holders of the bond had a small force of miners sinking a shaft on the *O.K.* mineral claim.

The country-rock on this group is a coarse-grained granite with feldspar predominating, and sometimes giving the rock a porphyritic structure; it is also hornblendic, and in places it is schistose from shearing movements, and sometimes so quartzose and granular as to almost resemble a quartzite; this latter characteristic is chiefly noticeable in the vicinity of the ore-

body. In colour the rock shows several shades from greyish, where almost unaltered, to reddish, where iron oxides are present in the shearing-plants. The mineralization is chiefly copper-pyrite ore, with some bornite, iron pyrites, a little native copper, copper carbonates, and talcose material in a gangue composed of quartz, feldspar, and mica, with the mica predominating. The origin of the ore occurring on this property appears to be by replacement, as the mineralization is not confined to the fissure-veins and fractures, for, while it follows the planes of these, the mineral extends into the country-rock walls for varying depths, so that the ledge-matter is found to average about 7 or 8 feet wide or from 4.5 to 14 feet as is shown in an adit about 250 feet in length, which is the main development-work on the group of claims.

This adit has its portal close to the location-line and 225 feet west from the east end line of the *O.K.* mineral claim. At a point about 100 feet west from the portal a new shaft was being started at a level about 10 feet below that of the portal of this adit, but had not been sunk to solid rock below the wash-gravel and debris. The adit has been driven most of the distance as a drift along the strike of an ore-body in a direction N. 65° E. (mag.); the dip of the ore-body is 80° towards the south.

At the portal of the adit this ore-body is exposed about 7 feet wide, having characteristics, as regards mineralization and gangue material, similar to those already referred to. For a distance of about 80 feet the adit follows the line of strike of the ore-body, then the course of the adit has been slightly changed, and for nearly 100 feet it is driven along a narrow stringer practically in barren ground. From that point a crosscut was made, about 21 feet long, towards the north, where an ore-body was again exposed and was followed to the face of the adit, which is about 80 feet vertically below the outcrop at that point.

The writer formed the opinion when making the examination that the ore-body proper would have found to maintain continuity between the two points referred to if the original course of the adit had not been changed to follow the narrow stringer mentioned. Information recently received from W .J. Elmendorf, mining engineer, of Seattle, who made an examination of this property in February, 1916, is to the effect that during the late autumn and past winter a new drift has been driven between the points where the original adit traversed barren ground, and that this work has proven the unbroken continuity of the ore-body from the portal of the adit to the face a distance of about 250 feet.

An upraise 36 feet high has been made from the adit level to the surface, in which ore is exposed the entire distance; this is located about 40 feet from the portal of the adit, and at a point a few feet nearer the portal a winze has been sunk from a station cut into the south side of the adit. This winze is said to be 50 feet deep and in ore all the way down, but could not be examined because of being full of water. The ore-body is 14 feet wide measuring from the north wall of the adit to the hanging-wall at the collar of the winze, but, as the foot-wall is not exposed on the north side of the adit at this point, this measurement does not represent the full width of the ore-body there. At some places along the drift the width of the fissure is much narrower, as both walls are shown within the width of the adit, which is about 5 feet. In the new drift the width of the ore-body, as stated by W. J. Elmendorf, compares favourably with that as shown in the workings examined by the writer.

There is a dump of ore near the portal of the adit measuring about 40 feet square by an average of 5 feet deep, and containing approximately 500 tons. A grab sample was taken from this dump, but not to be considered as representing an average. This assayed: Gold, trace; silver, 0.5 oz.; copper, 15.8 per cent.

On the *I.O.U.* mineral claim, adjoining the *O.K.* on the east, mineralized outcroppings were seen similar to those on the latter claim, and in a general N. 65° E. (mag.) direction from the portal of the adit described. At a point about 500 feet in that direction from the portal of the adit a shaft has been sunk 12 feet deep, and an open-cut or trench made about 20 feet long, in which is exposed an ore-body having somewhat similar characteristics to that on the *O.K.* mineral claim, but carrying a larger percentage of iron pyrites and not as much talcose material. This occurs in a granite country-rock which is not as much altered as on the *O.K.*, and which carries a considerable percentage of hornblende.

About 135 feet farther towards N. 65° E. (mag.) another outcropping occurs mineralized with copper ore. This has been opened by an open-cut in which an ore-body is exposed 4 feet wide, with its line of strike N. 65° E. (mag.) and dip at an angle of 80 degrees towards the south. The country-rock, mineralization, and gangue material are very similar to those associated with the ore-bodies already described.

In their report on the *O.K.* mineral claim, a portion of this property, Messrs. Keffer and Johns make the following statement: "Near the entrance of the tunnel a winze has been sunk 50 feet on the ore. The vein where exposed varies between 4.5 and 14 feet in width, the average width being approximately 10 feet. Assays of the ore range between 3 and 19 per cent. in copper, the average being 5 per cent. The gold and silver values average about 60 cents per ton. Assuming as 'positive ore' the block included between the surface and the bottom of the winze, with a length equal to that of the adit-tunnel and an average width of 10 feet, the tonnage as proved by the comparatively small amount of development now done is 19,500 tons."

Tamarack Group. This group of mineral claims adjoins the *Chataway* group on the east. It is at present known as the *Sanson* group, and as such has been bonded to Messrs. Keffer and Johns, of Spokane, Wash. The group was not examined by the writer during 1915 because George H. Chataway, one of the owners, informed him that the general conditions surrounding the property were practically similar to those existing when the Provincial Mineralogist made an examination in 1907. His report is as follows: "The *Tamarack* group, consisting of the *Tamarack*, *Shamrock*, *King*, *Duke*, *Billy*, *Muir Fraction*, *May L*, and *Star* mineral claims, is situated at an altitude of 5,200 feet, about one mile and a half to the south-west of the wagon-road at Fish lakes, and is owned by Dr. Sanson and others, of Ashcroft, who have built a branch road up to the property and erected a very good cabin. The development consists of three or four shafts, each sunk about 25 feet deep, and a number of open-cuts. These workings show that there are on the property a considerable number of parallel quartz veins having a general north-east strike, most of which carry more or less copper pyrites or bornite. These quartz veins vary considerably in width, but the work done does not prove their continuity. The vein at the No. 2 shaft is 4 to 4½ feet wide at the shaft, but no drifts or other workings have been made along its strike. The mineral occurs in bunches of varying size in the quartz vein-matter, and the selected ore assayed high in copper."

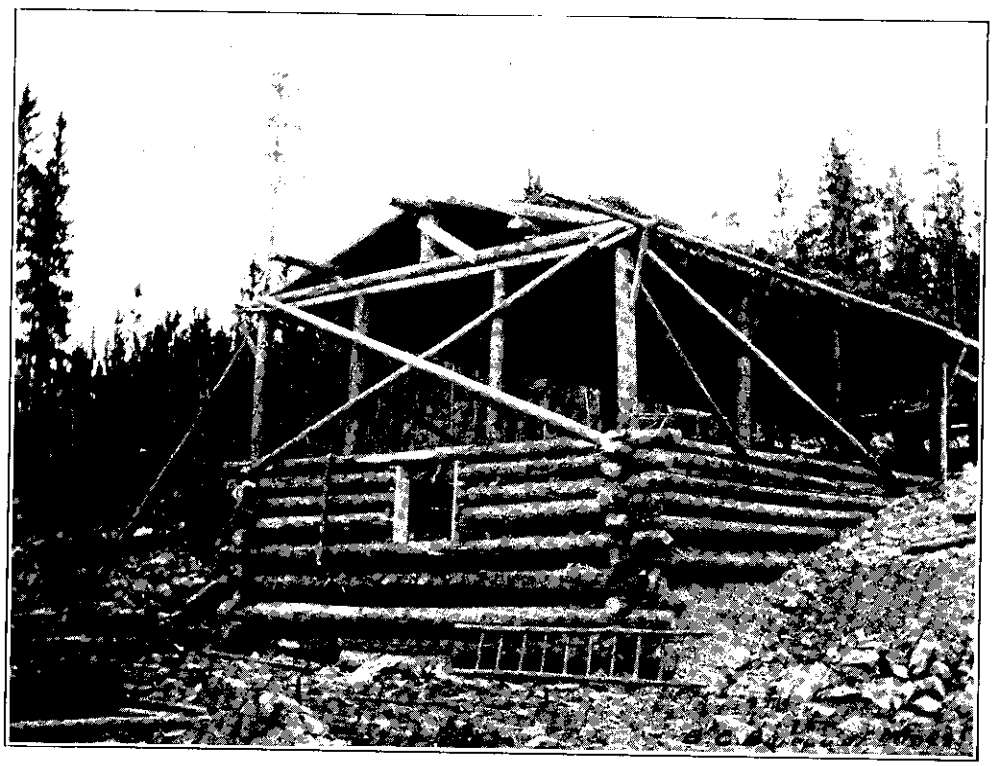
Frederic Keffer, M.E., of Spokane, who examined and reported on practically the same property, but under the name of the *Sanson* group, in February, 1915, says as follows: "This group of seven claims joins the *Chataway* on the east, and is to be regarded as an extension of the latter group. The country-rock and vein-filling are identical with the *Chataway*, and generally the conditions are the same. The workings on the copper-showings consist of three open-cuts as shown on the map herewith. The average copper contents of the surface ore is 2.80 per cent., with gold and silver $1. The width of the vein as exposed in the lower cut is 11 feet. The ore occurrences on these two groups are over a mile apart, but as yet no connection has been traced between them. The deep covering of soil renders prospecting somewhat difficult."

Osprey Group. This group contains the *Osprey* and *Eagle* mineral claims, owned by W. R. Perry, of Clinton, and located south-easterly from the *Tamarack* group, with the north-westerly end line of the *Osprey mineral* claim adjoining the south-easterly end line of the *Tamarack*. The country-rock on this group of mineral claims is a hornblendic granite very similar to that on the *Tamarack* and *Chataway* groups, and the mineralization is evidently due to replacement, for, while it follows fracture-planes confined to a defined zone in the country-rock, with lines of strike which vary from almost due east and west to N. 65° E. (astronomic) and dips at angles of from 50 to 53 degrees towards the south or south-east, this mineralization extends beyond the fracture-planes into the adjacent country-rock, which gradually grades from sheared and decomposed granite that is mineral-bearing to unaltered hornblendic granite that is non-mineral-bearing. The width of mineralization varies from 3 to 7 feet and contains copper carbonates, chalcopyrite, and some molybdenite, most of which can be hand-sorted to good advantage, but apparently a system of concentration by which the entire body could be treated would be the most satisfactory method that could be adopted.

The most important work on the *Osprey* group consists of a crosscut adit 40 feet long driven from a point 200 feet S. 80° E. (mag.) from the dividing line between the *Tamarack* and *Osprey* claims; an open-cut made at the discovery post on the *Osprey* claim located 315 feet in a S. 80° E. direction from the face of the adit mentioned; and an open crosscut 18 feet long as an approach to an incline shaft said to be 18 feet deep; but as the shaft was full of water at the time the examination was made it could not be inspected. The last-mentioned work is 700 feet easterly from the adit.

In the adit referred to there is exposed a mineralized fracture-zone 7 feet wide, made up of copper carbonates and chalcopyrite in a gangue composed of quartz and decomposed granitic

Chataway's Ranch, Highland Valley.



Glossie Shaft-house, Highland Valley—Ashcroft M.D.

rock. At the collar of the incline shaft, which has been sunk on a fractured zone in granite, the mineralization is 6 feet wide, in an ore-body carrying copper minerals that has its line of strike N. 40° E. (mag.) and dip at an angle of 50 degrees towards the south-east.

Victor Group.

This group contains the *Victor Nos. 1, 2,* and *3* mineral claims, situated on the south side and at the south-east end of the Highland Valley camp, three miles and a half south-east from Chataway's ranch, at an elevation of about 4,700 feet above sea-level. The property is owned by John McGillivray, of Vancouver.

The development-work done on this group of mineral claims consists of a crosscut adit 110 feet long; a winze sunk 30 feet deep on an incline of about 30 degrees at the face of the adit; and a shaft sunk 20 feet deep at a point situated about 200 feet in a south-easterly direction from the adit and on the opposite side of a deep gulch. No examination could be made of the winze because it was full of water, but the writer was informed by Geo. H. Chataway, who sunk the winze, that an ore-body 4 feet wide was exposed from top to bottom.

In driving the adit referred to, three mineralized veins or ledges were crosscut—two near the portal and the third near the face; the two first mentioned are each 3 feet wide and the third one is about four feet wide.

The country-rock is granite, very much sheared, fractured, and altered. In the sheared zones there occur outcroppings of minerals made up of chalcopyrite, iron pyrite, and copper carbonates. Apparently these ocurrences of mineral are too low in grade to warrant the assumption that the crude ore will stand shipping, but sufficiently high, if development shows that the extent is great, to suggest possibilities for the property as a concentrating proposition.

The wagon-road from Ashcroft to Highland valley is a portion of the route from Ashcroft to the Nicola valley, about seventy-five miles in a southerly direction. This road for the entire distance was found by the writer to be so constructed as to grades, etc., as to be well adapted for automobiles as well as wagons, and during the past summer was frequently used by autos. There is, though, a much nearer route, between Highland valley and the Canadian Pacific Railway than the present one; this would reach the railway at Spatsum Siding, thirteen miles in a southerly direction from Ashcroft, or at another point on an Indian reserve about four miles farther south at the junction of Pukaist creek with the Thompson river. Pioneers in this district informed the writer that a good wagon-road could be readily constructed to either of these points, and the distance to the railway from any of the mining properties in the Highland Valley camp shortened by about fifteen miles. If such a wagon-road was built, it would mean a reduction of nearly, if not quite, 50 per cent. in the cost for transporting ore in wagons or sleighs, which during 1915 ranged from $6 to $8 a ton, an almost prohibitive tariff, except where ore contained more than 10 per cent. in copper values, which is a much higher grade than the bulk of the ore found in the Highland Valley camp.

LILLOOET DISTRICT.

LILLOOET MINING DIVISION.

REPORT OF C. PHAIR, GOLD COMMISSIONER.

I have the honour to submit the annual report on the progress of mining in Lillooet Mining Division during the year 1915.

MINERAL CLAIMS.

The development since my last report has been very little. Actual work, other than the annual assessment-work, was confined chiefly to the *Pioneer*, *Coronation*, *Wayside*, *Lorne*, and *Broken Hill* groups.

Pioneer. On this group an average of about twenty men was employed during the season in making preparations for the installation of a mill, which is now on the ground and almost completed; its capacity is about 30 tons a day. The erection of this mill is the most important event that has taken place in the Division for years. There is plenty of free-milling ore in sight which has been proved by several years' development.

Coronation. Work was resumed on this group in August by six men after having been closed down for nearly a year. Some ore was milled, but I have no information of the quantity or the result.

Wayside. A small milling plant was erected, which was only operated for a short time owing to the lateness of the season and want of proper facilities for saving the gold. About 20 tons was milled, giving a value of $234. An average of four men was employed.

Lorne. The tunnel was extended 60 feet, but the stamp-mill was not operated. Four men were employed.

Broken Hill. This company reported to me as follows: "The property is located on Sebring creek, in the Bridge River district, and consists of six full-sized mineral claims, known as the *MacLeod*, *Mineral Wonder*, *Silver Standard*, *Standard No. 1*, *Standard No. 2*, and *Golden Boulder*.

"In 1913 the company built a pack-trail from Bridge river to the property, built a bunk-house, and drove 200 feet of tunnelling through solid rock, measuring 6 feet 6 inches by 4 feet 6 inches, at a total cost of $5,000. This work is in the main lead and is known as No. 1 tunnel. Six samples of ore taken from this tunnel ran in value from $5.85 to $34.96 and averaged $13.57 to the ton.

"In 1914 another tunnel was started a few hundred feet down the creek, and is known as the No. 2 tunnel, with the purpose of cutting the main lead on the west side of Sebring creek. One hundred feet from the portal we encountered a number of small stringers where assays ran as high as $28 to the ton in gold, silver, and copper. An upraise was necessary, which broke through at 40 feet, enabling the work to be carried on day and night without any hindrance whatever.

"On the whole, 325 feet of tunnelling was done by contract at a cost of $4,650. It is encouraging that the company has never got a blank assay from this No. 2 tunnel.

"In 1915 No. 2 tunnel was continued; the main drift was extended, while we also crosscut to the east, with the idea of opening up the east side of Sebring creek at a greater depth. This makes a total of 265 feet of tunnelling through solid rock at a total cost of $3,577.50.

"Since the incorporation of the company it has done 780 feet of tunnelling, all through solid rock, at a cost of $13,227.50. The work has all been done by contract, the contractor paying his men $3 a day and board.

"The country-rock on the property is slate and quartzite, often altered, and in places highly schistosed. The quartzite includes dykes of granite and numerous smaller intrusions of porphyrite. The main vein, extending through the hillside, is 104 feet wide and can be traced for a number of miles, and it is the company's intentions to carry on development-work on what promises to be a very profitable and possibly a very valuable mine."

PLACER-MINING.

Golden Dream Mining Company, Limited.—The manager of this company has reported as to the year's work as follows: "Hydraulic-mining operations were started on the Golden Dream Mining Company's placer leases on Bridge river early in April by the construction of 700 feet of 30- x 30-inch sluice-boxes, and the installation of 500 feet of 11-inch hydraulic pipe-line with a head of 240 feet.

"Owing to delay in receiving a shipment of iron riffles from the Coast, hydraulic work was not commenced until about June 20th. As the overburden was composed of from 10 to 15 feet of a hard cemented hard-pan, the progress made was slow and expensive, so bed-rock was not reached until late in August.

"Only a small strip of bed-rock was washed and cleaned up, but, owing to the heavy cost of washing the cement hard-pan and handling the boulders, the results were not considered satisfactory and work was suspended about October 1st.

"A narrow quartz vein was encountered in the bed-rock, and this was drifted on for a distance of 45 feet. At this point a shaft was sunk to a depth of 14 feet, where the vein was found to have widened to 2 feet. The quartz carries low-grade free-milling values and further development will be carried on either during the winter or early next season."

Lillooet (B.C.) Mining Company, Limited.—A force of men was employed for only a part of the season, engaged on its lease at Horse Shoe bend, Bridge river, in sinking test-holes with a Keystone drill. Work was suspended before the end of the season on account of the war, as further funds could not be obtained from England, where this company is financed.

A few individual miners operated at Bridge river and Cayoosh creek, but they did not make much more than a living.

OFFICE STATISTICS—LILLOOET MINING DIVISION.

Free miners' certificates issued	240
Mineral claims recorded	133
Certificates of work recorded	145
Placer claims recorded and rerecorded	18
Placer and dredging leases in force	37
Conveyances, etc., recorded	38

Revenue.

Free miners' certificates	$1,378 50
Mining receipts general	1,655 35
Tax, Crown-granted mineral claims	412 75
	$3,446 60

CLINTON MINING DIVISION.

REPORT OF E. C. LUNN, GOLD COMMISSIONER.

I have the honour to submit the annual report of the Clinton Mining Division of Lillooet District for the year ending December 31st, 1915.

As will be shown by the statistics enclosed herewith, the mining industry of this Division has not shown any marked activity during the past year, although the free miners' certificates are nearly double that of last year, which would go to show activity in prospecting, but the actual mining claims recorded are far less than for the year 1914.

Certain placer claims situated on Watson creek, on the west side of the Fraser river, are reported to have paid and the miners intend to return in the spring.

It is only during the past month that the Pacific Great Eastern Railway has been operating to Clinton, and therefore the mining industry has not yet received any advantage from the new transportation facilities.

A certain amount of interest has been shown in the soda-deposits in the vicinity of Clinton and some claims staked.

Doubtless on the termination of the present war, and when capital is again available, prospecting will be carried out on a much larger scale.

OFFICE STATISTICS—CLINTON MINING DIVISION.

Free miners' certificates (individual)	79
Mineral claims recorded	24
Placer claims recorded	3
Certificates of work issued	61
Conveyances, etc., recorded	51

CLINTON MINING DIVISION.

NOTES BY W. M. BREWER, M.E.

Maggie.

This mineral claim is situated on the Ashcroft-Barkerville stage-road, eighteen miles from Ashcroft, and is owned by Mr. Bryson, of Ashcroft. This property was examined by the Provincial Mineralogist in 1907, and his report published in the Minister of Mines' Report for that year. Since then the development-work has been extended but very little; in fact, the property has practically remained idle until the summer of 1915, when it was bonded by W. J. Milne and associates, of Vancouver, who engaged a force of ten miners under the superintendence of J. Goldsworth. The old workings were unwatered and preparations made to extend the development on three levels. This work was progressing at the time of the writer's visit on September 9th last; but the lower levels had not been entirely unwatered, and later he was informed by the owner that the bond was cancelled owing to the inability of the bondholders to finance the proposition, which has reverted to the owner.

The examination by the writer, so far as could be made, which was only partial, because of water and caves underground, disclosed practically the same conditions as existed in 1907, when the Provincial Mineralogist made his examination and report. This report is as follows: "The formation is a light-coloured magnesium rock in which the lead being developed is a crushed zone following a fault-plane, having a general east-and-west strike and a dip of about 70 degrees to the south. The mineralization consist of copper pyrites in lenses of quartz occuring at irregular intervals in the crushed zone. During the course of development (in 1907) the lessees shipped some 45 or 50 tons of higher-grade selected ore to the Ladysmith smelter, which yielded about 8 per cent. copper and 2 oz. silver to the ton, with no return for gold. The freight from the mine to Ashcroft was $3 a ton, while a railway freight (from Ashcroft) and treatment rate of $5 a ton was charged by the smelter. These charges rendered it necessary to ship only the higher-grade ores, so that from the shipping-ore there had been sorted out from 100 to 125 tons of second-class ore, which was estimated to run about half the value of the first-class; this second-class ore will not stand the treatment charges necessary at present (in 1907). The underground workings consist of a shaft started on the top of a small knoll about 100 feet higher than the wagon-road and the Bonaparte river, and sunk about 265 feet. At the level of the wagon-road an adit-tunnel has been driven in for about 600 feet, from which, at 150 feet in, a crosscut 35 feet long has been driven to the north to meet the shaft, while farther in another crosscut has been made to the north for 60 feet, meeting the lead at that distance. At a depth of 185 feet in the shaft, or 85 feet below the adit level, is the No. 2 level, connected with the shaft by a crosscut, and with the No. 1 or adit level by a winze. On this level a drift has been run to the east for 75 feet, with crosscuts at the end amounting to 55 feet; and to the west a drift has been extended for about 120 feet, and a stope 70 feet long had been raised some 30 feet above the level from which ore was being taken. No. 3 level is at a depth of 165 feet below the No. 1 or adit level, and is also connected with the shaft by a crosscut tunnel. On this level some 175 feet of drifting and crosscutting is said to have been done by previous lessees, but, as it was insufficiently timbered, the workings had caved and were, in July, 1907, being cleared out and retimbered, about 100 feet of the level having been so recovered."

From the present writer's examination last summer he was impressed with the fact that this property, despite the development-work that has been already done, was far from being

thoroughly prospected. The underground workings were not in condition to be sampled systematically, and any other sampling would be misleading; consequently, no samples were taken by the writer, nor could any estimate of "ore in sight" or "possible ore" be made; but the property certainly appears to possess sufficient possibilities to warrant a thorough and systematic prospecting with diamond-drill.

SCOTTIE CREEK.

This creek is a tributary of the Bonaparte river, into which it flows near the 18-mile post from Ashcroft, on the Ashcroft-Barkerville stage-road. The writer, in order to examine a deposit of chrome-iron ore, visited this creek in company with Mike A'Hearn, an old-time prospector, who resides on a farm adjoining the Bryson or Vesey ranch, at the 17-mile post on the stage-road.

From near the mouth of Scottie creek a good pack-trail has been constructed along the steep bank on the right limit of the creek, the valley of which is quite narrow until a point about three miles above the mouth is reached, where the valley proper widens and a series of terraces or benches extend back from the valley-level to a range of hills, the summits of which reach elevations of about 1,000 feet above the creek-bed.

There are several indications of early attempts by placer-miners to work the creek for placer gold; these are in the shape of old pits, timbered shafts, and piles of tailings, but, so far as information could be gathered, none of these reached bed-rock, and the upper gravel-wash is reported to have yielded only about $1.50 a day to the man.

The rock formations seen along Scottie creek, with the exception of an important belt of limestone, which the creek crosses near the mouth, are very similar to those seen along the stage-road in the vicinity of the *Maggie* mine, already referred to in this report, and these are described by Dr. G. M. Dawson as follows: "Numerous exposures in the roadside show the intimate association and interbedding of the cherty siliceous rocks with serpentines, pure and impure, and of the latter with volcanic breccias of greenish-grey colour. Some of the fragments in the breccias are from 4 to 6 inches in diameter, while in other beds the material is fine and must originally have been of the character of volcanic sand. Schistose layers in the breccias have a greasy lustre, and appear to have more or less serpentine developed in them, while portions of the fragments which have been vesicular are now filled with soft green chloritic matter. An igneous rock similar to that forming the breccias is found in other beds. Lenticular masses and streaks of limestone occur both in the breccias and serpentines. They do not resemble the limestone found elsewhere in the formation, being highly crystalline and without any trace of its organic origin; they may probably have been segregated in the mass."

Chrome-Iron Ore.

The portion of Scottie creek that the writer examined carefully is about three miles and a half above the mouth, where a deposit of chrome-iron ore occurs in the first range of hills back from the creek on the north side or right limit. These hills are made up chiefly of ridges and knolls of altered peridotite, carrying a large percentage of chrysolite, and decomposed magnesium rocks, greasy and very highly coloured, with tints of green, yellow, and brown. The erosion has been so extensive as to cut a series of deep gulches through the hills, leaving many of the knolls isolated from the main range of hills and with sharp peaks and precipitous sides. This erosion has laid bare the iron ore on the sides of some of the knolls and the points remaining between the gulches, so that the outcroppings can be followed from point to point in an easterly direction for a considerable distance. Sometimes the outcroppings occur as solid masses or beds of ore; at other places as nodules of varying sizes, some quite large, mixed with the decomposed rock.

The most important of these outcroppings shows on a point between two gulches, and a crosscut trench 20 feet long and about 6 feet deep has been made across a bed of fairly solid ore about 3 feet thick, dipping to the north; but sufficient work has not been done to permit of any estimate being made as to extent of the deposit.

A sample was taken by the writer of selected ore from the dump of several tons at the entrance to the open-cut. This assayed as follows: Chromium, 22.6 per cent., equivalent to 33 per cent. chromic oxide.

Chromium is used in steel-making. Steel containing about 0.5 per cent. of it is rendered very hard; but its chief value is in its salts, the chromates. These are highly coloured compounds, generally red or yellow. Some of the insoluble chromates are used as pigments;

chromate of lead, or chrome, is the most important. The soluble chromates, those of soda and potash, are valued chemicals, and are largely used in the preparation of pigments, dyeing and tanning and oxidizing agents.

In the *Mineral Industry*, Vol. XXIII., the following statements are made relative to the production, markets, and sources of chrome-iron ores:—

"*Production.*—During 1914 the Canadian production amounted to 123 short tons, but during 1906 Canada produced 7,936 short tons. The United States produced 591 long tons during 1914, and the largest production ever recorded for that country was in 1894, when the output reached 3,680 long tons.

"*Markets.*—Chromite is usually sold on the basis of 50 per cent. content of chromic oxide, and the average price of ore on the Pacific Coast during 1911 was $13.58 per long ton, and during 1912 was $13.70, although some of the richer ore sold for $17. In 1913 the average price of the ore sold declined to $11.19 per long ton.

"*Sources of Supply.—Canada.*—Chromite is found in the Eastern townships of the Province of Quebec, in the neighbourhood of Coleraine, Thetford mines, and Black lake. It exists as irregular pockets and masses, streaks and disseminated mineral in Cambrian serpentines.

"*United States.*—The only deposits operated during recent years are those in California, where mines are situated in Shasta, Del Norte, Alameda, Fresno, and San Luis Obispo Counties.

"*Analyses.*—Representative samples of Canadian chromites yielded the following results in chromic oxide: No. 1, 51.03 per cent.; No. 2, 53.07 per cent.; No. 3, 55.06 per cent.; No. 4, 65.16 per cent.; No. 5, 49.75 per cent. Samples from Shasta County, California, yielded, in chromic oxide, from 45 to 55 per cent. Samples from Fresno County yielded in chromic oxide 43.21 and 43.73 per cent."

From the foregoing statements an idea can be formed by any one interested as to the conditions which surround the industry of carrying on mining operations for the production of chrome-iron ores on a commercial scale.

At the time of the writer's visit he was informed by his guide that none of the mineral claims examined for chrome-iron ore were in good standing, all having been allowed to lapse.

From Scottie creek the writer returned to Ashcroft, from which town he rode to Kamloops via the Ashcroft-Highland Valley wagon-road to its junction with the Mamete Lake-Merritt wagon-road near Chatrandt's ranch, on Guichon creek, about seven miles north from the head of Mamete lake. After crossing Guichon creek a wagon-road was followed up the valley of Meadow creek, on the north side of the creek to its junction with the Kamloops-Cherry Creek road, which was crossed, as also the Kamloops-Jacko Lake road, and the route via Batchelor lake to Kamloops selected. By this route the distance from Ashcroft to Kamloops is seventy-nine miles, which was ridden in two days; this was exclusive of the time occupied in examining Chatrandt's mineral claim on Meadow creek, in the Kamloops Mining Division. For the most part the road crosses an excellent summer cattle-range, passes many valley hay-ranches, and enters a well-timbered section near the head of Meadow creek, which extends to within about fifteen miles from Kamloops, where high benches of bunch-grass pasture land occur, much of which has during recent years been settled up by farmers, who are succeeding in raising some good crops by the dry-farming system on land at elevations of from 800 to 1,600 feet above the level of Kamloops lake.

VANCOUVER ISLAND AND COAST.

ALBERNI DISTRICT.

ALBERNI MINING DIVISION.

JOHN KIRKUP, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining in the Alberni Mining Division during the year ending December 31st, 1915.

The *Della* group, situated about nine miles from the head of Great Central lake and operated by J. B. Woodworth, sent a trial shipment of gold ore to Tacoma, and the smelter returns were highly satisfactory.

With this exception no mining was done in the district during the past year, other than the annual assessment-work on a few claims embodied in the accompanying statistics.

OFFICE STATISTICS—ALBERNI MINING DIVISION.

Mineral claims recorded	15
Certificates of work	20
Bills of sale, etc., recorded	4
Free miners' certificates (individual)	61

CLAYOQUOT MINING DIVISION.

REPORT OF WALTER T. DAWLEY, MINING RECORDER.

I have the honour to submit the annual report on mining operations in the Clayoquot Mining Division for the year ending December 31st, 1915.

As regards the general mining outlook, evidence of increased activity in the near future is not lacking. The four claims known as the *Rose, Mamie, Sadie,* and *Maggie,* situated on Elk river and owned by C. Dawley and Anthony Watson, are bonded, and development-work will commence almost immediately. Similar remarks apply also to the copper-claims owned by the Messrs. Drinkwater, of Alberni.

Assessment-work recorded as follows:—

Leora and Sylvanite.—Situate on Elk river. Five years' work was duly recorded on these claims, which are owned by Hanbury & Bowes, of Victoria, B.C. A new 65-foot shaft was sunk 6 x 8 feet, also drifted east and west 75 and 20 feet respectively.

Golden Gate.—Situate on Disappointment inlet and owned by Mrs. E. A. Chesterman. Over 20 feet of tunnelling 6 x 4 feet was done on this claim, which adjoins the *Kalappa* group.

Solar No. 1, Great Central No. 7, and Gordon.—Owned respectively by W. Johnston, T. G. Johnston, and L. Johnston, of Vancouver, B.C. Considerable rock-cuts were made on these claims, which are situate on Big Interior mountain.

Jessie B.—Owned by Hattie G. Gibson, of Victoria, B.C. A 12-foot shaft was sunk on this claim, which is situate on Elk river, Kennedy lake.

Ex, Ten, You, and Eight.—Owned by J. D. McLeod, of Vancouver, B.C. These claims are situate on Granite creek, Bear river. Considerable tunnel and trail work was done on these claims, the tunnel being extended 15 feet and the trail completed from the river to the claims.

Iron King and Pete.—Owned by Wm. Wilson, of Victoria, B.C. Open-cut in rock 18 feet long, 12 feet wide, and 6 feet high; also several other open-cuts and surface stripping, uncovering the iron ore showing, and being about 100 feet long by 20 feet wide.

Ivanhoe and Double Standard.—Situate at Camp bay, Muchalat arm, and owned by Wm. Wilson, Victoria, B.C. Three open-cuts, 12 x 8 x 6 feet, 6 x 6 x 8 feet, and 4 x 4 x 6 feet; also stripping, 6 x 4 feet and 8 x 6 feet.

Ptarmigan Mines, Bear River.—Owing to the war, work on these claims has been entirely suspended, but there appears little doubt that as soon as normal conditions again prevail work will be resumed.

OFFICE STATISTICS—CLAYOQUOT MINING DIVISION.

Free miners' certificates (individual)	31
Mineral claims recorded	42
Certificates of work recorded	27
Payments in lieu of assessment-work	6
Powers of attorney, transfers, etc., recorded	15
Other receipts issued	8

Revenue.

Free miners' certificates	$ 100 00
Mining receipts, general	1,069 00
	$1,169 00

QUATSINO MINING DIVISION.

REPORT OF O. A. SHERBERG, MINING RECORDER.

I have the honour to submit the annual report on the mining operations in the Quatsino Mining Division for the year ending December 31st, 1915.

The work done this year at the *Old Sport* mine, owned by the Quatsino Copper Company, Limited, consists of driving a 500-foot tunnel, which cut through a 25-foot ledge of low-grade copper ore at a depth of 135 feet. Stripping and crosscutting on surface exposes the ledge to the extent of more than 3,000 feet. The property shows up well under development, but, owing to some financial troubles, the company decided to close down the work in August. From information received here, the company expects to have things in shape to open up again in the early spring.

A number of mineral claims were located on Klaskino inlet this year, owned by the Klaskino Copper Company, Limited. The work done up to the present time consists of establishing a camp and building a floating wharf for landing supplies.

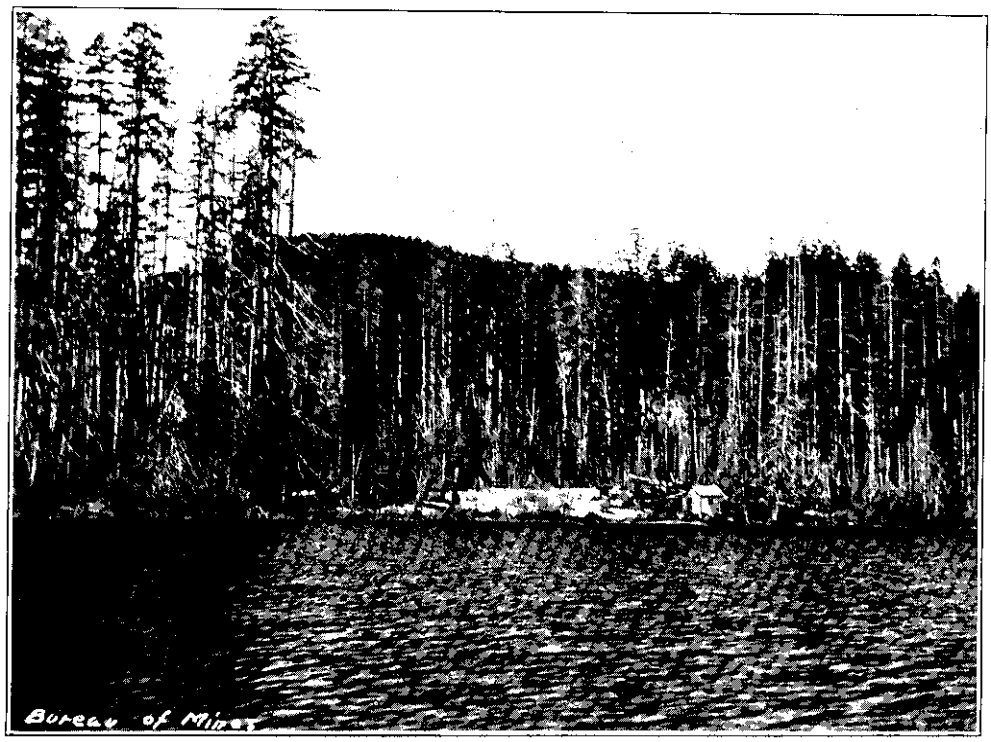
The annual assessments have been kept up on all individual mineral claims, with a very few exceptions.

Certificates of improvement have been applied for on the *Morris*, *Snow Storm*, and *Deer Trail* mineral claims, situate on Kyuquot sound, and owned by the San Juan Mining and Manufacturing Company, Limited.

OFFICE STATISTICS—QUATSINO MINING DIVISION.

Mineral claims recorded	162
Certificates of work recorded	238
Bills of sale recorded	25
Free miners' certificates issued	116

Camp at Blue Grouse Mine—Cowichan Lake District.



Blue Grouse Landing on Cowichan Lake.

NANAIMO DISTRICT.

NANAIMO MINING DIVISION.

REPORT OF GEORGE THOMSON, GOLD COMMISSIONER.

I have the honour to submit herewith the annual report on the mining operations in the Nanaimo Mining Division for the year ending December 31st, 1915.

During the past year very little mining was done in this district, the only properties from which any ore was shipped being the *Little Billie* and *Marble Bay*, both of which are situate on Texada island; the former having shipped during the year 1,129 tons of ore, and the latter, which was worked continuously throughout the year, made shipments to the extent of 10,071 tons copper-gold-silver ore; the number of men employed being sixty-seven.

With the exception of the above, very little work was done other than the annual assessment-work, which was done on quite a number of claims, as shown by the accompanying office statistics.

OFFICE STATISTICS—NANAIMO MINING DIVISION.

Mineral claims recorded	175
Certificates of work	186
Certificates of improvement	2
Bills of sale, etc.	21
Free miners' certificates (company)	2
Free miners' certificates (individual)	285

VICTORIA DISTRICT.

VICTORIA MINING DIVISION.

REPORT OF HERBERT STANTON, GOLD COMMISSIONER.

I have the honour to submit the annual report on the mining operations in the Victoria Mining Division for the year ending December 31st, 1915.

LODE-MINING.

There has not been much metalliferous mining carried on in this Division during the past year; in fact, since the closing-down of the copper-mines in the Mount Sicker district several years ago, the greater part of the mineral production of this Division has been derived from the non-metallic minerals.

The net value of the mineral-output of the Division for the year 1915 is estimated to be about $900,000, only about half what it was the preceding year. The high price of metals prevalent during the war, particularly of copper, has, however, greatly stimulated the development of prospects containing ores of this metal, and this year there has been a small output of copper ore from Sooke peninsula, where the Willow Grouse Syndicate, consisting of R. G. Mellin, R. Hincks, and others, has been operating the *Willow Grouse* group under a lease and bond, and has shipped during the year to the Tacoma smelter some 532 tons of copper ore, the smelter returns from which show better than 8 per cent. of recovered copper, with small gold and silver values, amounting to about 50 cents to the ton.

On the west side of Cowichan lake a local syndicate has, for the past year, been developing the *Blue Grouse* claim, and has shown up quite a nice deposit of copper ore which will average about 5 per cent. copper, with small gold and silver values. The property is situated about seven miles up the lake and about three-quarters of a mile from the water, being at about 500 feet higher elevation.

The work done consists, in addition to numerous open-cuts and pits, of an adit-tunnel cross-cutting the ledge about 30 feet wide, with short drifts to the right and left on the ledge.

The property contains some promise of developing a considerable quantity of ore, but the development has not yet progressed sufficiently to justify the installation of suitable transportation facilities, without which ore of this grade could not be profitably shipped, and, as a consequence, no shipments were made.

In the vicinity of the *Willow Grouse*, at Sooke, another copper-showing has been under development, but no ore was shipped.

One great handicap to prospecting in this Division is the fact that the greater part of the Division is within the "E & N. Railway Land Grant," which land, as also most of the old Crown-granted property, of which there is much in this Division, carries with it the ownership of the coal and base metals, such as iron, copper, lead, etc., leaving in the possession of the Crown only the precious metals—gold and silver. Consequently, a prospector staking a claim on any of these lands only acquires the right to the precious metals, and, as these usually occur associated with the base metals, he must, before mining, make some arrangement with the owner of the base metals, a matter sometimes difficult to arrange.

PLACER-MINING.

A little placer gold exists in the stream-beds of the Leech, Sooke, Jordan, and other rivers on the south-western end of Vancouver Island, and each year a certain number of whites and Chinese do some work and take out a little gold, probably not sufficient to constitute standard wages, but enough to provide "grub."

The large gravel-banks on Sombrio river, which carry a little gold and have been held under placer leases, have not been worked this past year.

NON-METALLIC MINERALS.

The non-metallic minerals in this section have chiefly been utilized in some form of building material, and, as the building trade and allied industries have been nearly dormant for the past two years, this branch of the mineral industry has been seriously depressed.

Cement.—There are two large and well-equipped cement plants in the Division, both situated on Saanich inlet. The Victoria Portland Cement Company, of Tod inlet (R. P. Butchart, president, Board of Trade Building, Victoria), is expected to have made an output of about 120,000 barrels of Portland cement, of a value of approximately $200,000, in the production of which there was quarried about 30,000 tons of limestone and a proportionate tonnage of clay. This year's output is only about a quarter of that of 1912, but is probably all the market will absorb, which gives some indication of the depression mentioned in the building trades.

The Associated Cement Company, with works at Bamberton, made about 156,000 barrels of cement, worth approximately $265,000, which is not half the output the company made last year.

Lime.—The Rosebank Lime Company (W. F. McTavish, manager), Esquimalt, produced burnt lime to a value of about $20,000.

Sir John Jackson, Limited, quarried, at Albert head, about $220,000 worth of riprap and about $5,000 worth of crushed rock for the company's use in the breakwater which it is constructing for the Dominion Government at Victoria.

The Producers Sand and Gravel Company, at Albert head, sold approximately $55,000 worth of sand and gravel, chiefly for use in concrete-work.

Of pottery, tile, etc., there was produced, this past year, material valued at between $55,000 and $60,000, chiefly by the British Columbia Pottery Company, whose plant is situated in Victoria district.

In normal times there is a large number of red brick, etc., made in this Division, but this past year it is estimated that the production would not exceed in value $35,000, produced chiefly by the Victoria Brick Company, the Pioneer Brick Company, and the Baker Brick and Tile Company.

OFFICE STATISTICS—VICTORIA MINING DIVISION.

Free miners' certificates issued	576
Free miners' certificates (special)	3
Mineral claims recorded	61
Certificates of work issued	43
Bills of sale recorded	9

Revenue.

Free miners' certificates	$4,183 00
Mining receipts, general	351 15
	$4,534 15

VANCOUVER MINING DIVISION.

REPORT OF A. P. GRANT, MINING RECORDER.

I have the honour to submit the following report of mining operations in the Vancouver Mining Division, from August 1st to December 31st, 1915:—

The following list gives the number and localities of the recorded claims in this Division:—

MINERAL CLAIMS.

Lynn creek	3
Bowen island	11
Hotham sound	6
Sechelt inlet	11
Cheakamus	48
North arm of Burrard inlet	3
Indian river	87
Burnaby	1
Seymour and Furry creeks	14
Staamish	12
South valley	6
Pender harbour	3
Jervis inlet	11
Britannia valley	20
Cypress creek	7
Potlatch creek	8
Howe sound	8
McNab creek	5
Mill creek	2
Mamquam	2
Gambier Island	5
Total	273

There has been quite an increase over the previous year in the number of new claims located, and the outlook for mining business seems bright.

The Lynn Creek Zinc Mines property was bonded in June last to G. A. Kent, who has furnished me with the following particulars: "Since taking charge of the property a gang of nine men has been kept continuously at work, and the following work has been done to date: 150 feet of main low-level tunnel, 5 x 7 feet in the clear, has been run to crosscut the main ore-body on the 1,400-foot level; 350 feet of stripping and open-cuts have been done on the various parts of the claims; and plant and equipment for carrying on work has been installed, and the following substantial buildings erected: Two offices, bunk-house, cook-house, storehouse, powder-house, and blacksmith-shop. Eight miles of trail have been opened from the waterworks intake at Lynn valley to the mine. Several bridges have been built, and the trail is in good order for packing."

During the past year the Bowena Mining Company has obtained Crown grants of its mining properties on Bowen island. In a report from the secretary, C. M. Oliver, he states that the tunnel on the No. 2 vein is now in a distance of 175 feet. General samples from the portal of the tunnel to a quartz-porphyry dyke about 100 feet from mouth, and from the dyke to the face of the tunnel, taken by Alex. Sharp, assayed: Gold, 0.01 oz.; silver, 0.42 oz.; copper, 0.5 per cent.; and gold, 0.02 oz.; silver, 1.28 oz.; copper, 2.9 per cent., respectively, showing a decided improvement in values as the tunnel advances and depth is gained.

On the No. 1 vein about 100 feet of open-cut work has been done where the vein outcrops on the shore of Howe sound, and a small trial shipment from this cut was sent to the Tacoma smelter, giving returns of: Gold, 0.12 oz.; silver, 1.98 oz.; copper, 5.54 per cent.

A drift on the vein has been started at this point, and is now in a distance of 15 feet, with over 2 feet of ore showing in the face.

The property has been equipped during the year with a floating wharf 70 x 20 feet, and it is planned to install a compressor and drill plant shortly.

The Baramba Mining Company has worked its claims at Hotham sound continuously for the past year, has built a floating wharf on the property, and expects to put a larger force to work this spring.

Other claims are being worked on Jervis inlet by James Raper, the cuts and tunnels being in magnetic-iron ore carrying a small amount of copper.

The owners of claims located along the Cheakamus and Pacific Great Eastern Railway have kept them in good standing, and in some cases the assays run high in gold, silver, and copper.

Britannia Mine.

Mr. Donahue, secretary-treasurer of the Britannia Mining and Smelting Company, Limited, has furnished me with the following particulars of that company's operations for the year 1915:—

"Mined, 209,971 tons; milled, 212,158 tons; production shipped to smelter, 30,123 tons; containing: Copper, 9,058,045 lb.; silver, 50,306 oz.; gold, 398 oz.

"*Construction.—Transportation.*—The main working-shaft, with outside measurements of 10 x 20 feet and containing two 6- x 7½-foot hoisting compartments and one 3- x 7½-foot manway, was completed during the year. This shaft, which was constructed as a vertical raise from the 2,200-foot level to the lowest workings of the *Fairview* mine, designated as the 1,050-foot level, is situate at a point approximately 3,900 feet from the portal of what is known as the main level of the *Britannia* mine. This tunnel or level, completed during the year 1914, has a total length of 4,336 feet; 9 feet in the clear; 13 feet in width; grade 0.1 per cent. in favour of the load; is laid with 3-foot gauge track of 45-lb. rails. At the head of this main working-shaft a station 87 x 30 x 14 feet high has been cut to accommodate the 20,000-lb. Allis-Chalmers double-drum electric hoist, having a total weight of 152,000 lb. This machinery was installed during the year and is working very satisfactorily. A description of same follows:—

"Drums: 78 inches diameter by 48-inch face; grooved for 1¼-inch rope. Brakes: Air-operated; post type; brake-wheel 98 inches diameter by 12-inch face. Clutches: Air-operated; Lane friction type; 72 inches diameter by 11-inch face. Shafts: Drum-shaft 10½ inches diameter centre; intermediate 7 inches. Gears: Wuest double-staggered herring-bone type; cast steel. Rope-speed: 1,000 feet a minute. Duty: Hoist has a total lifting capacity of 9 tons. Power: Direct-connected with 350-horse-power, alternating-current, 3-phase, 60-cycle, 440-volt induction-motor, with full-load speed of 430 revolutions a minute; the motor controlled by 350-horse-power water-rheostat.

"Continuing on the main level (2,200 feet) at a distance of 4,150 feet is situate the loading-station at the lower end of an 8 x 10 incline, completed during the year. This incline was also driven as a raise, and extends through to the 1,050-foot level or lowest workings of the *Fairview* mine, having a total length of 1,268 feet. Connections are made at distances of 200 feet between the main shaft and this raise. On the 1,800-foot level, or 400 feet above main tunnel, at which point connection is also had with the shaft, a station has been cut, with dimensions of 20 x 20 x 30 feet. In this room we have installed an Allis-Chalmers No. 7½ style 'K' Gates gyratory crusher, weighing approximately 12 tons, and being driven by a 57-horse-power motor. This crusher is equipped with standard 2-arm spiders, giving two receiving openings, each 14 x 52 inches, and has more than exceeded the maker's guarantee to reduce the ore as delivered to a size of 3½ inches at the rate of 100 tons per hour. Between the crusher-chute and the receiving grizzlies on the 1,050-foot level, a distance of approximately 850 feet, is provided storage for 4,000 tons of ore, and below the crusher-discharge we have additional room for 2,000 tons, making a total capacity of 6,000 tons in this raise.

"The ore is handled from the loading-station at foot of raise to the head of incline by means of 15-ton General Electric locomotives working in tandem and handling Fairbanks-Morse cars of 20 tons capacity. These cars are the self-dumping type and are equipped with air-brakes, automatic couplers, etc.

"The outside haul of ore is a distance of approximately three miles and a half over a 3-foot gauge surface railroad laid with 45-lb. rails. This railroad has an average gradient of 3 per cent. in favour of the load, and in order to maintain this average the construction of switchback and loops were required. At the head of the incline storage-bins with a capacity of 2,000 tons have been erected, underneath which the skips on the incline railway receive their loads of ore for delivery to mill at foot. This incline railway is the final step in the transpor-

tation and extends a distance of 5,500 feet, with an average grade of 30 per cent.; is standard gauge, double-tracked, and laid with 56-lb. rails. The lower terminals of incline are located in ore-bunkers above new mill, from which the ore is fed by gravity to the sorting-belt in mill.

"For the handling of the ore we utilize skips weighing 12 tons and having a capacity of 20 tons of ore, the up-going skip carrying supplies, etc. The operating mechanism is placed in station hewn from solid rock at the head of incline, and consists of Allis-Chalmers 25,000-lb. double-drum lowering and hoisting engine, having: Drums: 8 feet diameter by 4-foot 6-inch face; grooved for 1½-inch rope; capacity of each, 6,000 feet of rope. Brakes: Each drum is provided with two post-type brakes, 10 feet diameter by 9-inch face. Clutches: Lane friction type; 7 feet 6 inches diameter by 10½-inch face. Shafts: Drum-shaft 12 inches diameter. Gears: Wuest double-staggered herring-bone type; cast steel; pinions of open-hearth steel. Rope-speeds: Hoisting with slow-speed gears, 250 feet per minute; hoisting with high-speed gears, 500 feet per minute. The total weight of this equipment is 242,000 lb. For handling the empty skip up, when it is necessary to operate independently of lowering skip, a 75-horse-power, 3-phase, 60-cycle, 440-volt alternating-current motor is used.

"*Mill.*—The first half of the new mill, with a capacity of 1,000 tons daily, was placed in commission on December 15th, and the work of rushing the second unit of similar capacity is being prosecuted with all diligence, and should be in service by March 1st, 1916. In this new mill has been installed the most up-to-date machinery for the economical treatment of the ore, the last stage being the Minerals Separation process or oil-flotation.

"*Power.*—A 2,000-kw. steam-turbine has been installed in the Beach power-house, making a total of 2,500 kw. steam-power available during low water and consequent shortage of hydro-electric power. The turbines are served by two 500-horse-power Babcock & Wilcox boilers installed during December, 1914. Provision has also been made for increasing the hydro-electric plants by the construction of dams and laying of pipe-lines along Britannia creek. From the Park Lane dam to tunnel power-house we have laid a total of 11,125 feet of pipe, consisting of wood-stave, 24, 22, and 20 inches, and steel pipe, 20, 18, and 16 inches diameter. In addition to the above, we have just completed the laying of 7,750 feet of 36-, 30-, and 28-inch wood-stave pipe and 6,900 feet of 28-, 26-, 20-, and 18-inch steel pipe to replace old line between Tunnel camp and Beach power-house. An addition was made to tunnel power-house to provide room for one 300-kw. Westinghouse motor-generator set to furnish power for haulage-locomotives; this generator set being driven by one 1,400-horse-power Pelton water-wheel. Provision is now being made for increasing air-supply by the addition of one 3,631-cubic-foot Rand compressor direct-connected to one Pelton water-wheel of 550 horse-power, which unit is also to be installed in tunnel power-house. We have under order at present with the Canadian Westinghouse Company two 2,500-k.v.a. water-wheel generators, to be driven by two 3,750-horse-power Pelton water-wheels, and these installations in Beach power-house will be completed the early part of 1916.

"*Miscellaneous.*—The surface railway and incline provide transportation for the ore treated in the new mill. The old mill, with daily capacity of 800 tons, is served by aerial tramway. This latter has a total length of 13,000 feet, the upper terminal being situate about half a mile from the portal of the main mine level. This terminal, which was constructed during the past year, has concrete walls 3½ inches thick set on solid rock, and provides storage capacity of 1,000 tons. The ore is delivered to this terminal via surface railway-line. As a further storage capacity a concrete retaining-wall has been built above the new mill-bins, back of which we have room for 15,000 tons of ore. This is known as our stock-pile, the ore for same being delivered by aerial tramway. Underneath this stock-pile a tunnel has been driven, in which conveyor-belt has been installed, so that the ore can be handled directly to new mill sorting-belt when required.

"During the past year a new concrete powder-house has been erected. This building is on a spur track off the switchback on the main haulage-road, and is located about midway between the terminal and the head of incline. The building in question is fire and bullet proof, and has a storage capacity of 50 tons of explosives.

"We have also erected at Tunnel townsite twelve additional dwellings and new store building; at the Beach, sixteen new dwellings and also new wharf.

"On account of the use of the Minerals Separation process, it is necessary to have in stock at all times a large quantity of pine-tar oil, and to provide suitable storage for this a large

tunnel was driven beneath the new mill-site. This tunnel has a 3-foot gauge track (Beach standard), so that the hauling of oil in and out is attended with the least possible work.

"In conclusion, will add that the operation for the year suffered a serious set-back on account of the snowslide occurring on March 21st and resulting in the loss of many lives."

PLACER-MINING.

The only placer locations which are being worked steadily are situated at the head of Jervis inlet.

OFFICE STATISTICS—VANCOUVER MINING DIVISION.

Free miners' certificates issued	1,273
Special free miners' certificates issued	15
Quartz claims recorded	273
Certificates of work issued	341
Surveys recorded as work	34
Quartz claim conveyances recorded	123
Placer claim conveyances recorded	2
Abandonments recorded	2
Grouping notices filed	41
Placer powers of attorney recorded	5
Placer rentals renewed	2
Certificates of improvement recorded	63
Crown grants applied for	50

Receipts.

Free miners' certificates	$7,700 75
Mining receipts	2,250 25
Total	$9,951 00

VANCOUVER MINING DIVISION.

NOTES BY THE PROVINCIAL MINERALOGIST.

Britannia. The only important production of metalliferous mineral from this Division during 1915 was from the *Britannia* mine, situated on Howe sound. The production for the year was 212,158 tons, containing 398 oz. gold, 50,306 oz. silver, and 9,058,045 lb. copper. This shows a decrease as compared with the previous year of about 2,783,187 lb. copper, and corresponding decreases in tonnage and amounts of precious metals. The mine was closed for a time in the early months of the year owing to a disastrous snowslide which killed fifty-seven men and carried away part of the tramway system, bunk-houses, and upper works; this accounted for the decreased production. A large increase in the production of copper from this mine can be expected in the future, as the milling and handling equipment is being continually increased and large ore reserves are proven in the mine.

During the last three years the *Britannia* mine, under the management of J. W. D. Moodie, has been developed, equipped, and enhanced in value in a way that is but little known, even in the near-by city of Vancouver. The company's policy has been to work along quietly and to avoid publicity as far as possible.

The *Britannia* mine is owned by the Britannia Mining and Smelting Company, Limited, but the control or possibly all of the stock in this company is owned by the Howe Sound Company. This latter is then the holding company, really owning the mine, while the former is the operating company. Two other companies, the Britannia Copper Syndicate and the Britannia Land Company, also were mixed up in the ownership, but the dissolution and absorption of these companies was effected early in 1915, and now all operations are conducted by the Britannia Mining and Smelting Company, Limited. This latter arrangement was really a book-keeping adjustment in order to reduce three staffs and sets of books to one, and thus reduce overhead

expenses. During the year the majority of the stock in the El Potosi Mining Company, which operates properties in the Chihuahua district, Mexico, was bought by the Howe Sound Company, by the issue of $5,380,000 worth of bonds, which bonds were secured by the whole assets of the company.

The Britannia Company also, in the latter part of the year, bought the Howe Sound Power Company, which company owned important water rights on Furry creek, in South valley.

The fiscal year of the Britannia Company ends with the calendar year, and from the last annual report of the company, for the year 1915, the following report of General Manager J. W. D. Moodie is taken:—

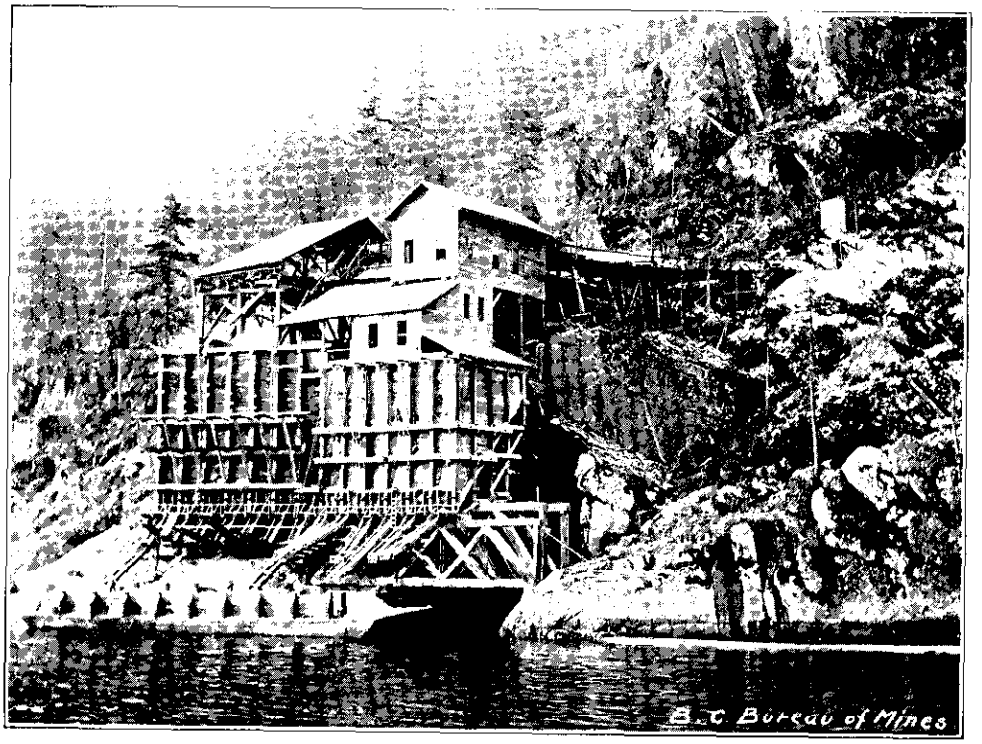
"I respectfully submit résumé of the operations of the Britannia Mining and Smelting Company, Limited, for the fiscal and calendar year ending December 31st, 1915. The year opened with prospects that *Britannia* would make its best showing in 1915. The snow and land slide in March, which wiped out the mine camp, upper tramway terminal, crusher building, machinery, etc., necessitated the suspension of operations for three months until new producing and transportation facilities from the mine could be provided. Operations were resumed in the latter part of June, but were interrupted in September, October, November, and December because of a shortage of water for power and milling purposes, due to an unusually protracted period of dry weather. This condition arose before the system of dams and intakes under construction had progressed so far toward completion as to be available for water-storage, thus curtailing the power service seriously.

"*Statement of Operations.*

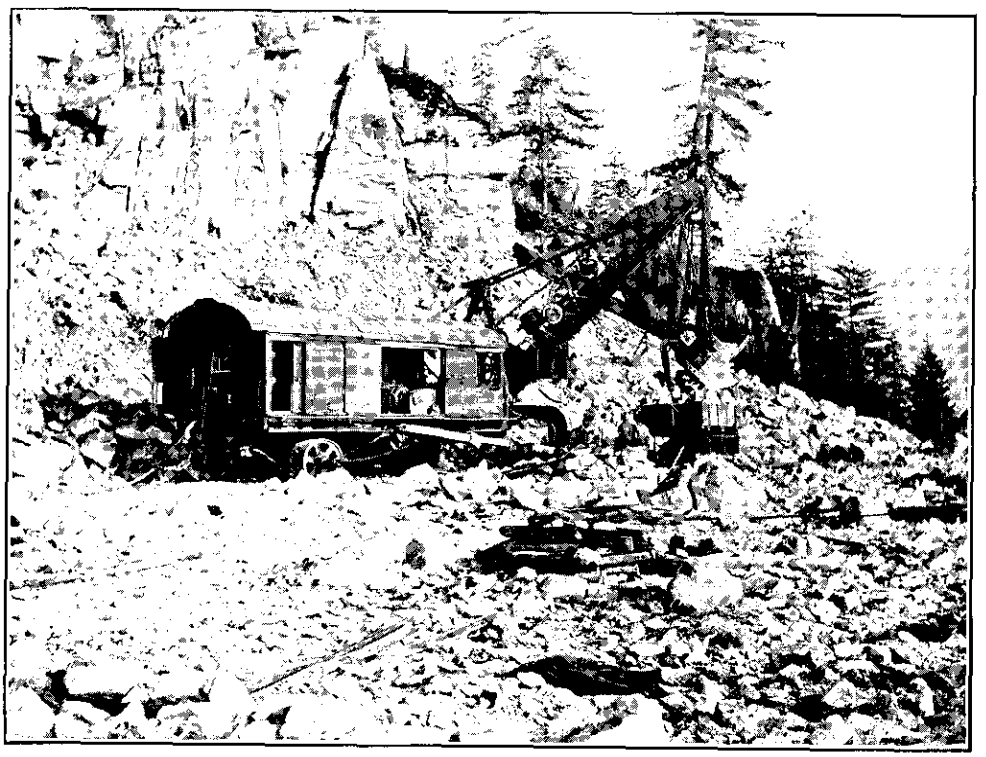
"Gross value of production (30,123 tons)—		
Containing 9,058,045 lb. copper @ 17.4468c.	$1,580,336 64	
50,306 oz. silver @ 50.08c.	25,195 56	
397,862 oz. gold @ $20	7,957 24	
Payment for iron excess	2,644 11	
		$1,616,133 55
"Less smelter charges		355,380 72
Net smelter returns		$1,260,752 83
"Less mine-operating expenses—		
Mining and crushing	$ 275,864 04	
Transportation	33,477 57	
Milling	139,440 32	
Administration, etc.	60,563 65	
		509,345 58
Profit on operation of mine		$ 751,407 25
Auxiliary profit		58,517 26
Total operating profit		$ 809,924 51
"Annual charges against operations—		
Depreciation a/c plant and buildings	$ 284,573 61	
Snowslide losses and expenses (including plant and buildings lost)	210,347 52	
Interest	69,431 02	
Reserve for contingencies	36,158 50	
"Miscellaneous	15,175 69	
		615,686 34
Net profit, 1915		$ 194,238 17

"*Property.*

"Throughout the year, by your authorization, the company continued its policy of acquiring by purchase and location such adjoining properties as were considered desirable for the future welfare of the whole operation in protecting the possible extension of known ore-bodies, as well as to conserve the many watersheds needful and to secure rights-of-way for pipe-lines, tunnels,



Bunkers, Granite Quarries—North Arm, Burrard Inlet.



Loading Broken Granite—North Arm, Burrard Inlet.

etc. Such property purchases entailed throughout the year an expenditure of a little in excess of $100,000. Apart from mine-development, the sum of $44,633.61 was expended during the year for prospecting, exploration, surveying, etc., and the labour necessary for assessment-work on un-Crown-granted claims. A summary of our property holdings as of December 31st, 1915, follows:—

164 Crown-granted mineral claims 16 Beach lots	7,538.16	acres.
167 un-Crown-granted mineral claims	7,500.00	„
	15,038.16	acres.
8 timber licences	4,366.06	„

"*Mine.*

"Because the expenditures for construction and transportation were necessarily large, only a small amount of development and prospecting work was done in the mine during the year, as follows:—

Drifts	1,353	feet.
Raises	653	„
Crosscuts	589	„
	2,595	feet.

"The total amount of ore handled during the year from the mine to the Beach by aerial tramway was 199,906 tons, at an average transportation cost of $0.1674 per ton.

"The average mining cost for the year per ton of ore, inclusive of development (including all charges with exception of tramming 97,045 tons of broken ore added to stopes during the year) and crushing charges, was $1.7712.

The total ore broken for 1915 amounted to	291,332	tons.
Of which there were drawn from the mine	194,287	„
Leaving balance added to ore broken in stopes	97,045	tons.

"Adding the above balance to total broken ore in stopes on December 31st, 1914, there is a total tonnage of broken ore in stopes at the close of the year of 578,206, which should average 3.5 per cent. copper.

"Your attention is respectfully invited to the following summary of *Fairview* mine tonnages:—

Broken ore in stopes December 31st, 1915	578,206	tons.
Ore developed in place	2,885,947	„
Probable ore	2,544,000	„
Possible ore	4,275,250	„
Making a grand total of	10,253,403	tons.

"All of which should average 2 per cent. copper. No allowance has been made for ore occurrences below the 1,200-foot level, notwithstanding that the continuance of some of the veins is shown on the 1,600- and 2,200-foot levels with only small development.

"No work was done in the nature of development or operation during the year in the *Bluff*, *Jane*, or *Empress* mines, the tonnages and grade of which, with due allowance for precious metal content, as reported recently by engineers and from our knowledge of previous operation, are shown in the following table:—

Mine.	Positive Ore.	Broken Reserve.	Probable Ore.	Possible Ore.	Total Tonnage.	Average Grade Cu.
Bluff	1,286,800	1,386	4,413,200	..	5,701,386	1.50
Jane	96,000	..	105,000	799,000	1,000,000	1.50
Empress	100,000	..	143,000	..	243,000	3.25
Totals	1,482,800	1,386	4,661,200	799,000	6,944,386	1.53

"*Mill.*

"The total tonnage milled during the year was 212,158. The average cost per ton milled, including royalty paid for use of flotation process, was $0.6333.

"The product resulting from tonnage milled and as shipped to smelter was 30,123 tons, containing:—

Gold	397.87 oz.
Silver	50,306.00 oz.
Copper	9,058,045.00 lb.

"And with assay values per ton of:—

Gold	0.0132 oz.
Silver	1.67 oz.
Copper	15.04 per cent.
Iron	24.73 "
Insoluble	26.11 "
Zinc	3.10 "

"*Construction.*

"Utopia dam (at the head of Britannia creek), with a total length of 225 feet, was completed to a height of 50 feet, and a wing-dam 340 feet long, with an average height of 18 feet, was constructed on the north side.

"On the *Park Lane* claim a concrete dam approximately 240 feet in length was constructed to a height of 25 feet. It is the intention to continue this dam to a length of 485 feet and the height to 40 feet during the year 1916.

"On Britannia creek, at an elevation of 1,950 feet, the construction of a concrete dam was started in September and attained a height of 10 x 120 feet, when work was suspended. Work on this dam will be resumed early in 1916 and carried to completion, with a total length of 210 feet and a height of 30 feet.

"To furnish adequate domestic water-supply, as well as reserve power for generating energy at the Beach power-house, a concrete dam with a total length of 85 feet and height of 50 feet was constructed on Mineral creek.

"The total expenditure on these items during the year was $56,294.74.

"Pipe-lines consisting of 3,225 feet of wood-stave pipe ranging in sizes 24, 22, and 20 inches and 7,900 feet of steel pipe ranging in sizes 20, 18, and 16 inches were laid from the Park Lane dam to the tunnel power-house, and from the dam at the 1,950-foot elevation to the Beach a line, 14,610 feet long, consisting of 7,700 feet of wood-stave pipe ranging in sizes 36, 30, and 28 inches; a steel pipe-line of sizes 28 and 26 inches for a distance of 3,710 feet, connected with two lines of steel pipe, each of which has a length of 3,200 feet in sizes of 20 and 18 inches.

"A 2,000-kw. steam-turbine was installed in the Beach steam plant, with two Babcock & Wilcox boilers, making a total of 2,500-kw. steam-power available for use during periods of low water and consequent power shortage.

"The amount expended on these pipe-lines and steam plant during the year was $184,565.04.

"The construction of a railroad-line for ore-haulage from the tunnel to head of incline (a distance of three miles), as well as the inclined railway forming the connecting link between the upper and lower railroads and mill-bins, was completed during the year. The length of the incline is 5,400 feet, average gradient 30 per cent., standard gauge, double track, and laid with 56-lb. rails. Storage-bins were erected at the head and foot (above the new mill) of the incline with a capacity of 1,000 and 2,000 tons respectively. As a means for providing further storage facilities, a concrete retaining-wall was constructed on the hillside back of the new mill and will permit of placing in reserve approximately 10,000 tons of ore.

"On account of the demolition by snowslide of the upper section tramway terminal at mine, and to harmonize with the new transportation system, whereby delivery of the ore is made from the raise on 2,200-foot level, a new tramway terminal was constructed at a point 4,000 feet west of the tunnel portal. This building is substantially built on concrete foundations, with timber superstructure, forming bins of 1,000 tons capacity, to which bins the ore is dumped from railway-cars and directly fed by gravity to the rope tramway. Adjoining the tramway machinery on

the lower floor is a complete blacksmith and repair shop. There is provision for storing under cover freight and supplies handled from Beach via tram-line; also a spur track from the main railroad-line to lower level, providing transportation beyond the terminal. A steam-heating plant was installed in this building to prevent ore freezing in the bins.

"To complete railway, incline, storage-bins, and new tramway terminal $110,061.78 was expended.

"At the mine a large double-drum hoist, with full motor equipment, cages, etc., was installed, which necessitated the cutting of a large station and rope-raise on the 1,050-foot level. Further, a high-voltage line with transformers was laid from the tunnel power-house through the 2,200-foot level, and shaft to crusher-room and hoist-station. On the 1,800-foot level a station 20 x 20 x 30 feet was cut, in which a crusher having a capacity of 100 tons per hour was installed. The enlarged operation at the mine necessitated an additional air-line, which was provided by the installation of 12-inch casing laid from the tunnel power-house through the tunnel and up the shaft to the 1,050-foot level. In addition, a railway motor-generator set, and also a 3,631-cubic-foot air-compressor was installed at the tunnel power-house.

"On the above facilities and equipment $62,533.90 was expended.

"To accommodate these improvements the enlargement of the power-house at the tunnel was necessary, and the building was extended 30 feet and the required foundations for water-wheels, generator set, and compressor laid. Also a locomotive repair-shop was constructed. A cement-mortar powder-house 22 x 22 feet was erected alongside the railroad-line at a point about 3,000 feet from the tramway terminal and affords storage capacity for 1,800 cases of explosives. Rolling-stock consisting of two electric locomotives, 15 tons each, and ten 20-ton self-dumping ore-cars and four of 7-ton capacity were put in service during the latter part of the year. To control the skips on the incline a 25,000-lb. double-drum lowering and hoisting apparatus, with 75-horse-power motor, was installed in a station 40 x 40 x 20 feet cut in solid rock at the head of the incline.

"These buildings and equipment represent an expense of $64,973.56.

"For the accommodation of the employees, one 5-room, sixteen 4-room, and two 3-room dwellings were built at the Beach, and two 8-room, one 6-room, four 4-room, and thirteen 3-room dwellings erected at the Tunnel camp, as well as a new 3-story store building 60 x 26 feet, at a total cost of $50,724.58.

"The first 1,000-ton unit of the new concentrating-mill, together with slime and concentrate tanks, as well as launder to ocean, was completed during the year. In addition, the second unit was enclosed, all machinery foundations completed, and a portion of the machinery installed.

"The total amount expended during the year on the new mill, including the machinery payments, was $222,162.47.

"A new wharf 120 feet long by 60 feet wide, with freight-house 30 x 30 feet, was constructed at the Beach at a cost of $7,919.60.

"*Miscellaneous.*

"During the latter part of the year your company bought the Howe Sound Power Company, which company owned important water rights on Furry creek, in South valley, the power possibilities of which it is the intention to develop and conserve by a system of dams, intakes, and pipe-lines, thus materially increasing the company's hydro-electric development.

"The establishment of a telegraph-office at the Beach has proved a great convenience in expediting the business of the company.

"A favourable contract was negotiated with the American Smelting and Refining Company for the treatment of our product, dated July 15th, 1915, for a period of seven years.

"Owing to the increased price of copper and the fact that other producers had advanced wages, a voluntary increase was made to our employees during the latter part of the year. The policy of the company in taking the best of care of its employees has enabled us to create an efficient and loyal organization which is being continually built up to care for the larger tonnages that are expected to be realized shortly after the first of the year.

"*General.*

"It is proposed to carry on an extensive prospecting campaign during 1916. This includes the driving of a tunnel from a point near the head of the incline in an easterly direction, to be

known as the 2,700-foot tunnel, and simultaneously another tunnel to be driven from a point back of the mill, to be known as the 4,100-foot tunnel. For the present, the latter will be driven to a point where proper connection can be made with the 2,700-foot tunnel above. It is the intention to drive these tunnels 9 x 13 feet to serve as transportation routes from the mine direct to the mill. These tunnels will exploit a new country where there is a possibility of encountering commercial ore (of which surface showings give promise), in which event the cost of driving will be materially reduced or entirely offset by the value of the ore extracted.

"The 1,600-foot level will be extended westerly from the shaft to the *Jane-Bluff* country, with an upraise to the surface at a suitable point for ore-extraction, as well as the exploration and development of that territory which has been proven by diamond-drills to contain ore of commercial value.

"Also, it is the intention to do development-work to the east and south of the *Fairview* claim, including a vigorous prosecution of the *Beta* tunnel, which is being driven west to connect with a drift east from the shaft on the 1,600-foot level, a distance of 3,000 feet.

"The test runs in the new 1,000-ton unit of the new mill showed favourable results, and it is believed that with the transportation facilities completed that 2,500 tons of ore per day can be readily delivered to the combined milling plants. We have a very large tonnage of what might be termed low-grade ore, but whether a further enlargement of our mill will be advisable depends upon the disclosures from the developments outlined, including the two tunnels, and from other points in development which are contemplated.

"The further conservation of the Britannia watershed, the harnessing of the water-power of South valley, the extensive plan of development-work, and the various items of new construction entailed will necessitate the expenditure of large sums of money, but it is expected that more than enough for those purposes will be derived from the operations.

"Report showing full details of the year under review and financial status at December 31st, 1915, is now in course of preparation by Helliwell, Maclachlan & Company, chartered accountants, and will be submitted to you shortly.

"*Balance-sheet as at December 31st, 1915.*

"Liabilities—		
Capital—		
Authorized (100,000 shares of $25 each)	$2,500,000 00	
Issued and fully paid (91,966 shares of $25 each)		$2,299,150 00
Loans—		
Howe Sound Company	$1,186,966 13	
Tacoma Smelting Company	53,000 00	
		1,239,966 13
Current liabilities—		
Accounts payable	$ 126,401 68	
December pay-rolls	64,873 50	
		191,275 18
Reserves—		
Employers' Liability Insurance Fund	$ 28,104 14	
Fire Insurance Fund	7,767 68	
For contingencies	36,158 50	
Depreciation on mine properties, plant, buildings, and machinery	854,634 68	
		926,665 00
Profit and Loss Account—		
Balance December 31st, 1914	$ 627,351 20	
Net profit for year ended December 31st, 1915	194,238 17	
		821,589 37
		$5,478,645 68

"Assets—

Properties—			
Crofton townsite		$ 50,200 00	
Mine and development		2,070,744 31	
			$2,120,944 31
Plant, buildings, and machinery—			
Crofton smelter (inoperative)		$ 260,030 12	
Britannia Beach and mine		1,557,971 18	
Under construction		725,847 76	
			2,543,849 06
Investments—			
Britannia Power Co., Ltd.	$141,000 00		
Less depreciation	41,546 61		
		$ 99,453 39	
Britannia stores		297,621 57	
Liability Insurance Fund—cash in bank		1,395 55	
Fire Insurance Fund—cash in bank		7,267 68	
			405,738 19
Inventories—			
Merchandise, supplies, and construction material			124,289 11
Current assets—			
Accounts receivable		$ 220,686 09	
Bills receivable		6,158 50	
Cash in bank		56,456 24	
			283,300 83
Taxes paid in advance			524 18
			$5,478,645 68"

NEW WESTMINSTER MINING DIVISION.

REPORT OF IRVING WINTEMUTE, MINING RECORDER.

I have the honour to submit the following report of mining operations in the New Westminster Mining Division for the year ending 1915:—

The office statistics show an increase over last year, there being more free miners' certificates issued and more new locations recorded, but a slight falling-off in certificates of work recorded.

With the exception of the *Viking* claim, practically no mining, aside from annual assessment work, has been done during the year in the Division.

Viking Group. This group consists of the *Viking* (Crown grant applied for), the *Irma No. 3*, *Fighting Chance*, *Copper Queen*, and *Ramburn No. 1* mineral claims. It is situate on the east side of Pitt lake near the outlet, and is owned by the Viking Mining Company, Limited, of Vancouver.

The principal development-work, which is on the *Viking* claim, and was mostly done in former years, consists of an adit driven as a crosscut for a distance of about 330 feet, at which point the vein is intersected at a depth of about 230 feet; from this point a drift is run about 50 feet on the strike of the vein and an upraise made to the surface. The work has opened up a quartz vein varying from about 3 feet to about 6 feet in width and carrying considerable chalcopyrite.

Comfortable camp buildings for the accommodation of the men have been erected near the workings, and during the year an aerial tramway has been built from the portal of the crosscut tunnel to the landing on Pitt lake, a distance of about half a mile. Suitable ore-bins have also been erected at both the upper and lower terminals of the tramway.

An average of about eight men have been employed during the year under the direction of T. W. Shaffer, superintendent. I am informed shipments will be made during the coming year.

This property is exceptionally well situated for economic operations—timber for mining and water for power being on the ground, while the workings are only about 700 feet above the level of Pitt lake, and the lower terminal of the tramway is on navigable waters about twenty-four miles from New Westminster.

The mineral claims recorded during the year were distributed as follows:—

Pitt lake	73
Kanaka creek	2
Stave lake	35
Hatzic lake	3
Chilliwack and vicinity	18
Harrison lake and vicinity	13
Coquitlam lake	1
Total	145

OFFICE STATISTICS—NEW WESTMINSTER MINING DIVISION.

Free miners' certificates issued (individual)	247
Free miners' certificates issued (company)	2
Quartz claims recorded	145
Certificates of work issued	80
Conveyances, etc., recorded	25
Notices filed	4
Placer claims recorded	3
Certificate of improvements issued	1

Revenue.

Free miners' certificates	$1,151.25
Mining receipts	1,104.55
	$2,255.80

NEW WESTMINSTER MINING DIVISION.

REPORT BY W. M. BREWER, M.E.

In compliance with instructions received from the Provincial Mineralogist, the writer left Victoria on June 17th, 1915, for the purpose of making examinations of the various sections in which the occurrence of metalliferous minerals have been reported in portions of the New Westminster, Yale, Similkameen, Nicola, Ashcroft, and Kamloops Mining Divisions.

As the most convenient and economical method to travel through the country designated would be by horseback, the writer rode from Vancouver to Chilliwack via New Westminster, Murrayville, and Abbotsford, a distance of about seventy-five miles via the main auto-road, arriving at Chilliwack on June 22nd. This road has been constructed parallel to the track of the Great Northern Railway nearly to the south end of Sumas lake, where the line of the railway deflects towards the north-east, and has been built along the western shore-line of the lake, while the auto-road has been constructed near the eastern shore-line, nearly parallel to the track of the British Columbia Electric Railway, and around the base of Vedder mountain to the crossing of the Vedder river at its confluence with the Chilliwack river, about five miles south from the town of Chilliwack.

After crossing the Fraser river by the bridge at New Westminster, until reaching the foot of Vedder mountain, near the south-east corner of Sumas Lake, a distance of about forty-five miles, the country travelled through is covered by alluvial and glacial drift common to the delta of the Fraser river.

In Memoir No. 38, Canadian Geological Survey, Dr. Reginald Daly on page 522 says, with regard to the geology of Vedder mountain, as follows: "The north-western slope of Vedder Mountain ridge is underlain by unaltered basic igneous rock which seems to be intrusive into the Palæozoic argillites and sandstones of the ridge. As exposed, the body forms a remarkably long and straight band running from the head of the Chilliwack River alluvial fan to the International Line south of Sumas lake. The body was not followed farther to the southward. As shown on the map the known length of the mass is more than ten miles. On the north-west for most of its length it is covered by alluvium, so that the exact shape and relations of the body cannot be determined.

"At the point nearest to Sumas lake the igneous rock is bounded on the north-west by a narrow belt of dark-grey argillite, cropping out at intervals for about 700 yards along the wagon-road. Here the argillite seems to dip south-eastward, and thus under the intrusive rock, at an average angle of 65 degrees, while at the south-eastern contact on the summit of the ridge the dip of the argillite is about 40 degrees to the east-south-east. At this point, therefore, the intrusive appears to have the relation of a great sill injected into the bedding-plane of the sediments. The width of the outcropping igneous mass is about 1,000 yards."

From the point where the foot of Vedder mountain is first reached to the bridge across the Chilliwack river, known as the Vedder Crossing, the distance is about ten miles, and the wagon-road for that distance has been built over the western slope of the mountain near to the shore-line of Sumas lake where the geology described above is exposed.

VICINITY OF CHILLIWACK.

On the north side of the bridge the road forks, the branch to the north leading to the town of Chilliwack, and that to the east following up the Chilliwack river to its source in Chilliwack lake, a distance of thirty-seven miles in a nearly due easterly direction. The last named is a wagon-road for a distance of about twelve miles only to a point east of Ned Allison's ranch, and from there it is a good horseback trail to the foot of the lake.

The fall of the Chilliwack river is about 2,000 feet in about thirty miles. The Cheam Mountain range is on the north, the Mount Baker range of the Cascade system on the south side of the river; these mountains are extremely precipitous and rise abruptly from the valley, which, as a rule, is quite narrow. Several peaks in these ranges situated within a few miles of the river reach elevations exceeding 6,000 feet, such as Cheam, Slesse, Pierce, and McGuire, and, in consequence, all of the tributaries which empty into the river, especially those from the south, are torrential streams. The chief of these are the Lihumitson, Tamihi, Slesse, and Nesahwatch creeks.

The geological formations prevailing along the Chilliwack river are classified *in seriatim* by Dr. Daly in the memoir already referred to, as follows: "Commencing at Vedder bridge and travelling up the river to the east: first, a comparatively narrow belt of Carboniferous rocks grouped as the Chilliwack series, and made up of argillites, quartzitic sandstone, and limestone, with interbeds of grit and conglomerate; then a fault, striking in a north-easterly direction, is followed by a belt of Triassic rocks grouped as the Cultus formation, and consisting of dark-grey to black argillites, with interbeds of grit, sandstone, and conglomerate, which are exposed along the wagon-road for a distance of about ten miles. From that point to within a short distance of Chilliwack lake the rock formation belongs to the Chilliwack series, but around the lake the rock formation is classed as granodiorite, designated as the Chilliwack batholith, which occurs as an intrusive in the Chilliwack series, the intrusive contacts being well defined wherever exposed."

No occurrences of metalliferous minerals have been reported in close proximity to the river, but in the mountain range to the south, about ten or twelve miles distant from the river by trail, prospectors have located several claims in the vicinity of Pierce and Slesse mountains (which will be described later in this report), and one property, known as the *Red Mountain* mine, located across the International Boundary, which is equipped with a stamp-mill and has been operated for some years back. Easterly from the southern end of Chilliwack lake prospectors have located several mineral claims for iron ore as well as some for galena.

In addition to these reported discoveries of metalliferous minerals, there are extensive occurrences of limestone, glacial clay, and carbonate of lime at points along the river which

might possibly possess commercial value if railroad transportation was convenient, but under existing circumstances have no value.

The most important occurrences of limestone and glacial clay are situated near the mouth of Slesse creek, one of the tributaries of the Chilliwack river, which flows in from the south, having its source close to the International Boundary. A test made of the clay in the Provincial Assay Office showed that it would be good for common red bricks.

With regard to the deposit of carbonate of lime, the writer's attention was directed to it by Harry Hillier, a prospector in Chilliwack, who suggested it might be phosphate and valuable for a fertilizer. The occurrence outcrops on the side of the wagon-road about half a mile west from Ned Allison's ranch and nine miles and a half from the Vedder bridge. A sample was sent to the Provincial Assayer, who determined the material to be carbonate of lime precipitated from water, and good only as a lime fertilizer.

Chilliwack Lake.

The writer was met at the foot or north end of Chilliwack lake on the night of June 25th by C. O. Lindeman and E. Gowen, who rowed him to the mouth of Depot creek, about one mile from the head of the lake. Chilliwack lake is a fine body of water about six miles in length and a little over one mile in breadth.

In Dr. Reginald A. Daly's report for 1901, published by the Canadian Geological Survey, he refers to Chilliwack lake as follows: "One of the most noteworthy constructive effects of the former glaciation is seen in Chilliwack lake, which owes its origin to a heavy morainal dam."

Depot creek derives its name from the fact that in 1858 and 1859, when the International Boundary-line was being surveyed, the engineers established a base camp at the mouth of this creek, and a trail known to-day as the Boundary trail was constructed up the creek.

An interesting memorial of those early days still remains intact in a grove of heavy timber. This is the grave of Michael Brown, with a cedar cross headstone inscribed as follows: "Erected in memory of Michael Brown, a native of County Galway, Ireland, who was drowned in Chiluweyuk lake October 10th, 1858. His body was found and interned here June 18th, 1859, by his comrades, the members of Co. E., 9th Infantry, U.S. Army.—Aged 26 years.—Requiescat in pace." The letters in this inscription are cut into the wood with a jack-knife or some other sharp instrument, and are perfectly legible to-day—fifty-six years since the burial took place.

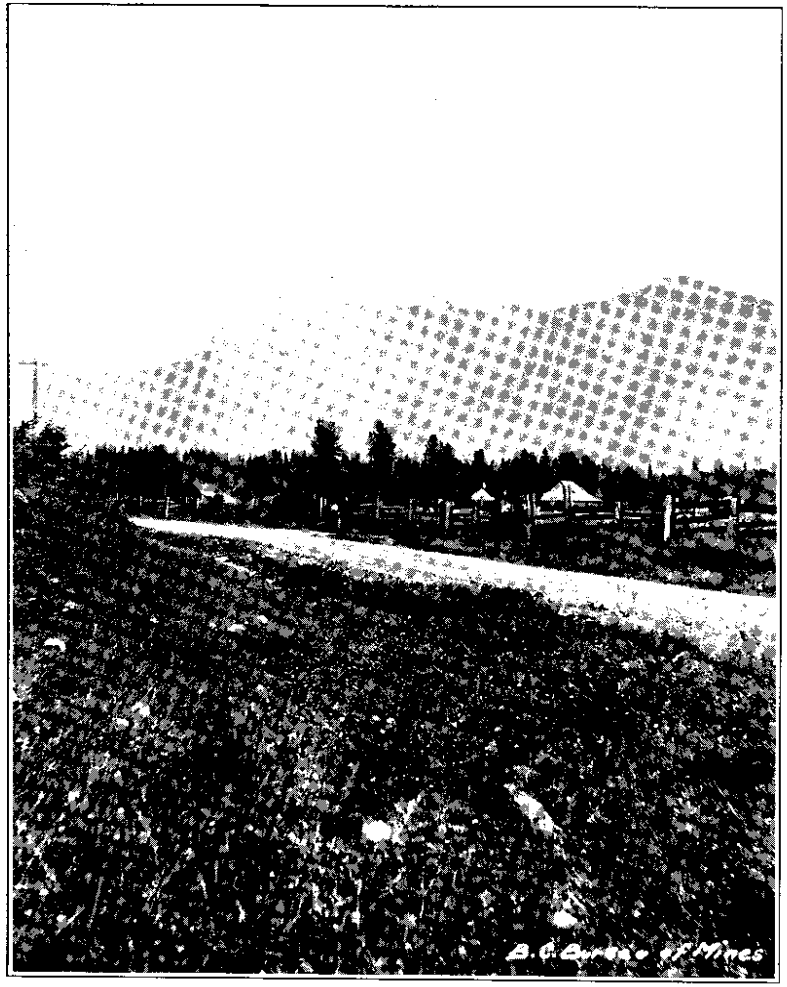
Soon after 5 a.m. on June 26th my companions and self left camp, at the mouth of Depot creek, to examine some prospects located at an elevation of 5,300 feet above sea-level in the range of mountains known as Custer ridge, about five miles east from the camp and near the headwaters of Silver creek, which empties into Chilliwack lake about one mile north from the mouth of Depot creek.

Iron Mountain Group.

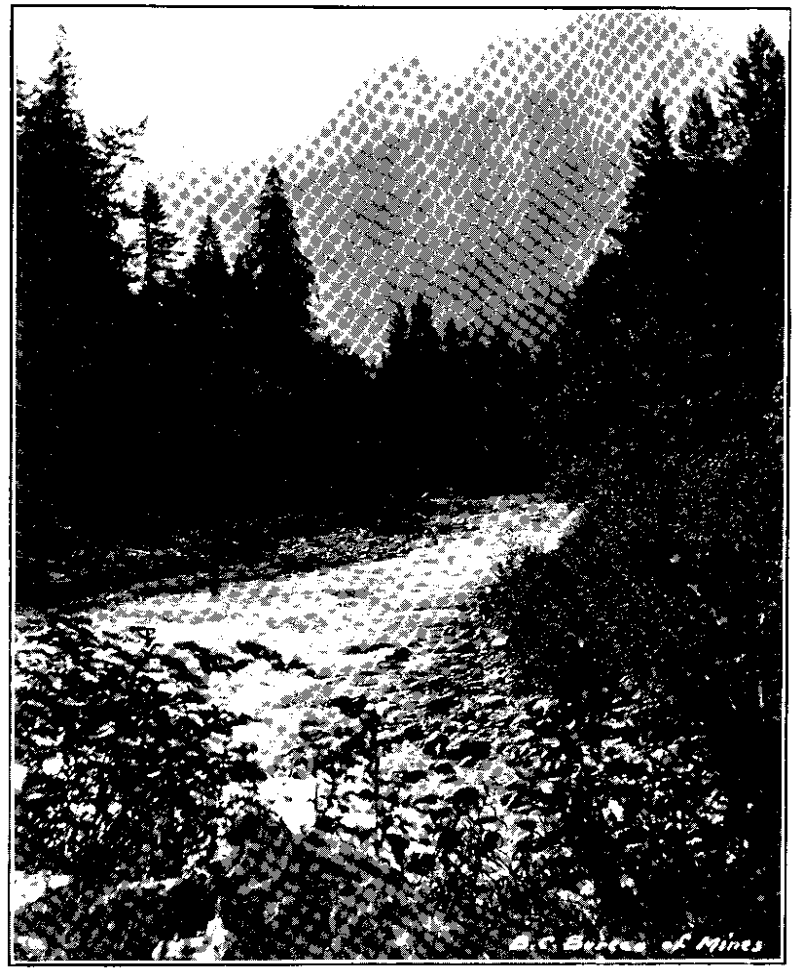
This group consists of six full-sized mineral claims and a fraction, named the *Yankee Girl, Tomboy, Daisy Fraction, Blue Belle, Empire, Golden Crown,* and *Lucky Strike.* The owners are C. O. Lindeman and several associates, all residents of Chilliwack. The group of mineral claims was located because of a strong showing of brown iron ore in a deep gorge near the summit of Custer ridge. The country-rock is the sheared granodiorite classified by Daly as the Custer granite gneiss. The iron ore overlays this formation, and where open-cuts have been made into the deposit it is shown that the ore occurs in bands, with ochreous material lying between the bands of solid ore. There are three short adits, each driven into ore from points about 20 feet below the apex of the outcroppings, and at intervals within a distance of 100 feet along the strike of the deposit, which is to the north-east. The dip is at an eagle of 40 degrees towards the south-east.

There is no hanging-wall shown, and apparently, judging by the masses of float down the gorge, a considerable portion of the deposit has been carried away by erosion. The portal of each of the adits is in iron ore, and each adit has been driven through the iron ore and accompanying ochreous material to the underlying granite. In two of the adits the mineral is 15 feet in width, but in the highest one in the gorge the width is 25 feet.

Samples were taken from two of the adits. One was an average chipped along the wall for 15 feet the full width of the mineral. This assayed: Iron, 38.8 per cent.; sulphur, 1.3 per cent.; phosphorous, *nil.* The other was an average chipped along the wall of the upper adit for 25 feet the full width of the mineral. This assayed: Iron, 40.8 per cent.; sulphur, 1.5 per cent.; phosphorus, *nil.*



Cheam Peak, near Chilliwack.



Looking up Sleese Creek, from Chilliwack River.

Other outcroppings of the same character of iron ore occur near a lake on the summit of the mountain at an elevation about 500 feet higher than where the samples were taken, but there is no apparent continuity showing on the surface between these points.

Silver King Group.

This group consists of eight mineral claims, known as the *Silver King*, *Galena Gulch*, *Wonder*, *Mint*, *Silver Tip*, *Cornucopia*, *Lone Jack*, and *Lone Star*. The owners are C. O. Lindeman and associates, all residents of Chilliwack. The group is situated at an elevation of about 5,000 feet above sea-level, about one mile and a half, in an air-line, north-west from the *Iron Mountain* group, and at the extreme head of one of the branches of Silver creek. The distance travelled by the writer and companions from the *Iron Mountain* group to reach the *Silver King* mineral claim was fully four miles, around the edges of jagged precipitous gorges in the mountain-side, without any trail to follow.

The outcropping of mineral responsible for the staking of this group of claims occurs on the boundary-line between the *Lone Star* and *Silver King* claims. Two outcroppings of mineral, assumed to be galena in quartz, were discovered on the saw-tooth-shaped summit of a very precipitous crag on the south-west side of a deep gorge that is at the source of the headwaters of Silver creek, and on the same side, but at about 300 feet lower altitude, there is a well-defined fault-plane with talcose gouge showing in the crevice. On the presumption that the plane of the fault was the hanging-wall of a vein, an adit was driven 55 feet along the strike towards the north-west, and from the face two crosscuts were made, one 83 feet long towards the south, the other 20 feet long towards the north-east.

The first-named crosscut was driven in the hope of exposing ore at depth under the outcrop mentioned, but the result showed that the crosscut had either not been driven sufficiently far, or else that the mineral had cut out. The last-mentioned crosscut was driven because it was alleged that values were obtained by assay from a sample taken on the surface of the rock on the north-east side of the fault-plane. This crosscut was all in quartzite, in which were crystals of iron pyrite disseminated through the rock, and at the face, 20 feet distant from the so-called hanging-wall, a well-defined slickensided slip was exposed which the miners presumed was the foot-wall. The writer took an average sample of the material in the crosscut between the so-called walls which was assayed in Victoria by the Assistant Provincial Assayer, who reported: Gold, trace; silver, trace; copper, *nil.*

Another adit has been driven 15 feet long, at an elevation of about 200 feet higher than that of the adit just referred to, in the expectation of exposing a vein of galena ore under an outcrop in which a mineral resembling galena occurs in bunches or kidneys, but this resulted in failure to accomplish the desired results. A sample from the outcrop assayed: Gold, trace; silver, trace; copper, *nil.*

Although there was much evidence of disturbance and some shearing movement in the rock formation, as well as many intrusive igneous dykes, the writer could not see any promising indications on the property of the occurrence of mineral-filled veins possessing commercial value, and it is a regrettable fact that so much work has been done with such negative results.

Pierce Mountain Group.

This group of mineral claims is situated close to a lake, at an elevation of 5,500 feet above sea-level, which is the source of Pierce creek, one of the smaller tributaries of the Chilliwack river flowing from the south between Nesakwatch and Slesse creeks. The property is reached by travelling over a very steep trail after crossing the Chilliwack river on a bridge at Charles Thurston's ranch, situated on the north side of the river, opposite the mouth of Slesse creek.

Pierce mountain, which rises to an altitude of 6,200 feet above sea-level, is a prominent landmark in the vicinity of the property. The locality is referred to by Daly in the report of the Canadian Geological Survey for 1901 as an illustration of "tandem cirques," as follows: "Another and finer association of 'tandem cirques' was examined with ease from a trail between Slesse and Middle (Nesakwatch) creeks, and leading to a gold property now being exploited by Mr. G. O. Pierce at an elevation of 5,000 feet. Here three 'tandem cirques' of considerable size succeed each other through head-wall descents of 1,000 and 300 feet. Two of them are occupied by rock-basin lakes."

The discovery about 1898 of the *Lone Jack* gold property on Red Mountain, in the United States, south of the International Boundary-line near the head of Slesse creek, in the Mount Baker district, proved an incentive to prospectors to stake claims on the Canadian side of the

boundary, and amongst the earlier of these locations was the *Pierce Mountain* group. In Daly's report for 1901 he credits this property as being a producer of free-milling gold ore valued at $40 to the ton, as also does H. Carmichael in the report of the Minister of Mines for British Columbia in 1904.

At the time of the writer's visit to the property on June 29th and 30th, 1915, there was neither Messrs. Brethwaite nor Fish, of Bellingham, Wash., the present owners, nor any representatives of theirs on the ground, so the examination was made as thoroughly as possible under the guidance of Ned Allison, a rancher on the Chilliwack river who had been employed as a packer to the property when it was being operated some years back.

The geology of the surrounding country is a wide belt of the Chilliwack series of carboniferous argillite to the west and south, with a diorite intrusion, called the "Slesse stock" by Daly, to the east, and the mine-workings are situated at the contact between these formations. The strike of the argillite on the summit of the mountain range, where the workings are, is magnetic north and the dip vertical.

There are several open-cuts and a shaft within a distance of about 200 feet along a general line from N. 30° E. (mag.) to S. 30° W. (mag.), which appears to be the line of strike of the stockwork that the writer presumed was considered the ore-body, the dip of which is 75 degrees towards N. 60° W. (mag.). The shaft is said to be 90 feet deep, but was full of water and consequently could not be examined.

In a large deep open-cut where the face was squared up there were two narrow seams filled with quartz, one 8 inches wide at the contact between argillite and diorite; the other 3 inches wide in the diorite, which, with this exception, was solid for a width of 10 feet; then there was a yellow ochreous decomposed material of varying width, with quartz in bunches or kidneys through it; then a diorite foot-wall. It is claimed that the shaft crosscut through this body of material, and that the same was mined as an ore-body.

Two samples taken by the writer from the open-cut referred to, one across the 8-inch seam of quartz and the other across the decomposed material, yielded only traces of gold and silver by an assay made by the Assistant Provincial Assayer.

The same result was obtained from a sample across 15 inches of quartz and decomposed irony material exposed in another open-cut about 100 feet southerly from the shaft, and where the quartz occurred between argillite walls.

Apparently, and as far as Ned Allison, the guide, knew, no work has been done for years on the property.

It would appear from the assay results of the writer's samples that, although he exercised every care to obtain a sample representing the ore-body on which so much work had been done, yet he failed to find any material carrying such values as are reported by Dr. Daly and Mr. Carmichael, and he regrets that he was compelled to make the examination in the absence of one of the owners.

Towards the north, and some distance from the *Pierce Mountain* property, at lower elevations on the southern slope of the range, several mineral claims have been staked, but as none of the owners were on their properties when the writer visited the locality, no examinations were made; and for the further reason that no guides could be found who were familiar with the workings or outcroppings.

Forest Ranger Group.

Some days later the writer met John Post, one of the oldest prospectors of the Chilliwack district, who gave the following information relative to the *Forest Ranger* group of mineral claims, consisting of the *Forest Ranger No. 1*, *No. 2*, and *No. 3* and the *Minnie Hipkoe*, owned by John Post, Clifford Post, and H. L. Larson, of Chilliwack.

This group of claims joins the *Pierce Mountain* group on the north, but is approached by another trail. The property is at 500 feet lower elevation than the *Pierce Mountain*. John Post said that some prospecting had been done on a quartz ledge about 3 feet in width. He also claimed that he had obtained some very rich specimens of free-gold ore in some places, but that the work was only shallow prospecting and not sufficient to demonstrate whether a mine could be developed. As Post himself was on his way to record work when met with, and could not give the time required to make an examination until later, the writer concluded that he was not justified in delaying his work.

Jumbo Group. This group of mineral claims consists of the *Jumbo*, *Gold Bug*, and *Lincoln* claims, owned by Thos. Lay, of Chilliwack; J. D. Kennedy; C. G. Major, New Westminster, as administrator for the Estate of W. T. Jones; J. Ensing, of Seattle; and J. R. Grant, of New Westminster. The property is situated on a mountain-side between Slesse and Glacier creeks at an elevation of about 5,500 feet, and twelve miles from the Chilliwack river, from which it is reached by following a good pack-trail up Slesse creek. The same trail is used for packing supplies to the *Red Mountain* mine in the United States, a short distance south from the International Boundary, where a small stamp-mill has been in operation for some years past, and during the past summer this was the only mine in the neighbourhood being worked.

Slesse creek rises south of the boundary-line and is one of the larger torrential streams that flow into the Chilliwack river. To the east, about three miles distant, Mount Slesse rises to an elevation of 6,200 feet above sea-level, while to the south, on the boundary-line, Red mountain forms one of the most picturesque and prominent landmarks in the whole district, because of the rich red colouring of its sides from the oxidation of the iron in the country-rock, the bluish colouring of the glaciers in the crevasses on the northern slope, and the white snow-capped peak which has a semicircular shape.

The country-rock in the vicinity of the *Jumbo* group is an argillite, in which the iron contents are of so great a percentage that much of the rock resembles ironstone. The line of strike of the argillite formation is N. 40° W. (mag.).

There are several open-cuts and two adits on the *Jumbo* claim; the most extensive work is situated high up the mountain, where an adit has been driven 160 feet, drifting for 70 feet along a seam of vitreous quartz, about 12 inches wide, which was exposed at a point about 30 feet in from the portal, and followed to a point 100 feet from the portal, where it pinched out and disappeared entirely. Although the adit was driven about 30 feet farther, there was no indication of any mineralization. The seam of quartz was sampled by the writer, but an assay of it showed no values.

The second adit is situated on the *Lincoln* claim at about 500 feet lower elevation than the one just referred to, and has been driven a distance of about 60 feet in the iron-stained argillite. An open-cut of considerable size, the sides of which have caved in, is situated about 30 feet above the last-named adit and nearly directly over the face. A sample taken from the most promising-appearing material, when assayed, was proven to contain only a trace of gold and 0.8 oz. of silver to the ton. So far as the writer could learn, no work has been done on this property for some years.

Brock-Reid's Property. This consists of a group of claims which adjoin the *Jumbo* group at a lower elevation. Several prospect-holes have been sunk and open-cuts made in a similar formation to that in which the work on the *Jumbo* group has been done. The results obtained did not appear to have been particularly satisfactory, so far as the writer could ascertain, although, as the owner of the property, who is a resident of Bellingham, was not on the ground, there may be some work which the guide had no knowledge of, and which consequently was not examined.

CONCLUSIONS.

The conclusions reached by the writer, after having made a careful and thorough examination of that portion of the Coast District described in the foregoing report, are: That, although some good prospecting has been done, there is a vast region that is practically unexplored; that at the higher elevations the opportunities for prospecting are very good, especially above timber-line, because the rocks are bare; but at lower levels the dense growth of underbrush and thickness of moss have the effect of discouraging any except the most enthusiastic prospector. The fact that, so far as the territory on the Canadian side of the boundary-line is concerned, no mines have yet been developed, and the properties examined by the writer are apparently not promising, should not discourage the prospector too seriously, because there are indications of mineralization in several places, and especially along the contacts of the Slesse diorite and Chilliwack series of argillites.

CHILLIWACK TO HOPE.

The writer rode to Chilliwack on July 5th after completing his work in the territory tributary to the Chilliwack river, and on the 6th accompanied Sam. A. Cawley, M.L.A., and

W. E. A. Thornton, Dominion Immigration Agent, to a point about twelve miles distant in an easterly direction on the Chilliwack-Hope wagon-road, where it was reported that John Fremont and Frank E. Wilson had located some mineral claims—samples from which had been assayed and showed values in gold and silver—and also to examine a deposit, supposed to be phosphate, situated near the north-west corner of Cheam lake.

Dundee and Josephine.

These mineral claims are located near the foot of Cheam peak, and the western boundary of the *Dundee* claim is about half a mile east from the wagon-road. The owners of the claims are John E. Fremont and Frank E. Wilson. The prevailing country-rock belongs to the Chilliwack series, made up chiefly of argillite, in which occur lenses of quartz sometimes containing particles of marcasite (white iron) and sometimes of iron pyrite.

The staking of these claims had been done on the assumption that the entire mass of argillite carried commercial values, and it was reported to the writer that some good values had been found by an assayer. In order to verify these statements two samples were taken from two open-cuts of rock, said to be similar to that assayed, but the result given in both cases by the Provincial Assay Office was: Gold, trace; silver, trace; copper, *nil*.

Deposit of Calcium Carbonate.

A deposit of whitish decomposed material on a small creek that empties into Cheam lake at its north-west corner, about one mile and a half north from the wagon-road, that has been assumed to be phosphate, was sampled. An analysis showed that this was only a water deposit of calcium carbonate. The extent is undetermined, and value as a fertilizer from a commercial standpoint is problematical.

Cream Commercial Fertilizer Co.

At the old settlement of Popkum, where the large Knight sawmill was operated years ago, and at present a station with side-track on the Canadian Northern Pacific railroad, the Cheam Commercial Fertilizer Company has its headquarters, with Frank E. Wilson as Superintendent. This company has acquired 200 acres of a deposit of limestone in the mountains near by, and the writer was informed by the superintendent that the company proposes to erect a plant and utilize the limestone in the manufacture of fertilizer.

Jones Mountain.

Continuing along the wagon-road towards Hope, the writer reached St. Elmo, fifteen miles in a north-easterly direction from Popkum, and about two miles in the same direction from the mouth of Wahleach (Jones) creek. There he found the veteran pioneer prospector and farmer, Joseph Shannon, who informed him that in company with Jack Griswold and John Donelly, he (Mr. Shannon) had staked some mineral claims in the mountains up Wahleach creek, on which occurred gold-bearing quartz ledges. He also stated that his companions and himself were expecting to go to the claims in a few days to perform their first assessment-work, and a tentative arrangement was made for the writer to visit the properties on his return to the Coast in the autumn, but the return was made via another route, and at too late a date to permit of a satisfactory examination.

The territory in the neighbourhood of Wahleach (Jones) lake, the source of the creek of that name, was also being prospected during this season by parties from the town of Hope, who discovered in the high mountain range near the lake an outcropping of chalcopyrite ore. This party of prospectors returned to Hope during the writer's visit there, when he examined a sample of the outcropping, which weighed several pounds, and carried a high percentage of copper. The discoverers described the prospect as promising to develop into an extensive body of ore. Some claims had been staked by these prospectors, and it was proposed by D. J. McRae, one of the owners, to have a trail made and work done at once to demonstrate some material data with regard to the possibilities of the occurrence. Under the circumstances the writer did not deem it advisable to visit the claims at the time, so he arranged that if he returned via Hope after his season's work had been done, he would make an examination, but this proved to be impossible.

INSPECTION OF MINES.

REPORT OF THOMAS GRAHAM, CHIEF INSPECTOR.

I have the honour to submit my fourth annual report covering the year ending December 31st, 1915, as Chief Inspector of Coal and Metalliferous Mines.

The reports of the District Inspectors relative to production of coal and coke, the number of persons employed, list of accidents and prosecutions, and a brief description of the mines in the several inspectorates, and also reports of the Instructors in Mine-rescue Work and First Aid, are hereto appended.

PERSONNEL OF STAFF OF INSPECTORS AND INSTRUCTORS.

The personnel of the staff of Inspectors and Instructors is as follows:—

Inspectors.

Thomas Graham, Chief Inspector, Victoria.
James McGregor, Inspector, Nelson.
Robert Strachan, Inspector, Merritt.
John Newton, Inspector, Nanaimo.
T. H. Williams, Inspector, Fernie.
Henry Devlin, Inspector, Nanaimo.
George O'Brien, Inspector, Fernie.

Instructors, Mine-rescue Stations.

John D. Stewart, Instructor, Mine-rescue Station, Nanaimo.
Charles O'Brien, Instructor, Mine-rescue Station, Fernie.

Instructor, First Aid.

Dudley Michell, Instructor, Victoria.

TONNAGE OF COAL PRODUCED.

The production for the year was 1,972,577 tons, a decrease of 193,851 tons compared with the figures of the previous year; this reduction being due to abandonment of the Hosmer Colliery, in the Crowsnest District, and the increased use of fuel-oil; and the great dearth of tonnage on the Pacific ocean reduced the output in the Coast District.

ACCIDENTS IN COAL-MINES.

I regret to report that the fatalities in and around the coal-mines during the year totalled fifty-two, the largest number in any one year since 1909, and was due to the deplorable disaster at the South Wellington Colliery of the Pacific Coast Coal Mines, Limited, in which nineteen lives were lost by drowning, and an explosion in the Reserve shaft of the Western Fuel Company at Nanaimo, in which twenty-two lives were lost; both these disasters are treated upon elsewhere.

During the year there were twelve separate fatal accidents, which caused the death of fifty-one persons, and one subsequent death due to an accident reported in 1914; this is a decrease of three in the number of fatal accidents, but an increase of thirty-five in the number of persons killed, compared with the statistics for 1914.

There were 4,991 persons employed in and about the coal-mines, being 741 less than reported in 1914; the ratio of fatal accidents per 1,000 persons employed being 10.42, compared with 2.97 in 1914; the ratio for the last ten-year period was 4.73.

The following table shows the collieries at which the fatal accidents occurred:—

Canadian Collieries (Dunsmuir), Limited, Comox Colliery	3
Canadian Collieries (Dunsmuir), Limited, Extension Colliery	2
Pacific Coast Coal Mines, Limited, South Wellington	20
Western Fuel Company, Nanaimo	25
Crow's Nest Pass Coal Company, Limited, Coal Creek	1
Crow's Nest Pass Coal Company, Limited, Michel	1
Total	52

The following table shows the various causes of the fatal accidents and their percentage to the whole, with corresponding figures for the previous year:—

Cause.	1915.		1914.	
	No.	Per Cent.	No.	Per Cent.
Asphyxiation	1	1.925	..	..
Drowning	19	36.54	..	..
Explosion	22	42.31	..	..
Falls of coal	1	1.925	3	17.66
Falls of rock	4	7.69	2	11.76
Haulage	3	5.77	6	35.30
Shafts	..	..	2	11.76
Explosives	..	..	2	11.76
Electricity	..	..	1	5.88
Surface, miscellaneous	2	3.84	1	5.88
Totals	52	100.00	17	100.00

Statistics in most coal-producing countries show that the most prolific cause of underground fatalities are falls of coal and rock at the working-face and mine haulage. Falls of coal and rock run from 50 to 60 per cent. of the whole, whilst mine haulage runs from 20 to 25 per cent. of the whole; accidents from these causes, therefore, form from 70 to 85 per cent. of all underground accidents, explosions, shaft, electricity, explosives, and miscellaneous accidents making up the remainder. The fatalities in British Columbia from falls of coal and rock and mine haulage in 1913 were 85.19 per cent.; in 1914, 64.72 per cent.; and in 1915, 15.385 per cent. The percentage shown in 1915 is rather misleading, and is caused by the large loss of life in the two major accidents at South Wellington and Nanaimo, these two accidents being responsible for forty-one of the fifty-two deaths during the year, and to obtain a proper ratio of the face and haulage accidents, compared with 1913 and 1914, it would be necessary to ignore the two major accidents, when the percentages for the face and haulage accidents would be: 1913, 85.19; 1914, 64.72; and 1915, 72.72.

The number of persons killed during the year—i.e., fifty-two—is the highest since 1909, when there were fifty-seven fatalities; the ratio per 1,000 persons employed, 10.42, is higher than in 1909, when it was 8.88.

METALLIFEROUS-MINE ACCIDENTS.

There were seventeen separate fatal accidents in and around the metalliferous mines of the Province during the year, causing the death of seventeen persons, being an increase of three in the number of accidents, but a decrease of two in the number of persons killed, compared with the figures of 1914.

There were 4,144 persons employed in and around the metalliferous mines, a decrease of thirty persons compared with the corresponding figures of the previous year.

The ratio of fatal accidents per 1,000 persons employed was 4.10, compared with 4.55 in 1914. The ratio for the last ten-year period was 4.40.

The mines at which the fatalities occurred are:—

Nickle Plate, Hedley	1
Granby, Phoenix	2
War Eagle, Rossland	1
Queen, Salmo	1
Britannia, Britannia Beach	2
Le Roi, Rossland	1
Gold Drop, Phoenix	1
Standard, Silverton	2
Utica, Kaslo	1
Granby group, Anyox	2
Rocher Déboulé, Tramville	1
Motherlode, Greenwood	1
Centre Star, Rossland	1
Total	17

This total is one more than was reported in the Fourth Quarterly Statement issued by the Department in January, the addition being a subsequent death from an accident several months previous, and through an oversight the subsequent death was not reported until after the quarterly bulletin was issued.

The following table gives the cause and percentages to the whole of the fatal accidents, with the corresponding figures for 1914:—

Cause.	1915.		1914.	
	No.	Per Cent.	No.	Per Cent.
Picking or drilling into unexploded powder	2	11.77	1	5.26
Premature blasts	..	..	5	26.32
Falls of ground	5	29.41	6	31.58
Gassing from powder-fumes	1	5.88	3	15.80
Falling into chutes, raises, winzes, etc.	4	23.53	1	5.26
Returning on unexploded shots	1	5.88	1	5.26
Mine-cars and haulage	..	..	1	5.26
Mine-fire	1	5.88	..	..
Sliding material in chutes	2	11.77	..	..
Hit with flying rock from shot	1	5.88	..	..
Aerial tramway	..	..	1	5.26
Totals	17	100.00	19	100.00

Explosives in one form or another account for four fatalities, or 23.53 per cent. of the whole, the percentage in the same class of accidents in the previous year being 53.63, a decrease of 30.10 per cent.

Falls of ground caused five fatalities, or 29.41 per cent., compared with six fatalities and a percentage of 31.58 in 1914, a decrease of 2.17 per cent. There is, however, a marked increase in the number of chute accidents, in which six lives were lost, the percentage being 35.30, whilst during the previous year only one life was lost in this class, the percentage being 5.26, the increase being 30.04 per cent.

EXPLOSIVES.

Demand for material used in the manufacture of munitions of war has very materially affected the cost of explosives, especially that class of explosives in which nitro-glycerine is the base. This increase in cost has brought about an effort to extend the use of ammonia-nitrate powders wherever they are suitable and can be used in the metal-mines.

The increased cost, coupled with the large quantities of explosives used in the metalliferous mines, makes the present time an opportune one to comment upon the saving that might be effected in the quantities of explosives used by a more careful supervision of the charging of

holes. In many mines little attention is given to the amount of explosive used, other than the desire to break the ground, and in many mines little, if any, tamping of explosives is done. This latter practice is not only wasteful in quantity of powder required to perform a given amount of work, but the resultant fumes and gases, through imperfect detonation and combustion, carry higher percentages of noxious and deleterious gases, which endanger and affect the health of the workmen.

It is pleasing to note that some of the larger companies are putting forth efforts along this line with gratifying results, not only in reduction in the quantities of explosives used, but in improved conditions in general in the mine.

EXPLOSIVES IN COAL-MINES.

On September 8th, 1915, "Explosives in Coal-mines Order No. 2" was issued, pursuant to subsection (*i*), General Rule 11, section 91, of the "Coal-mines Regulation Act." The list contained eight explosives, all manufactured within the Province, and all of which are included in the "Permitted Explosive Lists" either in Great Britain or in the United States of America. The order superseded all existing Explosive Orders, and became effective at once: Providing that nothing in the Order prohibited the use of such stocks of explosives then on hand at the collieries, and which were in accordance with the requirements of Explosive Order No. 1.

The following are the explosives contained in Order No. 2:—

Monobel A.I. ..... British List.
Monobel No. 1 ..... " "
Polar Permitite* ..... " "
Monobel† ..... United States List.
"Giant" Coal-mine Powder No. 5 ..... " " "
"Giant" Coal-mine Powder No. 6 ..... " " "
"Giant" Coal-mine Powder No. 7 ..... " " "
"Giant" Coal-mine Powder No. 8 ..... " " "

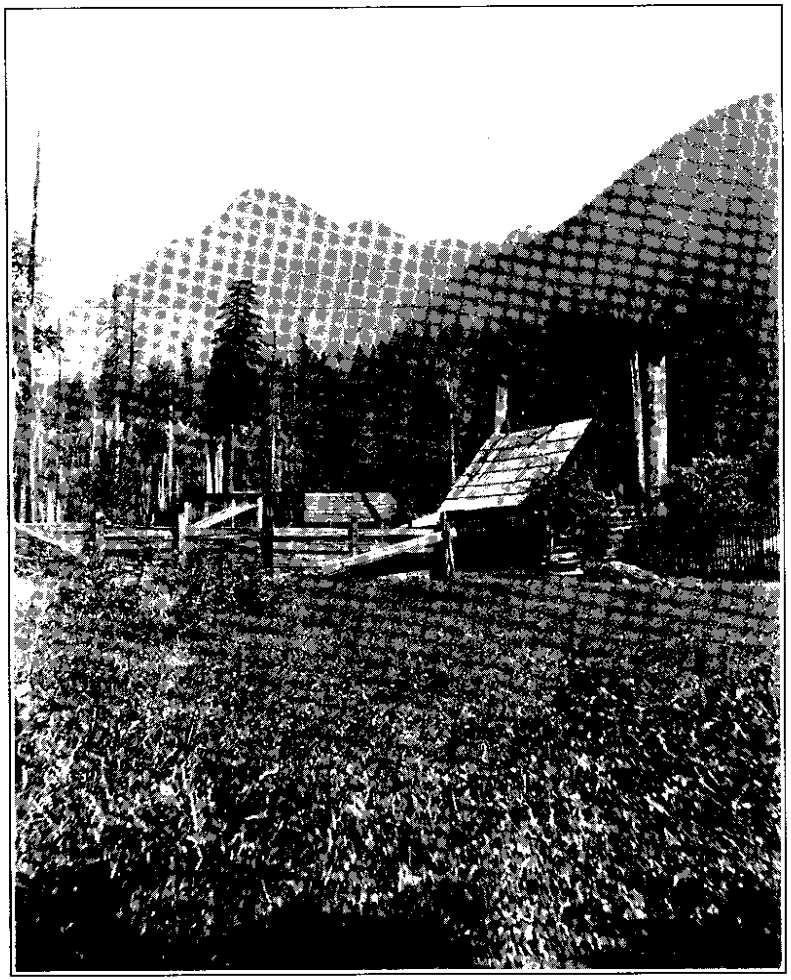
The following table shows the quantity of explosives used in the coal-mines during the year 1915, together with the number of shots fired, how shots were fired, tons of coal per pound of explosive used, and pounds of explosive per shot:—

District.	Pounds of Explosives used.	Tonnage of District.	Estimated No. of Shots fired by Electricity.	Estimated No. of Shots fired by Fuse.	Total No. of Shots fired.	Tons of Coal per Pound of Explosive.	Pounds of Explosive per Shot fired.
Crowsnest	20,215	852,571	34,767	1,663	36,430	42.17	0.55
Nicola	37,965	99,066	58,895	2,955	61,850	2.60	0.61
Coast	272,013	1,020,940	248,384	142,773	391,157	3.75	0.69
Totals for Province.	330,193	1,972,577	342,046	147,391	489,437	5.97	0.67

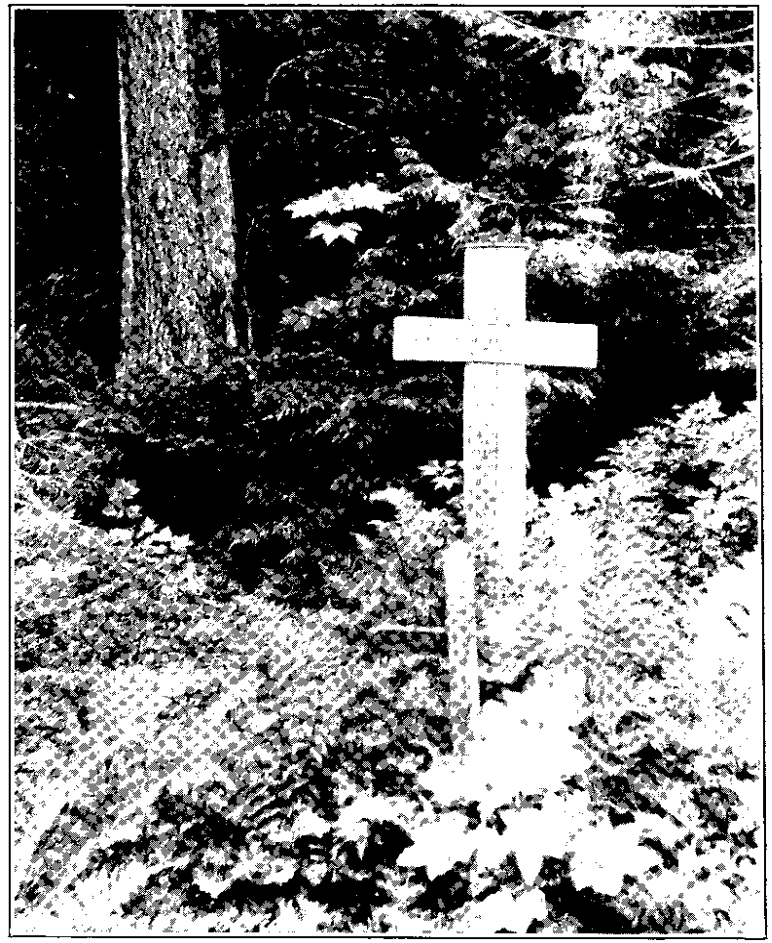
MACHINE-MINED COAL.

Two hundred and five thousand seven hundred and thirty-six tons of coal, or 10.43 per cent. of the total production for the year, was produced by mining-machines; 183,926 tons, or 89.39 per cent. of the whole, was produced by one company—the Western Fuel Company at Nanaimo.

* Polar Permitite is known on the British List as "Super-Rippite."
† Monobel is known on the United States List as "Monobel No. 1," but designated "Monobel" on this list to prevent confusion with "Monobel No. 1" of the British List.



Thurston's Ranch, Chilliwack River.



Grave of Michael Brown, of the U.S. Army, drowned in Chilliweyuk Lake, October 10th, 1858.

The following tables give the district, number of machines, how driven, tons of coal produced, and types of machines in use:—

District.	Number driven by		Tons of Coal produced.		Total in Tons.
	Electricity.	Compressed Air.	Electricity.	Compressed Air.	
Crowsnest Pass	..	2	....	1,418	1,418
Nicola-Similkameen	..	7	....	13,175	13,175
Coast	3	13	7,217	183,926	191,143
Totals	3	22	7,217	198,519	205,736

Type of Machines in Use.

Type.	District.			Total.
	Crowsnest Pass.	Nicola-Similkameen.	Coast.	
"Percussive" Post	2	7	10	19
"Bar" Longwall	..	..	3	3
"Chains" Shortwall	..	..	3	3
Totals	2	7	16	25

SAFETY-LAMPS.

There were 3,335 safety-lamps in use in the coal-mines of the Province in 1915; of this number, 3,311 were flame-lamps of the Wolf type, all fitted with internal igniters, and twenty-four electric lamps. The following table shows the distribution by districts, method of locking, and the illuminant used:—

District.	No.	Method of Locking.		Illuminant.	
		Magnetic.	Screw.	Naphtha.	Electricity.
Crowsnest Pass	1,363	1,363	..	1,363	..
Nicola-Similkameen	276	244	32	274	2
Coast	1,696	1,649	47	1,674	22
Totals	3,335	3,256	79	3,311	24

MINE-AIR SAMPLING.

Under the direction of Dr. Eugene Haanel, Ph.D., Director of the Mines Branch, Department of Mines, Ottawa, arrangements were completed late in 1914 by which the Mines Department undertook the important work of conducting at the laboratories in Ottawa analyses of mine-air samples. The Federal Mines Department furnishes the exhaust-bottles used in collecting the samples, together with mailing-cases for shipment of samples, franking privileges, etc., all being free of cost to the Province.

Advantage of this offer was taken by the Mines Department of this Province, and seventy-one samples of mine-air were collected in the coal-mines of the Province in 1915 and sent to Ottawa for analysis. Of this number, six samples were spoiled in transit, making sixty-five samples of mine-air on which returns were received.

The information obtained from the analyses of these samples have been of much value to the mine officials and to the inspection staff.

The work will be continued during the present year; the data will be tabulated in such form as will make it of most benefit to those in charge of the mines, and will also enable comparisons to be made, with similar work being done in other mining countries, relative to emanations of methane from the coals of this Province.

The samples were collected by the District Inspectors of Mines and mailed direct to the Mines Branch at Ottawa; copies of the returns of analysis of each sample were mailed from the Mines Branch to the Inspector who collected the sample, to the manager of the mine in which the sample was collected, and to the Chief Inspector of Mines.

EDUCATIONAL LITERATURE.

The Department during the year obtained from the United States Bureau of Mines 300 copies of Mines Circular No. 7, "The Use and Misuse of Explosives in Coal-mining." These were distributed to the firebosses and shotlighters at the various mines throughout the Province.

A short paper on the "Instruction, Organization, and Care of Rescue Parties," by George O'Brien, Inspector of Mines, Fernie, B.C., was printed in booklet form and distributed in the mining districts.

As an aid to persons taking a course of instruction in mine-rescue work, a small booklet was prepared and printed, entitled "Instructions on the Use and Care of Mine-rescue Apparatus," being in the form of questions and answers. These were compiled by Dudley Michell, First-aid Instructor of the Mines Department, and sent to the Government Mine-rescue Stations at Nanaimo and Fernie for distribution among those interested in the mine-rescue movement. Persons who have taken a course in mine-rescue work and applicants for such a course should obtain copies of this booklet, which they will find very helpful in the work.

MINE-RESCUE WORK.

There has been little general change in the number of mine-rescue apparatus in use in and around the coal and metal mines of the Province during the year 1915, the most notable addition being the installation of four sets of 2-hour latest type Draeger apparatus by the Britannia Mining and Smelting Company, Britannia Beach.

The Government remodelled all of their sixteen sets of 2-hour Draeger apparatus, bringing them up to the latest mouth-breathing positive-pressure type.

Training at the Government stations was not so active as in former years; only fifty-seven certificates of competency were issued during the year. In addition to these a class of thirty-eight completed training at the Nanaimo Station, but, as their examination was not held until the present year, they are not shown in the list of certificates of competency in mine-rescue work issued up to December 31st, 1915.

LIST OF CERTIFICATES OF COMPETENCY IN MINE-RESCUE WORK ISSUED IN 1915.

Date.	Name.	Station.	No.
June 30th	Spruston, Thomas A	Nanaimo	200
" 30th	Jaynes, Frank	"	201
" 30th	Myers, Peter	"	202
" 30th	Herd, William	"	203
" 30th	McMillan, John H	"	204
" 30th	Sloan, Hugh	"	205
" 30th	Jones, Samuel	"	206
" 30th	Thompson, John	"	207
" 30th	Gillespie, John	"	208
" 30th	Brown, John	"	209
" 30th	Brown, James	"	210
" 30th	Parnham, Charles	"	211
" 30th	Dando, John	"	212
" 30th	Dando, Caleb V	"	213
" 30th	Broderick, Matthew	"	214
" 30th	Scott, Thomas W	"	215
" 30th	Dando, Caleb	"	216
July 23rd	Clark, Lewis	"	217
" 23rd	Moyes, James	"	218
" 23rd	McKendrick, Andrew	"	219
" 23rd	McKibben, Matthew	"	220
" 23rd	Clark, Joseph	"	221
" 23rd	Archibald, George	"	222
" 23rd	Hays, William	"	223
" 23rd	Osborne, Hugh	"	224
" 23rd	Dunnigan, James	"	225
" 23rd	Stone, William	"	226
Nov. 1st	Healer, Robert	Fernie	227
" 1st	James, Edward	"	228
" 1st	Fisher, John H	"	229
" 1st	Groutage, Edgar E	"	230
" 1st	Wallis, John	"	231
" 1st	Seaton, C. A	"	232
" 25th	Delaney, James	Nanaimo	233
" 25th	Davidson, Hugh M	"	234
" 25th	Smith, George	"	235
" 25th	McLachlan, Alexander	"	236
" 25th	Malone, Patrick	"	237
" 25th	Purss, David	"	238
" 25th	Strang, James	"	239
" 25th	Strang, Thomas	"	240
" 25th	Morgan, John	"	241
" 25th	James, William	"	242
" 25th	Mitchell, Henry	"	243
" 25th	Watson, Arthur	"	244
Dec. 22nd	Henderson, Robert	"	245
" 22nd	Mordy, Thomas	"	246
" 22nd	Bell, Frederick	"	247
" 22nd	Bryce, Richard	"	248
" 22nd	Rogers, Ellis	"	249
" 22nd	Cameron, Samuel	"	250
" 22nd	Buchanan, Henry	"	251
" 22nd	Huby, Norman	"	252
" 22nd	Leeman, Thomas	"	253
" 22nd	Bevis, Nathanial	"	254
" 22nd	Spicer, John E	"	255
" 22nd	McNeil, Robert	"	256

The following tables show the number, distribution, and type of mine-rescue apparatus and oxygen resuscitating devices maintained at the coal and metal mines of the Province during the year 1915:—

Company.	Draeger Apparatus.		Fluess or Proto Apparatus.		Total Apparatus.	Resuscitating Devices.		Total.
	2-hour.	½-hour.	2-hour.	1-hour.		Pulmotors.	Lungmotors.	
Western Fuel Co.	4	..	4	2	10	2	2	4
Canadian Collieries (D.), Ltd., Comox Colliery	4	..	..	..	4	..	..	..
Canadian Collieries (D.), Ltd., Extension Colliery	4	..	..	..	4	..	..	..
Vancouver-Nanaimo Coal Co.	2	1	..	..	3	1	..	1
Pacific Coast Coal Mines	2	1	..	..	3	1	..	1
Middlesboro Collieries	2	..	..	..	2	1	..	1
Inland Coal and Coke Co.	2	..	..	..	2	1	..	1
Pacific Coal Syndicate	..	2	..	..	2	..	..	..
Princeton Coal and Land Co.	1	1	..	..	2	1	..	1
Coalmont Collieries	3	1	..	..	4	1	..	1
Crow's Nest Pass Coal Co., Michel Colliery	4	5	..	..	9	1	..	1
Crow's Nest Pass Coal Co., Coal Creek Colliery	4	6	..	..	10	2	..	2
Corbin Coal and Coke Co.	2	1	..	..	3	1	..	1
B.C. Government	16	10	..	..	26	3	..	3
Totals	50	28	4	2	84	15	2	17

The following table shows the number of mine-rescue apparatus and resuscitating devices in and around the metal-mines of the Province in 1915:—

Company.	Draeger Apparatus.			Fluess or Proto Apparatus.	Total Apparatus.	Resuscitating Devices.
	2-hour.	1-hour.	½-hour.	2-hour.		Pulmotors.
Consolidated Mining and Smelting Co. of Canada—						
Rossland	..	..	..	4	4	2
Kimberly	..	..	..	2	2	1
Nelson	..	..	..	..	..	1
Ainsworth	..	..	..	2	2	1
Trail	..	..	..	.	..	1
Granby Consolidated Mining, Smelting, and Power Co.—						
Phoenix	..	3	..	..	3	1
Anyox	..	..	1	..	1	3
Britannia Mining and Smelting Co., Britannia	4	..	..	..	4	3
Standard Silver-Lead Co., Silverton	..	..	..	..	..	1
Totals	4	3	1	8	16	14

In the underground operations of the coal and metal mines the number of persons employed was 6,417, so that there was available one mine-rescue apparatus for every sixty-five persons employed, and one oxygen resuscitating device for every 207 persons employed.

First Aid to the Injured.

The work of organizing first-aid classes in the various mining districts in the Province was well maintained throughout the year, and with quite encouraging results; the detail of this work is set out in the report of Dudley Michell, Organizer and Instructor of First Aid.

In several of the mining districts efforts were made by the Department of Education to open and maintain night-schools, with a view to encourage the study of mining and other technical subjects; I regret to say that little evidence was shown to take advantage of the facilities afforded, and, in many instances, the classes had to be abandoned because of lack of interest.

NANAIMO MINE-RESCUE STATION.

The following is the report of J. D. Stewart, Instructor at the Mine-rescue Station, Nanaimo, for the year ending December 31st, 1915:—

The equipment on hand at the station at the present time is as follows: Six 2-hour Draeger machines; four ½-hour Draeger machines; one pulmotor with four improved face-masks and four head-rings with straps for fastening same; one oxygen stretcher; two high-pressure oxygen refilling-pumps with six sets of pump packing; twelve smoke-goggles; twelve oxygen storage-cylinders; ten 2-hour cylinders; twelve ½-hour cylinders; one water-gauge and one measuring-bag; three spare positive-pressure reducing-valves for 2-hour apparatus; two spare reducing-valves for pulmotor; twelve diaphragms; four spare breathing-bags; six small Draeger electric safety-lamps; six spare Porox accumulators; twelve Ceag electric safety-lamps (also number of spare parts to renew cells); fifteen spare accumulators; charging-board and electric magnet; four canary birds for gas-testing.

Spare Parts for 2-hour Apparatus.—Twelve corrugated flexible respiration-pipes.

Supplies on Hand.—Four full storage-cylinders of oxygen, 400 cubic feet; 136 No. 1 cartridges; 529 No. 2 cartridges; 116 No. ½ cartridges.

Apparatus, etc., sent to Inspector Strachan, Merritt.—Two 2-hour Draeger machines, with all necessary spare parts to remodel apparatus to bring it up to latest model to date; two spare reducing-valves; two 2-hour oxygen cylinders; four Ceag electric safety-lamps; four spare accumulators.

Sent to Mine-rescue Station, Cumberland.—One pulmotor (complete).

Thirty-eight men have qualified themselves to receive the Government certificate for mine-rescue work.

During the first six months of the year the Western Fuel Company had a number of its employees training at its own station. The Canadian Collieries (Dunsmuir), Limited; the Pacific Coast Coal Mines, Limited, and the Vancouver-Nanaimo Coal Company also had a number of their employees trained.

The following are the names of the men who have been trained at this station and are entitled to certificates:—

Western Fuel Company, Nanaimo.—John Hunt, James Hodgson, John Marrs, Thos. H. Taylor, Thos. Lewis, Thos. Smith, John A. Challinor, Joseph Norris, Samuel Drake, Samuel K. Mottishaw, Paul Leynard, George Oswald, Edward Wilkinson, Ralph Stobart, James H. Robertson, Walker Addison, Andrew W. Waugh, John Dean, Alfred Gould, Andrew Murphy, Edward Gibson, William F. Brough, John Patterson, Arthur Newbury, Fred Hunter, David Brown, Jas. Richards, Francis John, and Thos. Mason.

Vancouver-Nanaimo Coal Company, Nanaimo.—Clair F. Kenney, Adam Stewart, Thomas Jordan, Aaron Stewart, Jos. W. Dykes, and Thomas M. Aitken.

Pacific Coast Coal Mines, Limited, South Wellington.—Robert Bonar, Joseph Neen, and Thomas Taylor.

The following is the amount of oxygen and potash cartridges used for training and practice work at this station during the year: 3,593 cubic feet oxygen; 243 No. 1 cartridges; 107 No. 2 cartridges; an average consumption a man of 94.5 cubic feet of oxygen and 9.2 cartridges, at an average cost of $15.70.

Twenty-four of these men received a full course of ten sessions of two hours each, at an average cost of $22.30 per man; the remaining fourteen received a course of two sessions of two hours each.

Since my previous report there have been several improvements added to the 2-hour Draeger apparatus, making for greater efficiency, safety, and comfort to the wearer.

These improvements principally consist of a larger reducing-valve, thereby supplying the wearer with a greater amount of oxygen, also a larger cooler which considerably reduces the amount of heat given off, making it more comfortable to wear, and the circulation is now so

arranged as to put the whole of the air on positive pressure, instead of part positive and part negative, as in the former apparatus, thereby making the present type considerably more safe to use in a poisonous atmosphere. There has also been added a saliva-trap, and the mouth-breathing attachments have also been improved.

Emergency and Special Calls for the Apparatus.—On February 9th, 1915, a call was sent in from the Pacific Coast Coal Mines, South Wellington, where water had broken in the mine. The apparatus was soon on the scene of the accident, but on my arrival found it was not required.

On May 27th a call was received at this station from the Western Fuel Company's Reserve mine, where an explosion had occurred. The apparatus was immediately hurried to the scene of the accident, where it was used to good advantage.

On September 4th, by orders from the Department of Mines, I had the apparatus conveyed to the Vancouver-Nanaimo Coal Company's mine, East Wellington, for the purpose of being used to inspect a sealed-off fire area in the said mine, the undertaking being very satisfactorily carried out under the supervision of Inspector of Mines John Newton, the apparatus giving every satisfaction.

On October 9th an emergency call was received from the Canadian Collieries' Extension mine, where a fire had occurred in No. 2 slope. The call was immediately attended to, but fortunately on arrival I found the danger had been overcome, and the apparatus was not needed.

There has been a new garage built in connection with this station, which is a wooden structure 22 x 30 feet, with corrugated-iron roof and sides, and concrete floor and foundation.

There have also been two auto-cars supplied, one McLaughlan 36-horse-power, five-seated car for emergency work, and one Ford runabout for use of the Mine Inspectors. The above are all of the additions and improvements made to this station during the year.

FERNIE MINE-RESCUE STATION.

The following is the report of Charles O'Brien, Instructor at the Mine-rescue Station, Fernie, for the year ending December 31st, 1915:—

I commenced my duties here on February 6th, 1915, and during the month a quantity of supplies arrived at this station from the Draeger Oxygen Apparatus Company, Pittsburgh, amongst them being material for the conversion of the old type apparatus into the latest model of "positive-pressure" apparatus.

By the end of March the whole set of machines (with the exception of one, which was converted in April) were converted into the new type, and passed three very satisfactory tests in respect to the circulation.

During April I used each machine personally, and subjected each one to very severe tests. Every machine responded to these tests in a highly satisfactory manner. The by-pass is not yet added to the machines owing to the makers being unable to forward the new valves at present.

Invitations were extended to all persons who were previously trained in the use of the "negative" machine, with a view to giving them a supplemental course of instruction in the use of the "positive" machine.

The number of persons previously trained and their respective location was as follows: Coal Creek mines, 82; Hosmer mines, 15; Michel mines, 12; making a total of 109 trained men. Of this number there are thirty-seven men who have left Coal Creek, fifteen men have left Hosmer (two of whom are now located at Coal Creek), while twelve men are still at Michel.

The number of men trained in the use of the positive-pressure machine is forty-seven; these men are located at Coal Creek; the Michel men have not yet taken the supplemental course.

The following is an inventory of supplies at this station: Six 2-hour sets Draeger positive-pressure apparatus complete with shipping-trunks; two spare combination head-mouth pieces; five spare pairs goggles; four spare breathing-bags and tubes to match; three spare automats; six by-pass couplings and wrenches (not fitted to apparatus); six spare 2-hour oxygen cylinders; two ½-hour Draeger apparatus complete (not in use); five ½-hour Draeger oxygen cylinders (not in use); one pulmotor and inhalator; one spare oxygen cylinder for same; one spare face-mask; one head-ring for pulmotor; twenty-five ½-hour potash cartridges; 154 No. 1 potash cartridges; eight adaptors for use with No. 1 cartridges; 556 No. 2 potash cartridges; twenty-four oxygen storage-tanks, with about 1,900 cubic feet of oxygen; one high-pressure refilling-

pump, with supply of packing for same; one oxygen litter; twelve Ceag electric safety-lamps complete; seventeen spare accumulators; four spare "positive" electrodes; thirteen spare "negative" electrodes; eight spare accumulator-tops; one hydrometer; one chargometer; one volt-meter; one rectifier with spare pair of platinum contacts; one electro-magnet; fifty lead plugs; supply of sulphuric acid, vaseline, cotton batting, celluloid paper, etc.; one water-gauge; one canary; one life-line 200 feet long; six Draeger lamps; twelve accumulators (not in use); one box of tools.

FIRST-AID WORK.

The following is the report of Dudley Michell, Instructor in First-aid Work:—

I have the honour to submit herewith my report for the year ending December 31st, 1915, on the work of organizing "first-aid" centres and of training persons in the use of mine-rescue apparatus in the various coal and metalliferous mines of the Province.

During the year over 700 miners attended first-aid lectures at the various mines of the Province. The net results show that 301 men passed a final examination in first-aid work and were awarded various grades of certificates by the St. John Ambulance Association. The actual number of men finishing the course may be placed at 450. The difference between the total number of men attending the lectures and the number passing final examinations is due to various causes, some of which are: Failure to pass examinations, class completing lectures but not examined, class disbanded, and lack of interest; all of which causes have retarded the results. I regret to say that the results obtained from the metal-mines are not so good as were to be expected.

The following table shows the net results of the classes which passed examination:—

Mining Camp.	Number passing Examinations.	
	1915.	1914.
Michel	23	..
Fernie	63	..
Coal Creek	53	..
Merritt	17	14
Nanaimo	25	23
South Wellington	8	12
Ladysmith	20	36
Extension	9	..
Cumberland	3	..
Bevan	21	..
Rossland	31	30
Hedley	15	..
Vananda	13	..
Totals	301	115

In addition to the above, classes were taught at Corbin, *Sullivan* mine, Kimberley, and *Mother Lode* mine, Greenwood.

The largest number of men trained in one year, and at one company's mines, in first-aid work was at the mines of the Crow's Nest Pass Coal Company, where 139 men passed examinations. This number shows approximately one trained man for every fourteen persons employed above and below ground, which result is highly satisfactory for one year's undertaking.

All the classes were taught and examined by duly qualified medical practitioners, and were conducted in accordance with the prescribed rules of the St. John Ambulance Association.

At the *Le Roi* mine, Rossland, a very systematic method of training was adopted. The afternoon shift was divided into three sections; each section reported at the mine once a week, one hour before the shift commenced, and received practical instruction by a trained first-aid man on the work of bandaging, etc. There has also been established at this mine a safety department, a safety committee, and a safety engineer, whose duties are the systematic inspection of the mine and headworks with regard to safety, encouragement of first-aid instruction, and "safety-first" teachings in general.

Whilst the movement is looked upon by some as a mere innovation and a fad, I am pleased to say that much of the success of the year's work is due to the encouragement and assistance of the mine managers.

Mine-rescue Work.

During the year, in addition to the work carried on at the Government Mine-rescue Stations at Nanaimo and Fernie, examinations were held in mine-rescue work at Cumberland, Extension, Merritt, and Rossland, with a result that fifty-seven persons passed these examinations.

The training was carried out in the rescue-stations of the various mining companies by the company's instructors.

The table below gives the details of these examinations:—

Name of Company.	Mine.	No. of Men trained.	Instructor.
Canadian Collieries (Dunsmuir), Ltd	Cumberland.	29	C. Dando.
" "	Extension...	12	J. H. Cunningham and J. Delaney.
Middlesboro Collieries, Ltd	Merritt.....	10	Frank Bond.
Consolidated M. and S. Co. of Canada.....	Rossland....	6	R. B. Shellady.

During the coming year I look for an extension of mine-rescue training at points not *adjacent to the Government stations.*

Training has also been carried out at the *Phoenix* mine of the Granby Consolidated Mining, Smelting, and Power Company; the work of this class was incomplete at the end of 1915 and was carried over into the 1916 classes.

During the year the Consolidated Mining and Smelting Company has enlarged the building used as a smoke-room at the *Centre Star* group at Rossland. There are now twenty-two persons holding Government mine-rescue certificates and fifty holding first-aid certificates at Rossland.

Encouragement of Training.

In order to encourage the first-aid and safety-first movement there were held during 1915 seven different competitions and demonstrations. These were held at Fernie, Michel, and Coal Creek mines of the Crow's Nest Pass Coal Company; at Ladysmith and Bevan mines of the Canadian Collieries (Dunsmuir), Limited; at Rossland; and at Nanaimo.

At Fernie, on July 1st, a competition open for the Fernie, Michel, and Coal Creek employees of the Crow's Nest Pass Coal Company was arranged by General Manager W. R. Wilson and a joint committee. In this competition fifty-five men and ten boys took part, there being eleven teams of men and two of boys, representing the different collieries as follows: Michel, four teams of men; Fernie, four teams of men and one of boys; Coal Creek, three teams of men and one of boys. One hundred and forty dollars in prize-money was awarded, which was donated by W. R. Wilson; Hon. Wm. R. Ross, Minister of Lands; T. H. Williams, Inspector of Mines; and Drs. Bonnell and Corsan. After the competition all the members of the first-aid classes were the guests of Mr. and Mrs. W. R. Wilson at dinner, at which the prizes were distributed. A concert was given in the Miners' Theatre in the evening.

At Michel, on May 24th, there were five teams of five men each competing for two separate sets of gold medals. The results of the competition showed a high standard of efficiency.

At Coal Creek, on May 24th, a competition was held between three teams of five men each. Thirty-five dollars in prize-money was awarded.

At Bevan, on July 1st, a competition was held for a silver cup donated by General Manager J. R. Lockard, of the Canadian Collieries (Dunsmuir), Limited. Three teams took part in the competition.

At Rossland, on July 16th, a demonstration was given in mine-rescue and first-aid work by a trained team from the *Centre Star* mine. This demonstration was given for the benefit of the members of the Canadian Mining Institute attending the midsummer meeting at Rossland.

On November 13th, at Ladysmith, the first annual competition was held for the Frost-Cunningham cup, donated jointly by Dr. Frost, of Ladysmith, and J. H. Cunningham, manager, Canadian Collieries (Dunsmuir), Limited. Four teams of five men each entered the competition.

At Nanaimo, on May 24th, at the annual miners' picnic a first-aid contest was embodied in the day's sports.

All these competitions were well attended, and I hope that during this year, with the assistance of the Department, to extend this work into a larger field.

At the request of a committee representing the United States Bureau of Mines, the Washington Coal Operators' Association, and District No. 10, United Mine Workers of America, and through the courtesy of the Honourable the Minister of Mines, I acted as a judge on mine-rescue work at the second annual State-wide mine-rescue and first-aid competition held at Cle Elum, Washington, on July 31st. There were thirteen teams entered the first-aid competition and seven teams entered in the rescue contest. The first-aid work was of a very high standard.

In September I was again requested to act as a judge on mine-rescue work at the national first-aid and mine-rescue meet held at San Francisco on September 22nd to 24th under the auspices of the United States Bureau of Mines and the American Mine Safety Association. Again through the courtesy of the Minister of Mines I was permitted to attend these duties. The work of examining at this competition was more difficult than at Cle Elum; I being assigned to the judging of the preliminary and oral examination required before a team enters the "mine."

The standard of efficiency in both first-aid and mine-rescue work was very high. One day was set aside for an elimination contest, as not more than one team from any one State was allowed to enter the final competition. The Utah Fuel Company's (Utah) team headed the mine-rescue competition with a general average of 96 per cent.; the Homestake Mining Company's (South Dakota) team heading the first-aid competition with a general average of 99 per cent. In these competitions there were entered teams from as far east as West Virginia and as far north as Alaska. I regret to say that British Columbia was not represented by any teams.

In comparing the work carried on at both of the above competitions with the work carried on in our own Province, I do not notice much difference as to the general standard of efficiency, more especially from a practical standpoint. There is very little difference between the general principle of training of the American Red Cross Society as practised in the States and the St. John Ambulance Association as practised in British Columbia (because of its Empire uniformity), the American Red Cross Society's method of training being more direct than that of the St. John Ambulance Association.

I believe that, with equal enthusiasm, experience in competitions, etc., British Columbia first-aid and mine-rescue teams would compare favourably with the teams on the other side of the border. The need of general encouragement seems to be the most difficult obstacle.

The following charts show the method of discounting used by the United States Bureau of Mines and the British Columbia Department of Mines in connection with mine-rescue and first-aid work:—

First-aid Work.

	Discounts (Points).
1. Not doing the most important thing first	6
2. Failure of captain to command properly	1
3. Slowness in work and lack of attention	2
4. Failure to entirely cover the wound or being unable to give location of injury	4
5. Ineffective artificial respiration	11
6. Splint improperly applied or padded	6
7. Tight, loose, or improperly applied bandage	5
8. Insecure or granny knots	4
9. Unclean first-aid material	3
10. Failure to have on hand sufficient and proper material to complete a dressing	3
11. Lack of neatness	2
12. Awkward handling of patient	4
13. Assistance lent by patient	3
14. Tourniquet improperly applied	7

	Discounts (Points).
15. Failure to stop bleeding	8
16. Not treating shock	5
17. Failure to be aseptic	7
18. Improper treatment	12
19. Failure to temporarily control hæmorrhage previous to application of tourniquet	7
20. Special discounts as described below.	

Mine-rescue Work.

Preliminary—	
1. High pulse, for each member	3
2. Failure to remain in smoke-room, each member	4
3. Failure to name tests for apparatus, each test	5
4. Apparatus not properly adjusted to wearer	7
5. Loose joint or connection, each	12
6. Breathing-bags flat, each apparatus	8
While performing event—	
7. Failure to maintain 2-yard interval while advancing	2
8. Failure to test condition of roof	3
9. Failure to test for presence of gas	4
10. Failure of captain to give command	4
11. Failure of member of crew to obey command	5
12. For breathing external air intentionally	15
13. Failure to protect live men against mine gases	10
14. Failure to use life-line in smoke	8
15. Failure to complete event in time specified	6
16. Losing time or doing unnecessary things	4
17. Special discounts as described below.	

During my visits to competitions I have gathered much valuable information relative to the systematic teaching of the "safety-first" principles in general.

In concluding this report, I beg to say that there are at the present time in the Province 256 persons holding Government certificates of competency in mine-rescue work, 234 of whom are employed in the coal-mines and twenty-two in the metalliferous mines. The total number of persons holding first-aid certificates in the coal and metalliferous mines at the end of 1915 is estimated at 850.

During the year I have travelled 13,105 miles on official duties. Trusting the contents of this report will meet with your approval.

EXPLOSION AT B NORTH MINE, COAL CREEK.

REPORT BY THOMAS GRAHAM, CHIEF INSPECTOR OF MINES.

I have the honour to submit my report upon the explosion which occurred about 7 a.m. on Saturday, January 2nd, 1915, at B North mine of the Coal Creek Colliery, owned and operated by the Crow's Nest Pass Coal and Coke Company, Limited.

B North mine is one of the newer mines of this colliery, only having been opened about two years previous to the accident, and gave employment to about 150 men in the twenty-four hours; of these, sixty-five worked on the morning shift, sixty-five on the afternoon, and twenty on the night shift.

Coal was produced on the morning and afternoon shifts; the men on the third or night shift were engaged in brushing and repair-work.

The mine was ventilated by a temporary Murphy fan, belt-driven from an electric motor, and produced 37,500 cubic feet of air a minute. The fan was working on positive pressure, the haulage-tunnel being the return.

Two main return airways were being driven from the slope east of the main entrance, the work being conducted from the inside towards the surface; the permanent fan will be placed at one of these openings when they are completed.

The ventilation was continuous, and safety-lamps of the Wolf type were exclusively in use.

The seam is about 10 feet thick, but only the upper 5 feet was being worked; the coal is very friable and gives off gas very freely.

The report of the District Inspector of Mines, Evan Evans, made on December 19th, 1914, showed 37,500 cubic feet of air in circulation, with 1½ to 2 per cent. of gas in the return air.

The last day the mine worked was on the morning shift of Thursday, December 31st, 1914, and was not to work again until Monday morning, January 4th, 1915.

On Thursday, December 31st, Overman William McFegan instructed six men to come to work at 7 a.m. on Saturday, January 2nd, to carry out some repair-work. Four of these six men arrived at the mine about 7 a.m. on Saturday morning, and a few minutes afterwards an explosion occurred, no person being in the mine at the time.

The explosion wrecked the fan-drift, which was constructed of lumber; the overman's cabin, which stood in line of the drift; and carried away a part of the snow-shed covering the mouth of the Main tunnel, injuring all four of the men at the mine. One of these, Thos. France, was severely injured about the head and leg. John Gydosic and Frederick Gillet were slightly bruised, and John Pawlik was slightly burned on hands and face.

The company's officials, the Mine Inspectors, and the Government Mine-rescue Station at Fernie were at once notified of the explosion.

George O'Brien, Instructor and Superintendent of the Government Mine-rescue Station, immediately prepared his apparatus for shipment, but when about to leave he was further notified that no person had been in the mine, and the rescue apparatus would not be required; therefore the apparatus owned by the Mines Department was not taken to Coal Creek.

At a conference between W. R. Wilson, general manager of the Crow's Nest Pass Coal Company; Bernard Caufield, superintendent of the Coal Creek Colliery; Evan Evans and T. H. Williams, Inspectors of Mines, it was decided that, as no person was in the mine, the best policy would be to restore the fan-drift and operate the fan before conducting any exploratory work.

Here some one suggested that there might be fire in the mine, and Mr. Wilson and the Inspectors agreed to erect a stopping in each drift, leaving the mine stand for a few days. To this plan Superintendent Caufield objected, stating that he did not believe there was any fire in the mine, and therefore saw no reason why it should be stopped off.

He suggested that they put on the mine-rescue apparatus owned by the company and make an examination as far as the separation doors between the intake and return airways, situated about 250 feet from the mouth of the mine.

This was agreed to, and Bernard Caufield, superintendent; William McFegan, overman, B North mine; Robert Adamson, overman, No. 5 mine; and Evan Evans, Inspector of Mines, formed the party.

These men were equipped with Draeger oxygen apparatus, three sets being mouth-breathing type and one helmet type; two of the mouth-breathing machines were positive pressure and fitted with by-pass valves, the others being negative pressure. Inspector of Mines Evans wore the helmet machine, and brought up the rear of the party. At the first crosscut from the entrance the party was all together; on leaving this point Messrs. Caufield and McFegan forged ahead and crossed over a small cave, thus separating the party by some 50 or 60 feet. It would appear that Mr. Evans here became convinced that no good could be accomplished by the party, and was heard by those outside the mine calling on the other members of the party to return. This he did several times, and in the evidence given at the inquest, Mr. Adamson, who was ahead of Mr. Evans some 20 feet, states that he thought Mr. Evans was in trouble. He (Adamson) wishing to communicate with the two members of the party ahead, and failing to attract their attention, moved his mouth-piece to call to them, and immediately was overcome. Mr. Evans moved up to Adamson, and was found endeavouring to raise him, when Messrs. Caulfield and McFegan returned on Adamson's call; here the three men endeavoured to take Adamson outside and had launched the body forward three or four times to get it over a cave, when Mr. Caufield felt that he had overdone himself, and was on the point of sitting down to recover when he states he remembered the party was only a short distance from fresh air, and made a rush for the same,

but tripped over something and fell headlong into the rib, remaining there. Shortly after this Mr. McFegan states than Mr. Evans, who was attempting to raise Adamson, collapsed and fell on top of Adamson; McFegan then went outside and gave the alarm. The party were not over ten minutes in the mine, and the point where Adamson collapsed was only about 200 feet from the mine entrance.

The apparatus worn by the party was the only one available, and McFegan's apparatus was quickly donned by John Moore, who entered the mine to where Adamson and Evans were. In the meantime Mr. Caulfield had been recovered by persons without apparatus, and was soon restored by artificial respiration.

Mr. Moore, on reaching Evans and Adamson, states that Mr. Evans was moaning and that the helmet was partly off his face; this he fastened back on the face. He also removed the cotton plugs from Adamson's nostrils, and opening a spare cylinder of oxygen he placed this at Adamson's nostrils. Then further help was procured and the two unconscious men removed, Mr. Evans being first brought to the surface.

The pulmotors—of which there were two—were immediately put to use on both men; Mr. Adamson responded after one and one-half hours' work, but efforts on Mr. Evans failed, and after four hours' continuous labour the doctors pronounced life extinct.

The loss of Mr. Evans is to be deeply deplored; the circumstances surrounding the explosion, with no person in the mine, were very fortunate, and it is all the more to be regretted that this valuable life was lost in exploratory work that could well have been left until more favourable conditions existed.

There can be no doubt but what the unfortunate action of Mr. Adamson in removing his mouth-piece to communicate with the leaders of the party, and his immediate collapse, led up to the after-events. This action on Adamson's part was contrary to all instruction given in mine-rescue training, and if Mr. Adamson thought Mr. Evans in trouble, his duty was clearly to return to Evans's assistance; had this been done the unfortunate accident would have been averted.

Messrs. Caulfield and McFegan claim they had no difficulty with their apparatus, which were working well, until they overexerted themselves in trying to get Mr. Adamson out, and the fact that Mr. Evans advanced to Adamson after the latter fell and assisted in the efforts to get him out would indicate that Evans was all right up to this point.

A very careful examination of the apparatus worn by these men was made by George O'Brien, Instructor at the Government Mine-rescue station, Fernie; T. H. Williams, Inspector of Mines, Fernie; Robert Johnstone, electrician of the Crow's Nest Pass Coal Company at Coal Creek; and by the writer.

The breathing-bags, tubes, and regenerators were all in good condition. The reducing-valves were tested at high pressure, 150 atmospheres; medium pressure, 60 atmospheres; and low pressure, 30 atmospheres; the valves on the three mouth-breathing machines were found in excellent condition; the reducing-valve on the helmet machine worn by Mr. Evans was slightly below normal at the medium and low pressures, the water-gauge showing 8 centimetres at 150 atmospheres, 7½ centimetres at 60 atmospheres, and 7 centimetres at 30 atmospheres.

Mr. Adamson was a large man, weighing over 200 lb. Mr. Evans was also a large man, weighing 220 lb. An autopsy was held upon the body, and the heart was found in fair condition; there was considerable fat around the heart, which would materially affect its capacity for work.

Mr. Evans was the holder of a certificate of competency in mine-rescue work from the United States Bureau of Mines, and also from the British Columbia Mines Department. The other members of the party were holders of certificates issued by the British Columbia Mines Department.

The Coroner's jury returned a verdict of death through asphyxiation by inhaling gas during exploratory work following an explosion, expressing the opinion that, had the rules contained in the British Columbia mine-rescue course been followed, there might have been no mortality, and recommending that in all mine-rescue or exploratory work a relief crew be at all times kept in readiness at the mine-mouth, and that the rescue party keep within touching distance of each other; they finding no person or persons to blame.

The Coroner confined the inquiry to events connected only with the exploration party, in which Mr. Evans lost his life; therefore the cause of the explosion and events leading up to it was a matter for further investigation.

Owing to a gravel cave near the mouth of the mine, an examination of the mine was postponed until the cave was cleared up and ventilation restored.

The writer attended the inquest, which was held on January 11th, and returned to Victoria pending the restoration of ventilation.

On receipt of information that ventilation had been restored, the writer again visited the mine on February 10th and 11th.

The party consisted of W. R. Wilson, general manager of the Crow's Nest Pass Coal Company; Bernard Caufield, superintendent of the colliery; William McFegan, overman of the mine; George O'Brien, Superintendent of the Government Mine-rescue Station at Fernie; T. H. Williams, Inspector of Mines; and the writer.

The mine was found to have suffered very much from the force of the explosion; most of the timber was displaced, and a cap or following rock, varying from 4 to 8 feet in thickness, had fallen almost continuous throughout the mine.

The work of exploration was very slow and difficult, and only a very limited portion of the mine could be examined, the roadways being completely blocked by caves.

The main entrance to the mine was examined as far as the foot of No. 5 incline, the slopes to the right of the main opening to the intersection of the two new air-courses, and a portion of the counter-level back to the fan.

The lines of force displayed in these sections were clearly shown from the fan into the mine down the crosscuts between the counter and the main opening to the surface. The stoppings in the crosscuts up to No. 10 were all blown to the eastward from the counter-level to the Main level; these stoppings were constructed of wood blocks 3 feet in length, laid in fine mine refuse and plastered on the face.

The mine was generally wet, and little evidence of coking was found except near the foot of No. 5 incline, where, at an offset in a crosscut, considerable steel-grey coke was in evidence.

Two days was spent in the exploratory work, when permission was granted the management to begin recovery-work.

Later exploratory work, as the mine was cleaned up, added to the data already obtained; all lead to the belief that the point of ignition was at the fan, and, as no person was in the mine, that the ignition was from the outside.

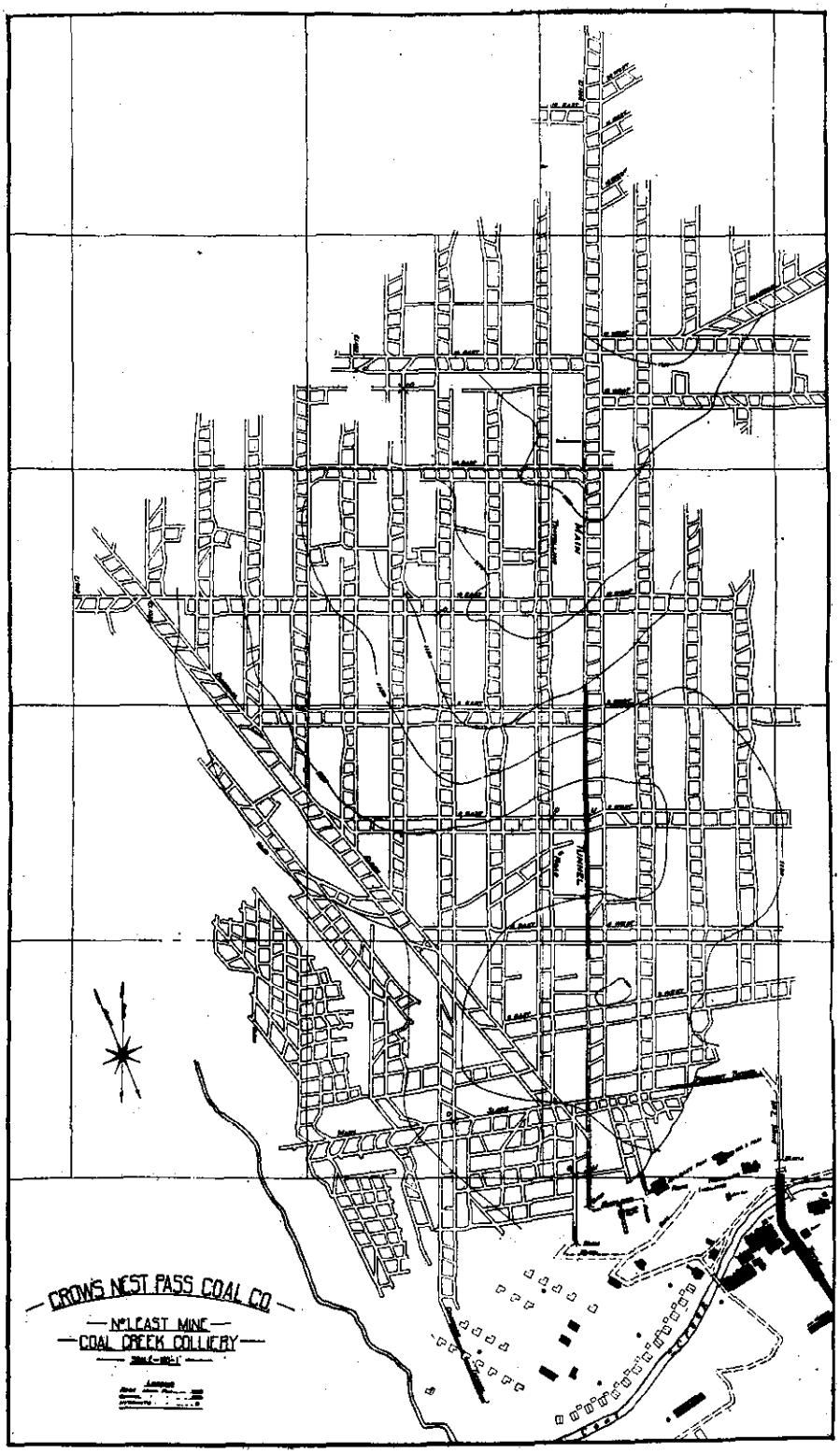
The overman's cabin, in which the firebosses' report-books were kept, was destroyed by the explosion; the books were never found, so that there was no written evidence to show when the mine had last been examined, but statements were freely made that the fan had not run from 3 p.m. on Thursday, December 31st, and that no examination of the mine had been made from the same time. The intake doors of the fan when working on the pressure system opened on to a platform between the fan and the motor-house, and directly opposite the door entering the motor-house. The fan and fan-drift was about 16 feet higher in elevation than the mouth of the Main tunnel.

A snow-shed covered the tracks from the mine entrance to the top of the surface incline running to the tipple; a door led into the snow-shed from the East side and led out of the shed directly opposite on the West side to a path leading to the fan and the overman and firebosses' cabin. This cabin was the lamp-station at the mine, and all lamps were retested here by the fireboss on shift before being taken into the mine.

Of the six men ordered to work on the morning of the explosion, John Gydosic arrived at the mine first; on arrival he noted that the fan was not running, and, as there had been a fresh fall of snow, he noted there were no foot-marks in the snow around the mine. Shortly afterwards Frederick Gillet, a driver, arrived with his horse. He had difficulty in inducing the animal into the snow-shed, but finally got him in and turned his head into the mine-mouth. Mr. Gydosic remarked to Gillet that the fan was not in operation and that there was no fireboss on hand, and that they had better go home. Gillet replied that he would grease his shoes, and went into the haulage-engine house for such purpose.

Then John Pawlik arrived and passed "good morning" and "New Year greetings" with Gydosic; this meeting was at the opening in the snow-shed leading to the fan.

Thomas France then arrived, and, according to Gydosic, similar greetings were passed between him and France. To this France's mind appears to be a blank, the explosion occurring just shortly after his arrival.


CROWS NEST PASS COAL CO.
No. 1 EAST MINE
COAL CREEK COLLIERY

Gydosic states that Pawlik passed out through the opening in the snow-shed towards the fan, and he does not remember seeing him again until after the explosion. All four men claim the explosion was first at the fan and then came out of the main entrance, destroying the snow-shed and throwing France and Gydosic up against the haulage-engine house, 40 feet away, where they were buried in the debris from the snow-shed. Gillet, who had been on the way from the haulage-house towards the mine-mouth, threw himself out the door in the shed on the East side. His injuries were very slight. France and Gydosic were severely bruised and cut, but were not burned.

Pawlik claimed to be sitting at the West exit from the shed, or on the side towards the fan, and that he had his dinner-bucket in his hand. When he recovered himself he stated he was on top of the snow-shed, and that his dinner-bucket was gone. Pawlik was slightly burned on the face and hands. The horse, which stood in the mouth of the Main tunnel, was killed. Later in the day, workmen while examining the fan building for repairs found a dinner-bucket on the platform between the inlet of the fam and the entrance to the motor-house. This bucket was of graniteware and the common two-deck type; the lower part contained liquids, the upper part had a fresh lunch in it. It was suggested by some one of those present that it belonged to France. John Moore, one of the firebosses, took the bucket to France's home, and was informed that it did not belong to France. Mr. Moore kept the bucket intact for a few days, when he was compelled to dispose of the contents.

Hearing of this bucket, the writer had it brought down to Fernie, and interviewed Pawlik, and after hearing his story and the loss of the bucket, produced the one found at the fan and Pawlik immediately recognized and claimed the bucket as his.

The location of this bucket at the fan entrance, and the statement of Pawlik that after the explosion he was on top of the snow-shed, leads to the conclusion that Pawlik was at the fan at the time of the explosion.

An inquiry into the explosion was opened, under the "Public Inquiries Act," at Fernie, B.C., on March 29th, 1915, John Stewart, of Ladysmith, B.C., acting as Commissioner.

During the progress of this inquiry the evidence deduced showed that the fan had not been running from 3 p.m. on Thursday, December 31st, and was still standing at the time of the explosion; that no examination of the mine had been made from 3 p.m. on December 31st up to the time of the explosion; and that no official of the mine was present at the mine at the time of the explosion.

The mine, as already stated, is a gaseous one; an analysis of a sample of mine-air taken from the main return air-course of this mine on November 23rd, 1915, showed 1.38 per cent. of methane; the quantity of air in circulation at the time was 18,000 cubic feet a minute; the methane given off a minute was therefore 248 cubic feet, or 357,120 cubic feet a day. The production of coal from the mine was 300 tons a day, so that the methane given off from the mine was 1,190 cubic feet to the ton of coal mined.

It will readily be seen that a stoppage of the ventilating apparatus would cause the mine-workings to rapidly fill with gas.

The conclusions are that the mine was full of gas on the morning of the explosion, and that John Pawlik, on arrival at the mine, went up to the fan to see if it was in operation, and that he either was smoking a cigarette at the time or struck a match, which came in contact with the gas at the fan-doors on the platform where his (Pawlik's) dinner-bucket was found.

Mr. Pawlik was not a witness at the inquiry, as he had left the country. Owing to his injuries he had not resumed work between the time of the explosion and the mid-month pay-day in January; he therefore received at that pay-day all moneys due him, and evidently left the country shortly afterwards.

The direct cause of the explosion was undoubtedly the ignition of a body of gas which had accumulated through the stoppage of the fan during the New Year holidays, and the failure to re-establish ventilation in the mine previous to the arrival of the workmen on the morning of January 2nd.

All coal-mine ventilation should be (excepting unavoidable breakdowns and repairs to machinery) continuous; intermittent ventilation is neither in keeping with good mining practice nor the spirit and intent of the "Coal-mines Regulation Act."

Especially is this true in gaseous mines, where a stoppage of the fan may mean an accumulation of large bodies of gas. The movement of any large accumulation of gas, no matter how carefully done, is always attended with more or less risk, and consequently should be avoided wherever possible.

In the case in question the mine was well known to be gaseous, and the complete stoppage of ventilation for a period of forty hours could only be attended with one result—namely, the filling of the entire mine with gas.

The responsibility for failure to maintain the ventilation was laid by the Commissioner upon the mine manager of the colliery and the overman at the mine.

Under the provisions of section 48 of the "Coal-mines Regulation Act," His Honour Judge Forin, of Nelson, was appointed a Commissioner to inquire into the competency of the manager and overman. The inquiry was held in Fernie on July 19th, 20th, and 21st, 1915; His Honour recommended the suspension of the certificates of the manager and overman for a period of one month.

A plan of the mine and sketch of the surface arrangement accompanies this report.

FATAL ACCIDENT AT SOUTH WELLINGTON COLLIERY.

REPORT BY THOMAS GRAHAM, CHIEF INSPECTOR OF MINES.

On the morning of February 9th, 1915, at 11.30 a.m., in No. 3 north level off No. 1 slope of the South Wellington Colliery, owned and operated by the Pacific Coast Coal Mines, Limited, there was a breaking-in of the accumulated water from the adjoining abandoned Southfield mine, which had formerly been operated by the New Vancouver Coal Company, and later abandoned by them, and now owned by the Western Fuel Company, their successors in title. As a result of this inflow of water nineteen men lost their lives by drowning. I attach a list of those killed.

At the time of the accident the writer was on his way to Fernie, which place he reached on the night of February 9th, where he received the news by telegram. Inspector Newton, of Nanaimo, was instructed to take charge of the situation, as the mine manager, Joseph Foy, was among those lost.

It was found that the water had risen in the No. 1 mine for a distance on the slope of 500 feet, equal to 25 feet vertical height above the entrance of No. 3 North level, so that it was evident that there was no hope of any one in the levels below remaining alive, and no rescue-work was possible, and that the bodies could not be recovered until the water was pumped out of the mine, to which end, and as soon as possible, all available pumps were set to work. Within a short time there were seven pumps at work, but with all these operating it was found that the water was only being lowered at the rate of 4 inches vertical a day, and that it would therefore be at least seventy-five days before No. 3 North level could be reached, when the water which had overflowed into the No. 2 slope and Old Alexandria mine at this point would be cut off, and thus the superficial area of water to be lowered in No. 1 slope would be reached and the work of unwatering greatly accelerated.

An inquest could not be held until some of the bodies had been recovered, and, as the work of unwatering was being pushed as rapidly as the available power would permit, nothing further could be done.

On my return to Victoria from Fernie, I found that Inspector Newton had forwarded to the Department a blue-print he had received from J. H. Tonkin, the general manager of the Pacific Coast Coal Mines, Limited. On comparing this print with the plan of the abandoned Southfield mine, it seemed evident that the company had been using on their most recently made mine-plans a direct copy of the adjoining Southfield mine (to a scale of 132 feet to the inch) instead of the enlarged plan to 100 feet to the inch, and that if a proper enlargement of the Southfield mine plan was applied to the plan of the Pacific Coast Coal Mines, Limited, the abandoned mine would be placed in such relation to the workings of the South Wellington mine as to show that it was probable that No. 3 North level had broken through into the Southfield workings, allowing the water to rush in, with the fatal results described.

I am speaking now of the impression made upon me at that time, and that this seemed a likely explanation of the cause of the disaster, but its accuracy was dependent upon a confirmation both of the old survey and plans of the Southfield mine, and also those of the recent workings of the South Wellington mine, the resurvey of which was impossible until the water was pumped out of the mines.

Whilst in my own mind I had little doubt as to the substantial accuracy of both these surveys and plans, and therefore of the explanation of the accident, I did not feel justified in making such charge public without the confirmation of a resurvey.

I, however, at once verbally informed the Minister of Mines of my belief, and also of the impossibility of proving my suspicions, and, under date of March 4th, 1915, I made an official report of these facts in a letter to the Honourable the Minister of Mines.

In view of the absence of actual proof of my suspicions, it was deemed advisable that such suspicions should not be made public until they were verified by actual surveys, to which end it was decided that as soon as practicable a competent mine surveyor would be appointed to make a resurvey of both properties, and an investigation held under the "Public Inquiries Act."

In the meantime some of the bodies were recovered and a Coroner's inquest was held at Nanaimo on May 17th, 1915, at the opening of which the writer announced the decision of the Department to have a survey made as soon as the mine was unwatered, and that an investigation would then be held under the "Public Inquiries Act." In view of this decision and the fact that my suspicions were still unconfirmed by survey, the writer did not deem the plans important to the Coroner's inquest.

D. B. Morkill, a British Columbia land surveyor, was on May 25th commissioned to make the survey and report direct to the Commissioner, Mr. Justice Murphy, who had been appointed to hold the inquiry.

Mr. Morkill's survey as shown by his plans submitted at the inquiry, proved that the plans of the Old Southfield mine and also the recent plans of the South Wellington mine were substantially correct, leaving no doubt that the accident was caused by the improper use of a direct copy of the Old Southfield plan, instead of an enlargement of such plan to a scale of 100 feet to the inch, in conjunction with the South Wellington Mine plans.

LOCATION OF MINE AND SURROUNDING PROPERTIES.

The accompanying sketch-plan shows the relative location of the South Wellington Colliery with respect to the surrounding properties, such location being directly connected with the cause of the accident, for the proper understanding of which an outline of the history and conditions of the various properties is essential.

The Southfield mine was originally the property of the old Vancouver Coal Mining and Land Company, Limited, an English company, all of whose holdings were subsequently acquired by the Western Fuel Company, the present owners, in the year 1903. The mine was first opened in 1883 by the old company and worked until the year 1893, when the mine was closed down, and a plan of the mine filed with the Department of Mines, after which time the mine gradually filled with water to within a few hundred feet of the surface, the mine thereby becoming inaccessible for examination. The mine surveys, in accordance with the English custom, were made with Gunters chain, and the mine-plans were platted to a scale of 2 chains, equal to 132 feet, to the inch.

The general custom on the American continent was to survey in feet; the customary scale for mine-plans was 100 feet to the inch, this scale being in use by all companies (with the advent of Western Fuel Company in 1903) operating in the Province, and became embodied in the Statutes as the legal scale in 1911.

It will be noted that the Southfield mine was abandoned and flooded long before the present owners came in possession, and that their knowledge of the property was confined to the plans on file in the office and left there by the old company, but, judging from inference, little doubt existed as to the accuracy of these plans, as whenever the surveys made under the management of the old company had been checked in the properties still working, they had been found to be substantially correct.

ALEXANDRIA MINE.

This was one of the properties owned and operated by the Wellington Colliery Company, or, as locally designated, the Dunsmuirs. It was opened in the year 1884 and was abandoned in 1901, and a plan on a scale of 100 feet to the inch filed with the Department of Mines; this mine also filled up with water.

According to the plans, the workings of this mine had been extended so as to materially encroach upon the seam lying under the surface of the property now held by the Pacific Coast Coal Mines, Limited, the owners of the South Wellington mine, as at that time the Dunsmuirs did not recognize the rights of the owners of the surface to the underlying coal.

SOUTH WELLINGTON.

The properties shown on sketch-plan herewith had been occupied as farms by certain individuals who held the surface rights originally as "squatters," but later legally recognized. These squatters claimed the coal underlying their lands, which was disputed by the Wellington Colliery Company, or Dunsmuir, interests, but by an Act of Parliament the squatters' rights to the coal was confirmed in 1904; in the meantime the coal remained untouched, except where encroached upon from the Alexandria mine, until after the abandonment of the adjoining properties, as already described.

In 1907 the squatters' areas were gathered together and acquired by interests which eventually became the Pacific Coast Coal Mines, Limited, which later in that year proceeded to open up the mine known as South Wellington.

It will be seen that this colliery at the outset was bounded on the north by the abandoned Southfield mine and on the south by the abandoned Alexandria mine, both of which were flooded: the outcrop was to the west along the line of the Esquimalt and Nanaimo Railway, and the coal dipped to the east.

At the outset the Pacific Coast Coal Mines, Limited, realized the care necessary to be taken in opening up a colliery lying between two flooded mines, and on January 30th, 1908, the then manager, George Wilkinson, applied to the Minister of Mines for copies of the plans on file with the Department of both the Alexandria and the Southfield mines. Under the provisions of the "Coal-mines Regulation Act" these plans could not be shown until ten years after abandonment without written permission of the owner; consequently the owners of both the Alexandria and the Southfield mines were asked for such permission.

Such permission was refused by the owners of the Alexandria mine—the Wellington Colliery Company—but the owners of the Southfield mine—the Western Fuel Company—through its general manager, T. R. Stockett, in reply to a letter from the Deputy Minister of Mines seeking information as to date of abandonment of the Southfield mine, replied as follows:—

WESTERN FUEL COMPANY,
NANAIMO, B.C., December 13th, 1907.

To the Deputy Minister of Mines,
Victoria, B.C.

DEAR SIR,—Referring to your request of yesterday as to the time of the abandonment of the Southfield mines, I beg to say that these mines were abandoned prior to the acquisition of the property by this company in 1903, and I am unable to lay my hand on information as to the exact date of their abandonment.

We have not the slightest objection to you showing the Southfield Mine map on file in your Department to parties that may be interested in the adjoining property; and, further, if the information that they wish is not clearly shown on the map you have, we will be glad to show them the original map here at any time.

Yours very truly,
THOMAS R. STOCKETT,
Manager.

A copy of Mr. Stockett's letter offering access to the original plans of the Southfield mine was forwarded to Mr. Wilkinson, manager of the South Wellington Coal Mines, Limited, under date of January 31st, 1908.

That this offer of Mr. Stockett's was taken advantage of by the South Wellington Coal Mines, Limited (now Pacific Coast Coal Mines, Limited), is within the personal knowledge of the writer, as he was then superintendent of the Western Fuel Company, and was the medium through which a strip of the blue-print of a tracing from the original Southfield plan was given to Mr. Wilkinson, the manager of the South Wellington Coal Mines, Limited.

The original Southfield plan showed clearly that it was to the scale of 132 feet to the inch.

The tracing of this original plan, from which the blue-print referred to was taken, was made by W. A. Owen while he was a draughtsman in the employ of the Western Fuel Company, and who at the time the strip of blue-print was given to Mr. Wilkinson was then the engineer of the South Wellington Coal Mines, Limited, and in charge of the surveys and plans of that company

It will be seen, therefore, that Mr. Owen, who was familiar with the plans of both companies, was fully aware that the Southfield plan was on a scale of 132 feet to the inch, while the South Wellington plans were on a scale of 100 feet to the inch. This is confirmed by the fact that Mr. Owen immediately transmuted the workings shown on the blue-print strip by the system of similar squares to the scale of 100 feet to the inch, to correspond with the scale in use on the plan of the South Wellington Coal Mines, Limited, and this enlarged work is shown on several tracings and blue-prints found in possession of the Pacific Coast Coal Mines, Limited, after the accident.

THE CONDITION OF THE MINE PREVIOUS TO THE ACCIDENT.

The condition of the mine previous to the accident is best shown by the reports of the District Inspector of Mines, John Newton.

Reports of examination of mine made on January 7th, and February 3rd, 1915, and posted at the mine-mouth, as required by subsection (4), section 77, of the "Coal-mines Regulation Act":—

NOTICE.

"COAL-MINES REGULATION ACT."

(Section 77.)

I hereby give notice that I have this day examined the underground workings of that part of the Pacific Coast Coal Mines Colliery known as South Wellington Nos. 1 and 2 mine, and find the following conditions to prevail therein:—

Part of mine examined: All parts of the above mines.
Ventilation: Fair.
Explosive gas: None found.
Roadways: Good.
Timbering: Fair.

General remarks: *No. 1 Mine.*—There was 12,750 cubic feet of air per minute passing into this mine for the use of forty-one men and four horses.

No. 2 Mine.—There was 12,000 cubic feet of air per minute passing into this mine for the use of thirty-four men and five horses.

I examined the rope inspector's report-book on all ropes and winches and found all reported in good condition.

Dated at Nanaimo, B.C., this 7th day of January, 1915.

(Signed.) JOHN NEWTON,
Inspector of Mines.

NOTICE.

"COAL-MINES REGULATION ACT."

(Section 77.)

I hereby give notice that I have this day examined the underground workings of that part of the Pacific Coast Coal Mines Colliery known as South Wellington Nos. 1 and 2 mine. and find the following conditions to prevail therein:—

Part of mine examined: All parts of the above mines.
Ventilation: Good.
Explosive gas: None.
Roadways: Good.
Timbering: Fair.

General remarks: *No. 2 Mine.*—There was 18,000 cubic feet of air per minute passing into this mine for the use of forty-two men and five horses.

No. 1 Mine.—There was 15,000 cubic feet of air per minute passing into this mine for the use of forty men and five horses.

I examined the rope inspector's report-book on all ropes and winches and found all reported in good condition.

Dated at Nanaimo, B.C., this 3rd day of February, 1915.

(Signed.) JOHN NEWTON,
Inspector of Mines.

Reports to Chief Inspector on examinations made on January 7th and February 3rd, 1915:—

OFFICE OF INSPECTOR OF MINES,
NANAIMO, B.C., January 7th, 1915.

PACIFIC COAST COAL MINES.

SOUTH WELLINGTON.

Certified Officials: J. Foy, Manager; L. Saville, Overman.

Firemen: J. Dykes, A. Kirkham, R. Rollison, D. Nellist, F. Hilley, R. Ranald, J. Neen.

No. 1 Mine.—There was 12,750 cubic feet of air per minute passing into this mine for the use of forty-one men and four horses, or an average of 240 cubic feet of air for each unit employed.

No. 2 Mine.—There was 12,000 cubic feet of air per minute passing into this mine for the use of thirty-four men and five horses, or an average of 244 cubic feet of air for each unit employed.

No explosive gas was found.

Timbering and roadways only fair.

I examined the rope inspector's report-book on all ropes and winches and found all reported in good condition.

OFFICE OF INSPECTOR OF MINES,
February 3rd, 1915.

PACIFIC COAST COAL MINES.

Certified Officials: Jos. Foy, Manager; L. Saville, Overman.

Firemen: J. Neen, D. Nellist, J. Dykes, F. Hilley, A. Kirkham, R. Rollison, J. Parrott.

No. 1 Mine.—There was 15,000 cubic feet of air per minute passing into this mine for the use of forty-two men and five horses, or an average of 262 cubic feet of air for each unit employed.

No. 2 Mine.—There was 18,000 cubic feet of air per minute passing into this mine for the use of forty-two men and five horses, or an average of 315 cubic feet of air for each unit employed.

No explosive gas was found.

Timbering and roadways good.

I examined the rope inspector's report-book on all ropes and winches and found all reported in good condition.

Report on accident, undated, but received on March 2nd, 1915:—

OFFICE OF INSPECTOR OF MINES,
NANAIMO, B.C.

Thomas Graham, Esq.,
Chief Inspector of Mines, Victoria, B.C.

DEAR SIR,—I have the honour to enclose herewith a report of a serious accident which occurred on February 9th, 1915, at 11.15 a.m., whereby nineteen men lost their lives, caused by the water breaking in from the Old Southfield mine, the property of the Western Fuel Company, into No. 3 North level, Diagonal slope, No. 1 mine, the property of the Pacific Coast Coal Mines Company, operating at South Wellington.

On February 9th, at 12 noon, I received a telephone message from N. Wright, the paymaster of the Pacific Coast Coal Mines, to hurry out at once, as the water had broke in from Old Southfield mine and entombed twenty-two men, including Joseph Foy, the manager of the mine.

I hurried out, and on arriving at the mine I immediately took charge of the operations. In company with J. C. McGregor and John Piper, I proceeded down No. 1 slope and found all avenues of escape for the unfortunate workmen had been cut off, as the water had risen 600 feet above No. 3 North level, where it broke in.

I then ordered pumps to be installed immediately, to pump the water out again. In the meantime, owing to the pressure being reduced from the Old Southfield mine, the bed of the creek which runs the overflow of water from what is known as Beck's lake had caved in, causing a serious delay in getting the pumps into operation, with having to divert the water from one creek into another channel.

We got one electric pump into operation at 6 p.m. on the date of the accident, a Cameron pump, obtained from the Western Fuel Company at 5 a.m. on February 10th.

Two more pumps were in operation on February 11th, and three more in operation by February 16th, making seven pumps in all.

I examined this mine on February 3rd, six days previous to the date of accident, and on visiting No. 3 North level, Diagonal slope, No. 1 mine, I remarked to Jos. Foy, the manager, who was accompanying me, that the places were very wet, and asked how far they were from the Old Southfield mine, and if he thought that the water was coming from that source. He answered: "No, it was coming from an old swamp on their own property, about 300 feet from their boundary-line." To prove this statement, when we got into the face of the level, close to the boundary pillar, he pointed to the roof, which was perfectly dry. He said: "Have no fear about Old Southfield, we are from 500 to 600 feet below any workings of Southfield mine; this is all solid coal—in fact, it is the only coal we have got, and we expect to have twenty or thirty places in this section before long, expecting to get all the coal below Southfield workings; but wait until we arrive at the surface and I will show you on the plan where we are as regards to Southfield."

When we arrived at the surface we went to the engineer's office and examined the plan of their present workings in No. 3 North level in relation to that of Southfield. Foy scaled the plan across, which showed a distance of 440 feet to the nearest place shown on the Southfield plan.

He then showed me what they proposed to do in this section; he was going to run No. 3 North level up along the side of the boundary pillar to connect with two slopes coming down from No. 4 West level at a point 200 feet below the Old Southfield line.

I then told him, when he reached a distance of 50 feet from his proposed line, he must have boreholes ahead, and flank holes to the side to make sure in case of any accident. He assured me that he would carry out these instructions to the letter, as he did not want to take any chances of losing any lives. He said it did not pay the company or anybody else to take chances, but at the present time there was nothing to be afraid of, as they were too far from the danger-line, but he would take all precautions necessary to guard against any danger from the Old Southfield workings.

I have, etc.,

(Signed.) JOHN NEWTON,
Inspector of Mines.

During the years 1911, 1912, 1913, and 1914 a great many changes took place in the official staff of the Pacific Coast Coal Mines. In the engineering department W. A. Owen resigned in July, 1911, and was succeeded by Mr. Rockwell, who acted until May, 1914, when he was succeeded by Edwin Wright, engineer in charge at the time of the accident. At the end of 1912 a reconstruction of the company took place, John Tonkin becoming the general manager, *vice* Mr. Michener. About January 1st, 1913, George Wilkinson, superintendent, resigned; a few days later Henry Devlin, mine manager, resigned to accept the position of Inspector of Mines. Mr. Devlin was succeeded as mine manager by Joseph Foy, Mr. Tonkin assuming the duties of superintendent until the arrival of R. Richardson Roaf, who acted as superintendent until September, 1914, when he resigned, and the dual duties of superintendent and mine manager were assumed by Joseph Foy.

In these many changes of officials it appears that the tracings containing the enlarged scale of the Southfield workings were replaced with new tracings on which the Southfield workings were not shown, and the old tracings were stored away in a drawer in the engineer's room.

In November, 1914, Mr. Tonkin, president of the Pacific Coast Coal Mines, Limited, called at the office of the writer and asked if there was any barrier-pillar law in the Province. On being informed that there was no such law, Mr. Tonkin stated that the present workings of the South Wellington mine were past (below) the easterly end of the workings of the Old Southfield mine, and, as the Southfield workings had been carried up to the boundary-line, his company had been compelled to leave all the barrier needed to protect his mine, and that he now proposed to go to boundary on that portion of the property lying east of the Southfield workings.

The writer replied that there was nothing in the "Coal-mines Regulation Act" to prevent him from going to the boundary, provided he left sufficient pillar between the eastward end of the Southfield workings and the place where he went across to the boundary. Mr. Tonkin said he would leave 250 feet pillar, and, as the vertical depth of the seam at any point in the mine did not exceed 200 feet, a 250-foot barrier was acceptable to the writer, it being 150 feet larger than that left at other portions along the boundary-line. Mr. Tonkin then said he would like to get a strip off the south end of the Southfield plan; the writer informed him that the Western Fuel Company had furnished Mr. Wilkinson with such a strip, and also offered access to the original plans, and that the information would be found in the mine office. A few days later Mr. Tonkin phoned to say that he had found the information.

It appears that the blue-print strip originally received from the Western Fuel Company, and which Mr. Owen transmuted, and also a tracing of entire Southfield and No. 5 shaft-workings of the Western Fuel Company, were found in the office of the Pacific Coast Coal Mines, Limited, at the mine. Where this tracing came from was not brought out in evidence at the inquiry, but there was nothing on it to show to what scale it was drawn, whereas the original plan in the possession of the Western Fuel Company and the tracings filed in the Mines Department showed the scale of 132 feet to the inch.

The blue-print strip obtained from the Western Fuel Company did not show the scale to which it was drawn, although the print from which it was cut showed this clearly; however, the scale was well known to Mr. Wilkinson and Mr. Owen, and it clearly showed over the entire surface, in pencil, the squares used by Mr. Owen in transmuting it to the 100-foot scale; but this was not the plan used by the officials to determine the location of the old working in relation to the South Wellington working, the tracing mentioned in the previous paragraph being used for this purpose. This tracing had a pencil-mark on it represented to be the centre of the

Esquimalt & Nanaimo Railway at the boundary-line between the two properties; this was taken as a common starting-point and the tracing and the South Wellington plan placed side by side along the boundary-line; the difference in the scales of the two plans made the Southfield workings appear 752 feet farther west, in relation to the South Wellington workings, than they actually were.

It would further appear that in the same drawer where the blue-print strip and the tracing mentioned were found there were several tracings and blue-prints of the mine showing the relative position of the workings on each side of the boundary in the enlarged scale, and therefore in true relation to each other.

It will thus be seen that the Pacific Coast Coal Mines, Limited, had in its office at the mine all the information, not only to show the correct position, but actually showing the correct position, of the workings in the old mine in relation to the old workings.

For reasons already stated, there was no reason to doubt the accuracy of the surveys of the Southfield mine, neither was there any reason to doubt the accuracy of the South Wellington plans; the surveys were being regularly made and added to the plans. The last survey of the place where the accident occurred had been made on January 28th, 1915, or six days previous to the time Mr. Foy, the mine manager, had shown Inspector of Mines Newton the relative position of the workings, as described by Mr. Newton in his report.

The belief that the plans were correct was proven to be well founded by the resurvey made by Mr. Morkill, Provincial land surveyor.

The daily supervision of the colliery was in the hands of Joseph Foy, who for five years had been in the service of the Pacific Coast Coal Mines, Limited, in official capacities. Mr. Foy was the registered holder of a first-class certificate of competency as a mine manager in British Columbia, and also held a similar grade of certificate in Great Britain.

In view of the information contained in the mine office, in tracings and blue-prints, worked to the proper scale and showing the correct relative position of the workings of both mines, it is difficult to understand how the information escaped the notice of the colliery staff, and the writer could not have foreseen that the information so contained in the office would be so overlooked or misapplied.

That such a mistake could be made suggests that, whilst mere legislation will not prevent accidents, there are a few points where amendments to the present safeguards against a recurrence of such an accident could be made. These may be cited as follows:—

(1.) Providing for the qualification of mine surveyors.

(2.) Providing for barrier pillars on all boundaries.

(3.) Deleting from section 70 of the present "Coal-mines regulation Act," *re* plans of abandoned mines filed with the Minister, the following words: "But no person, except an Inspector under this Act, shall be entitled, without the consent of the owners of the mine, to see such plan when so sent until after a lapse of ten years from the time of such abandonment"; and substitute the following: "Any owner or lessee operating a mine or property adjoining the abandoned mine, and the Inspector in charge of the district in which the abandoned mine is situated, shall, on application to the Minister, be furnished with a copy of the abandoned mine so deposited."

EXPLOSION AT RESERVE SHAFTS, NANAIMO, B.C.

REPORT BY THOMAS GRAHAM, CHIEF INSPECTOR OF MINES.

At 4 p.m. on Thursday, May 27th, 1915, an explosion occurred in the Reserve shafts owned and operated by the Western Fuel Company, Nanaimo, B.C., resulting in the death of twenty-two men.

At 5 p.m. the writer received a long-distance telephone call from Nanaimo stating that an explosion had occurred at the Reserve shafts; no particulars were then available, arrangements for transportation were immediately made, and the writer, accompanied by Dudley Michell, Instructor in First Aid, left by automobile for the scene of the disaster.

The Reserve shafts lie about four miles south-east of Nanaimo, on the delta of the Nanaimo river; the sinking operations were started in 1911, but, owing to labour troubles in 1913 and 1914, work was suspended for a year.

The field is opened by two rectangular vertical shafts, separated by 350 feet of natural strata; each shaft is 10 x 26½ feet inside the timbers, and is divided into three compartments, two for hoisting and one, 10 x 10 feet, for ventilation, this space being reserved for ventilation free from the baffling influence of the hoisting operations. The shafts are crib-timbered with 10- x 12-inch Douglas fir; the timbers were dressed on three sides and make a nice shaft.

No. 1 shaft was sunk to a depth of 1,068 feet and No. 2 shaft to a depth of 982 feet. Owing to the shafts going down in a disturbed area, with a very heavy pitch, the shaft-bottoms are located at a point 953.5 feet in No. 1 shaft and 948.5 feet in No. 2 shaft from the surface. The opening at both shaft-bottoms is made in the rock strata overlying the coal.

The surface equipment of the plant is very substantial and in every way modern, no expense being spared in providing the best equipment possible.

The underground connection between the two shafts was made in January, 1915, and from this time the mine was ventilated by a double-inlet Sirocco fan 90 inches outside diameter and 72 inches wide. The fan is rope-driven, ratio 3.5 to 1, at a speed of 275 R.P.M., and is expected to deliver 200,000 cubic feet of air a minute against a 4-inch water-gauge. At the time of the explosion the fan was running 75 R.P.M. and was producing 25,000 cubic feet of air a minute, the water-gauge being ¾ inch.

In the completed scheme No. 1 shaft will be used exclusively for hoisting coal. The cages are equipped with detaching-hooks, and the hoisting-engines with automatic overwinding devices.

The No. 2 shaft will be used for lowering and raising workmen and supplies; the ropes are fitted with detaching-hooks, the engines with automatic overwinding devices, and the cages with safety-catches, designed by A. S. Hamilton, master mechanic of the Western Fuel Company.

The underground work, as will be seen by the plan, is in its early development stage, the first coal being produced late in December, 1914; the work at the shaft-bottoms was being carried out simultaneously with the development of the mine, and the proposed arrangement for the future permanent work for ventilation is modern in every way.

The coal-seam opened by the shafts is that known as the Douglas, and the generally well-known vagaries of this seam, with its barren spots and pocket deposits, are here highly accentuated by a heavy disturbance running east and west, the centre of which seems to lie a few hundred feet to the south of the shafts. Here the seam is much disturbed and highly tilted, the pitch varying from 45 to 90 degrees, while to the north the seam appears to be rapidly approaching normal conditions, with the pitch varying from 15 to 20 degrees.

The seam is generally considered gaseous, and was expected to be so during the early development, and safety-lamps were exclusively used; the lamps used were the well-known Wolf lamps.

Several outbursts of gas have been reported during development; the largest of these occurred at the extreme bottom of No. 1 shaft, 1,068 feet in depth. Here a prospect was driven north and south from the shaft. The outbreak occurred in the opening to the south, which was driven a distance of 65 feet from the shaft, the pitch of the seam being 27 degrees.

This outburst occurred at 5.30 p.m. on June 27th, 1914, and was without much warning; it displaced from 25 to 30 tons of coal, the workmen narrowly escaping being buried in the coal. The gas released fouled the intake side of the shaft for a distance of 820 feet from the bottom; this condition was still reported at 11 p.m. of that night, or five hours and a half after the outbreak, and despite the operation of a small Sirocco fan with a capacity of 10,000 cubic feet a minute.

The firebosses' report-book of this date reads as follows: "June 27th, 1914, 11 p.m., No. 1 shaft. Outburst of gas in coal-place to rise, rush of coal, etc.; gas in shaft up to No. 1 pump lodgment; all work suspended." Signed Robert Broom, overman.

"June 28th, 1914, 6.30 a.m., No. 1 shaft. Outburst of gas, drained off, shaft clear, only a slight cap of gas in rise drift at face." Signed A. W. Baxter, fireboss.

Several smaller outbursts occurred at later dates in the crosscuts, the West heading, and the upper West counter-heading.

The work underground was all development, and consisted of two headings east and west; from the main West heading a slope was started to the north-west, and the general lay-out was to be the three-entry system; the lower West counter-heading, started off the slope, is designated on the plan as the Slope heading.

The upper counter-heading on the East side of the mine was still unconnected with the upper West counter, the delay in making this connection being due to the faulty nature of the ground, the heading being in solid rock. The fact that this connection was not completed at the time of the explosion was mainly responsible for the escape of the men working on the East side of the mine. A reference to the ventilation plan will show that the air-current, because of the lack of this connection, was carried down No. 1 crosscut west on to the main connection between Nos. 1 and 2 shafts; the after-damp from the West side was therefore short-circuited direct to the return No. 2 shaft, instead of passing around the East side workings. These main development places, east and west, with the necessary crosscuts, a rock tunnel from the East heading to connect with No. 2 shaft, and part of the permanent ventilating scheme, together with the widening of the shaft-bottoms, comprised all the work going on in the mine.

The operations were conducted on three 8-hour shifts—from 7 a.m. to 3 p.m., from 3 p.m. to 11 p.m., and from 11 p.m. to 7 a.m.

The overman's report showed that the maximum number of men employed in 24 hours was 118, and was in the 24 hours from 3 p.m. on Wednesday, May 26th, to 3 p.m. on Thursday, May 27th, distributed as follows: Morning, 53; afternoon, 36; night, 29.

The officials at the mine and their qualifications were as follows:—

Morning Shift.—George Wilkinson, mine manager, holder of a first-class certificate in British Columbia and in Alberta; William Roper, fireboss, holder of a second-class certificate in British Columbia; James Renny, shotlighter, holder of a second-class certificate in British Columbia.

Afternoon Shift.—Robert Broom, overman, holder of a first-class certificate in British Columbia and Great Britain; John Graham, shotlighter, holder of a third-class certificate in British Columbia.

Night Shift.—Andrew W. Baxter, fireboss, holder of a first-class certificate in British Columbia, Alberta, and Great Britain; Edward Wilkinson, shotlighter, holder of a third-class certificate in British Columbia.

Surface.—Arthur Wilson, foreman, holder of a first-class certificate in British Columbia and Alberta.

The accompanying barograph chart shows the atmospheric conditions for the week, May 24th to 31st, which was steady and slightly above normal, the reading at 4 p.m. on the day of the explosion being 30.15.

The firebosses' report-book shows gas reported in the lower West counter-heading on May 19th, 20th, 21st, and 22nd; the mine is reported clear of gas on May 23rd, 24th, 25th, 26th, and 27th; the evidence of officials at the inquest being that, whenever a "gas-cap" was shown on the flame of a safety-lamp, it was reported as gas.

A sample of the return air from West side was taken on May 8th, 1915, by Mine Inspector John Newton and sent to the Mines Department at Ottawa for analysis. This sample showed 0.75 per cent. of methane in the air; a copy of the complete returns of analysis accompanies this report.

VENTILATION.

The fan is situated at No. 2 shaft, and was exhausting; No. 1 shaft being the intake and No. 2 shaft the return, or, to be more specific, only the 10 x 10 section of this shaft was being used for the return air; the two compartments to be used for hoisting were separated from the third compartment by a board brattice situated at the shaft-bottom (*see* ventilation plan).

This left the two hoisting compartments open to atmospheric pressure, but no intake air entered the mine through No. 2 shaft; this arrangement being temporary, pending the completion of the surface plant and the widening and permanent timbering of the shaft-bottom.

The ventilation of the mine was good; the current was continuous, the development not having reached that stage where a split could be introduced; the quantity of air reported by the officials was 25,000 cubic feet a minute. Inspector John Newton, during his visit to the mine on May 8th, reported 23,600 cubic feet a minute in circulation.

Measurements of the volume of air made by the writer during the recovery-work showed 18,200 cubic feet on the West heading, 13,260 feet of which was going down the slope off the West heading, the total quantity in the main return being 21,175 cubic feet. The mine throughout was moist, hygrometer reading showing almost complete saturation.

The roadways were timbered throughout with framed sets of Douglas fir, diameter of timber from 10 to 14 inches, the maximum distance between sets being 4 feet centre to centre.

The explosion occurred about 4 p.m. on the afternoon of May 27th. William Wilson, hoisting engineer at No. 1 shaft, states that when the blast reached the surface he noted the time as 3.57 p.m. The chart on the air-compressor gauge, a copy of which accompanies this report, shows the drop in pressure due to break in air-pipe occurred at 4 p.m.

Evidence of the explosion reached the mouth of both shafts, but no damage was done on the surface at either opening. The explosion-doors at No. 2 shaft showed that they had been slightly eased from their seat, but they were not blown open. The doors on the air-lock entering the fan showed they had been blown open, as a small hasp for a padlock on the outer door was pulled off; the inner door on the air-lock remained open, but the outer door had fallen closed again.

Arthur Wilson, outside foreman, who was at the mine office when the explosion occurred, proceeded at once to the fan, and found that the engineer from No. 2 shaft had preceded him. They found the fan operating as usual, with no damage done; the ventilation was therefore maintained between No. 1 and No. 2 shafts, the intake and upcasts respectively, whilst the East and West headings were short-circuited by the destruction of the door and brattice in the mine.

Telephonic communication with Nanaimo brought an early response from Superintendent John Hunt, of the Western Fuel Company; John Newton, Inspector of Mines; and J. D. Stewart, Instructor at the Government Mine-rescue Station, later followed by George Wilkinson, the mine manager, who at the time of the explosion was in Nanaimo.

William Roper, fireboss on the morning shift, and who was still on the premises at the time of the explosion, descended No. 1 shaft in response to one stroke of a pull-bell from the bottom, but owing to a break in the cage-guides was unable to reach the bottom of the shaft; he returned to the surface for tools, when he was informed that seven men from the East side of the mine had reached the surface through No. 2 shaft.

This party was headed by William Thompson, who showed great coolness and much courage in the efforts to get out, and again with J. T. Neen in an endeavour to reach some men who had remained behind.

Mr. Thompson reported that the party consisted of nine men, all from the East side, who after the explosion had gathered at the junction of the East main heading and the tunnel leading to No. 2 shaft, a distance of 225 feet from the shaft. Thompson proposed trying to reach No. 2 shaft through the after-damp and smoke, which they described as being quite thick. John Graham, shotlighter, another of the party, suggested returning into a rock tunnel being driven off the East main level at a point 400 feet farther to the east to connect with No. 2 shaft, and then barricade themselves in. The majority favoured trying to reach the shaft, seven of whom, led by Thompson, did reach the shaft. Graham and the other man returned to the rock tunnel above mentioned, and on the way to this met two more men who accompanied them.

When the surface was reached, Mr. Thompson, believing that all of the party had followed him, was convinced that two had been overcome in the attempt to reach the shaft-bottom, and, accompanied by J. T. Neen, returned to the bottom of No. 2 shaft, and after several attempts to reach the East heading, Thompson finally accomplished it, and proceeded to the rock tunnel. On the way he met the four men in the Graham party on the way out, as they found the air rapidly improving, and they reached the surface with little difficulty.

An exploration party then descended No. 2 shaft with the object of reaching No. 1 shaft. On their descending the shaft they found three more men approaching from No. 1 shaft; these were Mazs and Clark, assisting a seriously injured man named Fiorette, whom they found on the level between the two shafts.

Mazs and Clark were the men who had given the bell signal at No. 1 shaft. Their working-place was No. 1 crosscut off the East heading; they had made their way to No. 1 shaft-bottom with much difficulty, but here found the ventilation good; the electric bell and telephone connections with the surface were destroyed. The end of a pull-bell wire was seen hanging in the shaft, which broke at a point beyond their reach on the first pull, but had rung the bell on the surface. Being unable to give further signals, they returned to the intersection of the shaft tunnel and the West heading, and, hearing the groaning of an injured person, they found Fiorette and assisted him to the fresh air. Mazs and Clark now attempted to enter the West

heading in search of Mazs' son, who worked in this section; this they were unable to do. They then proceeded to No. 2 shaft, taking Fiorette with them. This made fourteen men, out of the thirty-six who went on shift, who reached the surface alive.

A party equipped with mine-rescue apparatus now explored the West side and satisfied themselves that the men on this side of the mine were dead.

The work of repairing No. 1 shaft and the restoration of the ventilation in the West side was proceeded with, and the bodies of all the victims were recovered by noon of the following day, May 28th, excepting three who were supposed to be in the upper West heading, in by No. 5 crosscut. This section was found to be very badly caved, and the last of the three bodies was not recovered until June 5th.

The coal-chute in No. 5 crosscut was completely demolished, and, as the material caved in the upper counter had to be taken down this crosscut, it was found necessary to rebuild the chute. This work was proceeded with at once, and was completed on the morning of the 29th instant.

On the suggestion of the writer, the Mines Department had appointed James Ashworth, mining engineer, of Vancouver, under section 73 of the "Coal-mines Regulation Act," to make a report upon the disaster. Mr. Ashworth was expected in Nanaimo on the night of the 28th, and at the request of the writer the caved portion of the West counter-heading was left undisturbed until after Mr. Ashworth's arrival. Care had also been taken to leave everything undisturbed throughout the mine, excepting what was necessary to restore the ventilation and recover the bodies. The points where the bodies were found, with position, were all carefully marked; also all safety-lamps were hung up at points where found.

The examination of the mine was commenced on the morning of May 29th. The party consisted of James Ashworth, M.E.; Jos. G. S. Hudson, M.E., of Ottawa, representing the Mines Department of the Dominion of Canada; John Hunt, superintendent of the Western Fuel Company; George Wilkinson, the mine manager; Henry Meikle and Arthur Challoner, representing the employees; John Newton and Henry Devlin, Inspectors of Mines; and the writer. The party visited the mine every day until June 5th.

Mr. Ashworth was first shown the cave in the upper West counter-heading, after which the work of cleaning up the cave was proceeded with.

An examination of the East side of the mine showed little evidence of any effect from the explosion; this, in conjunction with the fact that fourteen out of the seventeen men employed on this side escaped, was considered proof that the explosion did not have its origin here, and must be looked for on the west side.

Considerable force was shown at No. 1 shaft-bottom; a trip of loaded cars on one track and a trip of empty cars upon the other track were telescoped and upended, knocking out several sets of timber. Several empty cars were blown clear across the shaft, carrying out the cage-guides, the telephone and signal-bell connections, and breaking the compressed-air pipe-line.

The door and check curtain, together with the firebosses' cabin, located on the Main level between No. 1 and No. 2 shafts, and just south of the intersection of the main West heading, were all carried out, as also were the doors between the main West heading and the upper West heading, which were located west of No. 1 crosscut.

All the stoppings between the main and the upper West headings, the greater part of the brattice on the West side, and the coal-chute in No. 5 crosscut were blown out. The boards from the brattice and chute were torn into short fragments and littered all over.

Owing to the excellent system of timbering in use, comparatively few sets of timber were blown out on the main roadways.

The lines of force were from the face of the upper West counter-heading and down crosscuts Nos. 5, 4, 3, and 2 to the main West heading and the shafts. There was also evidence of a distinct force coming up the slope off the main West heading and towards the shaft, as shown by broken brattice-boards piled up in a recess in upper rib of the Main heading and which contained the hoist for the slope.

The stoppings in crosscuts Nos. 2, 3, and 4 and the coal-chute in No. 5 crosscut were all blown on to the main West heading, in by No. 5 crosscut; on the main West heading the brattice to near No. 6 crosscut was down, and from this point to the face of the heading the brattice and also the coal-chute and air-box in No. 6 crosscut were in no way disturbed.

In the slope and lower counter-heading the brattice was all down, and a few sets of timber were displaced at three points, accompanied by small falls of roof-rock.

The first of these falls was on the slope just above the intersection of the lower West counter-heading with the slope. Here four sets of timber were displaced and as many cars of rock fell. It may be here stated that, when the party with the mine-rescue apparatus first explored the slope, the displacement of the timber was noted, but no rock had fallen at that time.

The second small cave was at the mouth of the lower counter-heading, where two sets of timber were out and about two cars of rock had fallen. The third instance was about 30 feet from the face of the lower counter-heading; here four sets were displaced and about three or four cars of rock was down.

CONDITIONS OF WORKING-PLACES AS FOUND ON WEST SIDE SLOPE AND LOWER COUNTER-HEADING.

The general condition of the seam was here nearly normal, the pitch being between 15 and 20 degrees; the coal was hard and firm, requiring the use of explosives to mine it.

The face of the slope (*see* sketch accompanying report) showed one hole drilled towards the centre of the place. A second hole was being drilled on the left or west rib; no shots had been fired; the face was as left by the previous shift, apart from the two holes found drilled.

The bodies of the two miners (Nos. 6 and 7) were found up the slope 60 and 90 feet respectively from the face. Their lamps were found at the face, one on each side, and were hanging on a piece of lagging nailed across the legs of the last two sets. It is therefore assumed that these men were at the face at the time the accident occurred, and afterwards had travelled to the place where their bodies were found, and were there overcome with the after-damp. No. 6 was slightly burned on the hands, and No. 7 slightly burned on the lower part of the legs. A sample of blood taken from these bodies was sent to G. S. Eldridge & Co., analytical chemists, Vancouver, where a spectroscopic examination showed that both samples contained marked amounts of carbon monoxide (CO).

The body of J. L. Mazs (No. 8) was found at the upper end of a car shown at the face of the slope (*see* plan). The body was lying on its back, feet under the car, and was badly burned. Mazs was a rope-rider and the car at the face was full and attached to the rope. His lamp was found about 30 feet farther up the slope than where the body was found, and directly opposite the end of the signal-wire. It is assumed from the position of the lamp that Mazs was around the end of the signal-wire at the time of the accident, and the body was blown down the slope to where it was found. The glass in this safety-lamp was broken and completely gone.

THE LOWER COUNTER-HEADING.

As previously stated, two small caves were found on this heading. About 30 feet in the heading the body of Fredk. Crew (No. 9) was found. The body was lying face down, head towards the slope, legs slightly drawn up. His safety-lamp was found a few feet in front of him. The body was burned, teeth blown out, lower jaw fractured, a punctured wound on neck and right side, lower right leg and left wrist broken. (NOTE.—"Teeth blown out" consisted of a plate or false teeth.)

Crew's body was found at the place on the level where he and his partner kept their explosives. On turning the body over, a piece of ½-inch hemp rope with a piece of guy-rope wire attached and used for slinging timber behind the cars on the slope, and a small piece of paraffin-dipped paper, part of a "carton" in which the explosives are put up, was found wrapped around the body and legs. The presence of this piece of paper caused some one to remark that possibly he had been putting up a shot and some powder exploded.

The writer, being present when the body was found, pinned a note to the clothing requesting that the doctor make a special examination of this body; and then a careful examination of the locality was made, and failed to disclose any signs of disruptive force due to the explosion of powder on detonators.

In a small wooden box opposite the body there was one 4-lb. carton of Monbel, unopened, and six electric detonators. These had been issued to Crew on going on shift. There were also nine loose 4-oz. sticks of Monobel, two of which had detonators in them. The injuries on Crew's body did not indicate that they had been caused by an explosion of powder or detonator.

On a cave about 30 feet from the face the body of John Leach (No. 10), and Crew's partner, was found. The body was only slightly burned on face and hands.

The face of this heading showed two holes drilled, one on the upper rib and one on the lower rib. Neither of these holes had been fired. The men who had worked on the previous shift report the place in the same condition as when they left it, except for the two holes drilled, and that a car of loose coal had been loaded; the weighman's record shows that a car of coal bearing the check number of Crew and Leach was among the cars hoisted from the shaft during the recovery-work.

The face showed evidence of heat, as it was covered with a fine soot, and a slight caking of the dust on the end of an empty car which stood at the face. Leach's lamp was found hanging on the lower rib leg of the last set of timber.

The empty car had one piece of a set of timber in it, and as the rope with wire attachment, by which the timber was fastened to the car, was found wrapped around Crew's body, the writer assumes that Crew was on the way out to the slope to give the rope-rider the attachment to bring down another timber, when the explosion occurred, and that his body being opposite the place where their explosives were stored was a mere coincidence.

The nature of the injuries, as already stated, had no resemblance to those made by an explosion of powder, and could easily be accounted for where so much debris had been in motion through the heading. Dr. Ingham expressed the opinion that the puncture wounds were likely due to pieces of brattice-boards.

MAIN WEST HEADING.

The body of John Davis (No. 11), bratticeman, was found between Nos. 4 and 5 crosscuts, body lying face down, head towards shaft, with hands outstretched, and badly burned. His lamp was found 30 feet inby the body; his saw and hatchet were found at the face of the Main heading, and it is assumed he was on the way out to the shaft-bottom after a supply of brattice-boards.

Thirty feet outby No. 6 crosscut the body of a horse was found, and behind the horse the body of Lewis Shaw (No. 12), driver, badly burned and hair singed off head.

Grouped around the bottom of No. 6 chute were found the bodies of Edmund Beck (No. 13), James McEwen (No. 14), miner, and William McEwen (No. 15), miner, slightly burned; all had died from after-damp.

Just inby No. 6 crosscut and at the side of an empty car the body of Robert Broom (No. 16), mine overman, was found. The battery used in shot-firing was found beside his body; the cable was not attached to the battery; hands and face were slightly burned; he died from after-damp.

At the face of the heading the bodies of Nick Selek (No. 17), miner, and Frederick Leschek (No. 18), miner, were found slightly burned; both died from after-damp.

A safety-lamp was found at the face of the heading. This proved to be the lamp of James McEwen, who, with his brother William, were the miners working in this heading. William McEwen's lamp was found near his body at No. 6 crosscut. The lamps of Nick Selek and Fred Leschek were found near the body of James McEwen at the foot of No. 6 crosscut, and from these facts it is assumed that Selek and Leschek, who were the miners in No. 6 crosscut, made their way from the foot of the crosscut to the face of the heading after the explosion, and at least one of the McEwen brothers moved from the face of the heading to the foot of No. 6 crosscut.

In the face of the heading there were two holes drilled, one on each rib and both in rock. Neither of these holes had been fired; a tamping-stick was in the hole on the lower rib, and some tamping cartridges of clay lay near the mouth of the hole. There was also an empty car at the face. It was learned from the men on the previous shift that no shots had been fired in this place; one of the holes had been drilled by them, the second one by the McEwen brothers.

No. 6 CROSSCUT.

This crosscut was not connected with the upper counter-heading; it was driven to the full pitch, which here varied from 45 degrees where it left the heading to 60 degrees at the face, which was 65 feet from the heading.

In the crosscut there was a coal-chute, an air-box, and a ladder. The crosscut was ventilated through the air-box, which was connected to a small Sirocco fan of the self-contained type, with small upright engine direct-connected to the fan, the power supplied being compressed air.

A loaded car stood in the switch under the coal-chute; stretched up the chute was the shot-firing cable carried by the shotlighter, who in this case was Robert Broom, overman, and whose body was found on the heading just inby the crosscut, and beside it the battery. The cable as laid up the crosscut would not reach to where the battery was found.

An examination of this crosscut showed that a shot had been fired; the shot in question was a short hole, possibly 3 feet in depth, along the upper right-hand rib, and was evidently intended to square up the rib for the end of a set of timber. The hole had been well placed, free and on the clear, and had done its work well. The work required to be done was small and could not have taken more than a 4-oz. stick of powder. There was nothing in the place to indicate any disturbance such as follows a blown-out or windy shot; the coal-chute, ladder, and air-box and the curtain through the brattice at the foot of the chute were all undisturbed.

There was, however, evidence of heat, as the boards nailed across the crosscut from leg to leg to support the coal-chute and air-box all showed caked dust on the sides facing a person ascending the crosscut; the face showed signs of flame having been present.

Jacob Punack, a miner who worked in this place on the morning shift, and William Roper, fireboss on the same shift, stated that there was a small run of coal from the face on the morning of the explosion, a few cars of coal having been displaced and a small quantity of gas given off.

THE UPPER WEST COUNTER-HEADING.

This was entered from the main West heading by No. 5 crosscut; the counter-heading extended beyond the top of No. 5 crosscut for a distance of 95 feet, the face being nearly opposite No. 6 crosscut.

At the foot of the crosscut there was an empty car, and against the canch or bench, to permit the car to get under the chute, the body of Thomas Harker (No. 19), miner, was found in a sitting position; his lamp was with the body; a car check or tally was in his hand, as if he had been about to place the check on the empty car. The body was very severely burned all over, the undertaker reporting it as the worst-burned body taken from the mine. The coal-chute was completely demolished and blown on to the main West heading; the upper counter was heavily caved from 20 feet inby the top of No. 5 crosscut to the face.

The work of cleaning up this cave was started on the morning of May 29th, but, owing to difficulties in handling material and the erection of timber, the movement of the hanging-wall, and the presence of gas, the progress was very slow, and, although conducted continuously, it was late on June 5th before the face was reached and the last body recovered.

The bodies here recovered were Thomas Bewley (No. 20), miner, and partner to Harker, found at the foot of No. 5 crosscut. This body was found 20 feet from the face; the body was badly burned, the left side of face from eye to chin was crushed, the lower jaw was fractured on left side; death was caused by burns and injuries.

Paul Vittar (No. 21) and Thomas Sutter (No. 22), timbermen, were found at the face, Vittar on the lower side and Sutter on the upper side. These two men had been sent to the upper West counter to assist in taking up and placing a set of timber, after which they were to assist in similar work in No. 6 crosscut. They had evidently just arrived at the face with one piece of the set, as the timber lay in the centre of the track paralleling the rails—Sutter at the front and Vittar at the back of the timber; Vittar still grasped the rope that was attached to the timber.

Bewley's lamp was in his hand, Vittar's was close beside the body. The inner gauze of this lamp showed that gas had burned in the lamp; both lamps were intact and in good shape. Sutter's lamp was found attached to his belt, and was badly damaged; the shield was broken, the dent in this extending into the gauzes, which were also dented but not broken. A piece of brattice-cloth was carried into this dent; this cloth must have been wrapped around the board or timber, which caused the damage to the shield; the glass was cracked and two small pieces of the glass had fallen inside the lamp. One of these was a small triangular piece, the sides being about ½ inch in length; the other piece extended the full height of the glass from fount to gauze-rings, and was about ¼ inch wide.

The coal-seam here was pitching 75 degrees and was from 12 to 14 feet thick. The coal was very soft, heavily slickensided, and much disturbed by the uptilting of the seam. There was no evidence of any shot-holes at the face. The evidence of the men working on the other

shifts was to the effect that the coal was loose and did not require shooting, and that the timber and brattice was well up to the face.

Many sets of timber had here been displaced, and 231 tons of coal was taken from this cave. When the face was reached it was a mass of loose "drummy" coal, from which tons of coal could have been knocked off with a board.

On June 2nd, during the time this cave was being cleaned up, a sample of gas was taken by Inspector of Mines John Newton, by reaching into the mixture beyond the end of the brattice. The sample was sent to the Mines Department at Ottawa; the analysis showed as follows: Chemical analysis: Carbon dioxide, 0.49 per cent.; oxygen, 3.07 per cent.; methane, 41.03 per cent.; and nitrogen, 55.41 per cent. Technical analysis: Air, 14.67 per cent.; fire-damp, 41.03 per cent.; and black-damp, 44.30 per cent.

A sample of coal from the face of the upper and lower West headings and thirty-three samples of dust were collected; the dust samples were jointly examined through the microscope by Mr. Ashworth, Mr. Hudson, and the writer, and nineteen of the dust samples were mutually selected to be sent with the coal samples to the Provincial Mineralogist for analysis, and comparison as to ratio between volatile combustible matter and fixed carbon contents. Appended to this report is a copy of the returns received from the Provincial Mineralogist.

Samples 9043 and 9064 are the samples of normal coal, ratio of F.C. to V.C.M. being 1.46 and 1.40.

It will be noted that in the samples submitted the greatest alteration is shown in No. 9044, the ratio being 2.70. This sample was taken from No. 2 crosscut between the main and upper West headings, and was taken off a piece of 2- x 4-inch timber which formed the framework of a tool-cabin in No. 2 crosscut. This cabin was blown on to the main West heading, and the sample was collected off the side of the timber facing the upper counter-heading.

The dust samples next in order of alteration are samples No. 9059, ratio 2.68, and No. 9058, ratio 2.33, both collected in No. 6 crosscut; No. 9059 from the bottom and No. 9058 from about 20 feet from the face of the crosscut. These samples were taken off the face of a brattice-board nailed across the crosscut from leg to leg of the timber sets as supports for the coal-chute and air-box, and from the side of the board facing a person ascending the crosscut.

Samples Nos. 9056 and 9057 were taken around where the shot was fired in this crosscut and showed no alteration of constituent parts.

Sample No. 9049, ratio 2.29, was next in order, and was collected on the upper West counter-heading between No. 4 and 5 crosscuts.

Sample No. 9046, ratio 2.20, was collected from a piece of lagging at the intersection of the lower counter-heading and the slope.

Sample No. 9047, ratio 1.81, was collected in upper West counter-heading at No. 3 crosscut.

Owing to the heavy cave inby the top of No. 5 crosscut in the upper counter-heading, samples of any value were unobtainable.

It will be noted that, apart from one sample, No. 9046, taken in the slope, the greatest alteration of the constituent parts of the dust samples collected lie in line of a force and flame coming from the upper West counter-heading face; following that heading and down the crosscuts 5, 4, 3, and 2 to the main West heading and the shafts, the evidences of flame in No. 6 crosscut, being the expansion from the foot of No. 5 crosscut towards the face of the Main heading, and the favourable conditions presented in No. 6 crosscut, which was a cul-de-sac going to the pitch, here 45 to 60 degrees, for the prolongation of any flame present.

CONCLUSIONS.

After a very careful examination of the mine and a study of the observed phenomena, the writer is of the opinion that the point of origin of the explosion was the face of the upper West counter-heading.

The area of the mine was small; the ventilation was admitted by every witness as being good; there were no old workings where bodies of standing gas could accumulate; the mine was reported free from gas at the change of shifts. One hour previous to the explosion, from the evidence obtained from the workmen on the preceding shift, work had been performed in every working-place in the West side during the shift, precluding the possibility of a slow accumulation of gas in the faces going unnoticed. There is no evidence of any blown-out shot, or even a poorly

placed unfired shot; the explosion is admitted by all to have been primarily a gas-explosion, and that dust played only a minor part in the explosion, and the forces developed by the explosion would indicate that there was quite a large body of gas present when ignited. The writer is therefore forced to the conclusion that the gas came from a sudden outburst, and no place in the mine has been found which would suggest an outburst of gas, except at the face of the upper West counter-heading.

At this point the pitch of the seam was abnormal, being from 70 to 75 degrees in a seam the general average of which is about 15 degrees; the thickness of the seam at this point was from 12 to 14 feet, while the general average thickness of the field was from 5 to 6 feet; the disturbed, slickensided, and soft condition of the coal, together with the large displacement of coal, point to the face of the upper West counter-heading as being the most likely place for a sudden outburst of gas, and the broken lamp on Sutter's (No. 23) belt could have furnished the means of ignition.

The writer is forced to think that a sudden outburst of gas did occur at the face of the upper West counter-heading, accompanied with a displacement of coal; that this displacement of coal was sufficient to trap Sutter, who was caught around the feet; both ankles were broken, and that he fell in a half-reclining, half-sitting position. The safety-lamp on his belt would thus assume a partially horizontal position between his legs; the flame of the lamp would come in contact with the glass, causing the break in the glass, as previously described, igniting the liberated gas and causing the initial explosion. This explosion, in the opinion of the writer, was responsible for the blowing-out of the twenty-eight sets of timber and the large cave of coal (231 tons), releasing an additional large volume of gas, and that the gas released carried a high percentage of methane; further, that there was not sufficient oxygen present to give complete combustion, and that the heated gases under the pressure set up by the explosion, and seeking relief at the shafts, expanded into the slope. The mixture, through incomplete combustion, was high in carbon monoxide, likely aided by distillation from the presence of small quantities of dust, was still sufficiently high in temperature to create ignition in the presence of oxygen, and found that oxygen in the cul-de-sac formed by the slope and the lower counter-heading, and that there was a secondary explosion in the slope, accounting for the evidence of force coming up the slope, as seen in the debris, consisting of broken brattice-boards, piled up in the recess, which contained the hoist at the top of the slope.

It has been suggested, in opposition to this theory of a secondary explosion in the slope, that there was no evidence of any one having heard two reports, but the small area of the district in which the explosion occurred, the face of the main West heading, the farthest advanced place in the district, being only 850 feet from the shaft bottom, would make the whole operation practically instantaneous.

INQUEST.

A Coroner's inquisition was opened at the Court-house, Nanaimo, on June 16th by Coroner T. W. Jeffs, of Vancouver. The inquest lasted three days, in which time thirty-three witnesses were examined. The following verdict was returned: "We, the jury empanelled to inquire into the death of Robert Kirkbride, William Ball, and twenty others, find that the deceased came to an accidental death by an explosion of gas on May 27th, 1915, in the Reserve mine of the Western Fuel Company, and after hearing the evidence of thirty-three witnesses, we cannot attach any blame to any one. We also find that every care and precaution was exercised by the management of the said company."

EXAMINATION OF LAMPS FOUND IN THE MINE.

The lamps of all the men killed were recovered excepting two. These were the lamps of Robert Haddow (No. 5), cager, and Robert McMillan (No. 3), pumpman. Both bodies were found at the bottom of No. 1 shaft, death in each case being due to the forces set up by the explosion. It is assumed that their safety-lamps fell into the sump.

The other twenty lamps were opened in the lamp-room by the lampman, James Lister, in the presence of James Ashworth, Joseph G. S. Hudson, John Hunt, Geo. Wilkinson, John Newton, and the writer. Photographs of Nos. 1 and 413, the lamps respectively of Frederick Crew (No. 9) and Thomas Sutter (No. 22), were taken by Mr. Ashworth.

The gas-tester at the mine was of the usual gasolene vapour type. Mr. Ashworth expressed the opinion that the vaporizer was too slow to give a proper test. Mr. Hunt, superintendent of the Western Fuel Company, immediately suggested that, if Mr. Ashworth would select the lamps he was specially interested in, they could be taken to No. 1 shaft, Nanaimo, and be tested there, where the lamps are tested in gas supplied from the city gasworks, this mine being the only one in the Province so equipped. Mr. Ashworth selected lamps Nos. 1 and 2, these being the lamps of Frederick Crew (No. 9) and John Leach (No. 10), the miners working in the lowest West counter-heading.

The lamps were tested by Mr. Weeks, one of the lampmen at the No. 1 mine, in the presence of Mr. Ashworth, Mr. Hudson, Mr. Hunt, and the writer. Each lamp was exposed to the gaseous mixture ten times, the mixture exploding within the lamp without passing the flame to the mixture in the tester.

The evidence taken at the inquest brought out the fact that those who had examined the mine were not all of the same opinion as to the point of origin of the explosion, or the cause of the same; Mr. Ashworth believing that the point of origin was in the lower West counter-heading off the slope, the initial cause being due to a combination of circumstances, together with an explosion of an electric detonator; the rest of the observers believing the point of origin to be in the face of the upper West counter-heading, due to an outburst of gas, possibly ignited by the breaking of the glass in Thomas Sutter's safety-lamp.

The phenomena displayed in mine conditions following an explosion are usually attended by many evidences of conflicting lines of forces, and where, in this case, as in most other cases, what actually did take place can never be determined, and therefore the cause must be deduced from what the observer sees as effects. There is much room at all times for honest difference of opinions, and the number of explosions that have not given rise to such difference of opinions are very few.

The plant at the mine was in every way efficient; the staff of underground officials were all experienced and capable men, the area of the mine being small, permitting the certificated officials plenty of time for frequent visits and inspection. For a maximum of 118 men there were seven certificated officials, being an average of one official for every seventeen men employed underground.

The workmen employed were mostly English-speaking, less than 10 per cent. being foreigners. At the close of the inquest Coroner Jeffs commented very favourably upon the intelligent class of witnesses, and the fact that the services of an interpreter had not been required.

The plant and general equipment of the property was in every way modern; the conditions underground, whilst more than ordinarily difficult, due to the faulted and disturbed condition of the strata, were good.

The reports of the firebosses were much too brief, merely stating gas or a little gas found; a statement as to the quantity of gas found, whether in the general ventilation or merely a pocket in the roof, whether the gas showed only a cap upon the safety-lamp or was explosive, would give the report of the fireboss much more value.

There were evidences of unused explosives being left over in the mine; that is, a miner taking a 4-lb. carton of explosives into the mine has at the end of his shift a few sticks of the explosive unused; these would be left in the mine until the next day. This was aggravated in some cases by reason of the workmen on each shift having a separate supply of explosives, rather than all three shifts using from a common stock.

There is much to be said against the practice of leaving unused explosives in the mine overnight; again, many contend that the danger from this is no greater than the added risk of rehandling in carrying the explosives in and out of the mine.

It is true that every time an explosive is handled, or carried a distance, the operation is attended with more or less risk. The writer, however, is of the opinion that the lesser of the two evils is to take all unused explosives out of the mine at the end of each shift.

Appended to this report are:—

(*a.*) Barograph chart showing the barometer reading at the Reserve shaft from May 24th to May 31st, 1915:

(*b.*) Analysis of sample of mine-air collected in the return from the West side shipped to the Mines Department, Ottawa:

(*c.*) Air-compressor chart at Reserve shaft, May 27th, 1915, showing drop in pressure through break in air-line at time of explosion:

(*d.*) Returns from G. S. Eldridge & Co., analytical chemists, Vancouver, on two samples of blood from bodies Nos. 6 and 7:

(*e.*) Returns of analysis of gas sample taken from end of brattice in the upper West counter-heading by Inspector of Mines John Newton on June 2nd, and sent to the Mines Department, Ottawa, for analysis:

(*f.*) Coal-dust samples as collected and examined by microscope by James Ashworth, J. G. S. Hudson, and the writer:

(*g.*) Returns of analysis of samples of coal and selected samples of dust submitted to W. Fleet Robertson for analysis to determine the ratio between fixed carbon and volatile combustible matter:

(*h.*) Plan of mine showing ventilation:

(*i.*) Plan of mine showing lines of force, places where bodies were found, and the places where the men who escaped were at work at time of the explosion:

(*j.*) Sketch showing plan and end view of the main West heading, lower counter-heading, and slope:

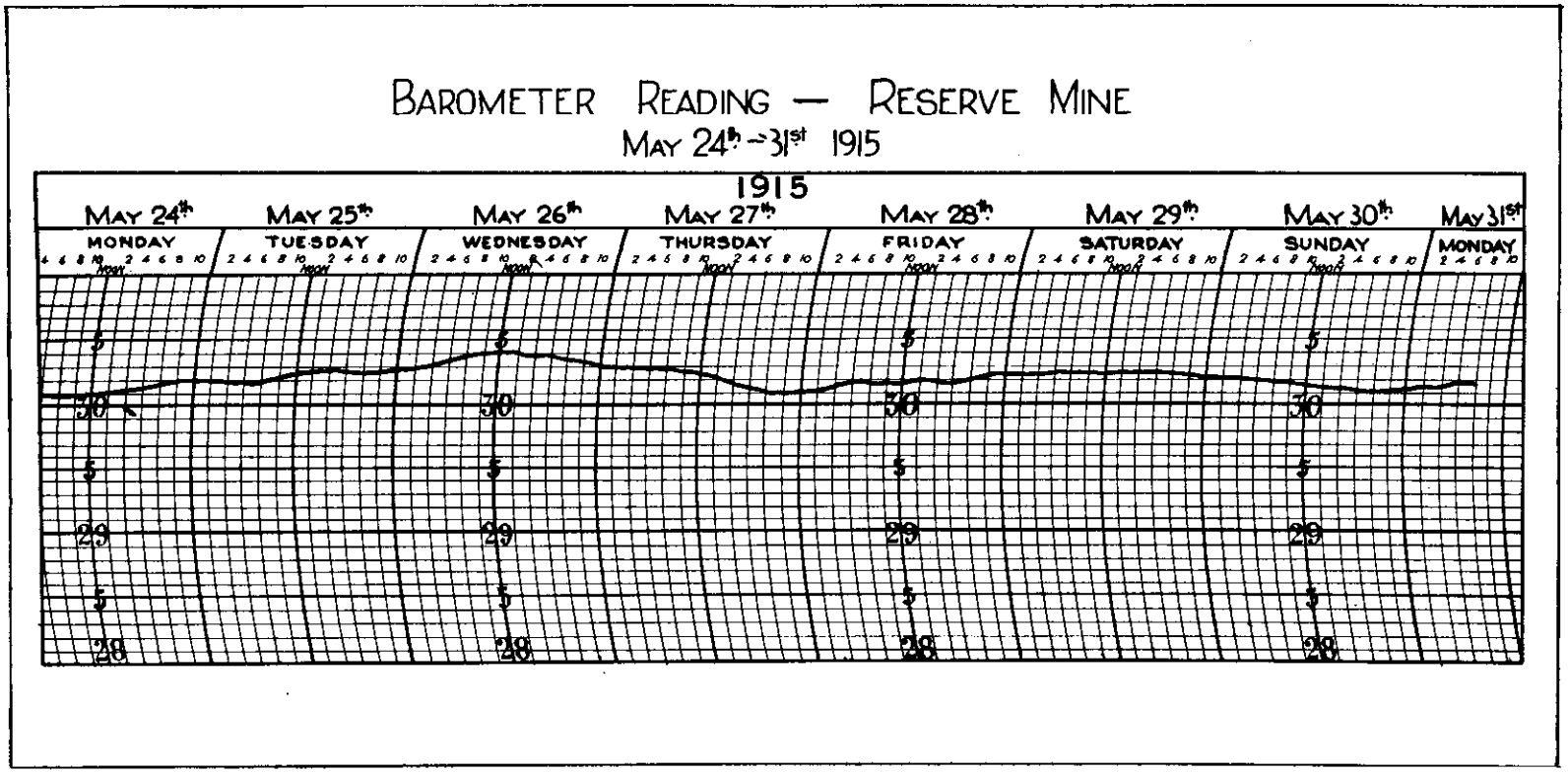
(*k.*) Sketch showing plan of No. 6 crosscut and end view of face, also plan of upper West counter-heading:

(*l.*) Plan showing projected lay-out of the underground work in reference to ventilation.

I have much pleasure in reporting that I was rendered every assistance necessary to a thorough examination of the property by T. R. Stockett, general manager, and other officials of the Western Fuel Company.

I have also to thank James Ashworth, of Vancouver, and Jos. G. S. Hudson, of the Mines Department, Ottawa, for their co-operation and assistance in the examination of the mine.

(Exhibit A.)


BAROMETER READING — RESERVE MINE
MAY 24th - 31st 1915
1915
MAY 24th
MAY 25th
MAY 26th
MAY 27th
MAY 28th
MAY 29th
MAY 30th
MAY 31st
MONDAY
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
MONDAY
noon
30
29
28

(Exhibit B.)

MINE AIR SAMPLE.

Department File No.: 521-601. Sample No.: 5-6. Mine: Reserve. Situated: Nanaimo.
Operated by: Western Fuel Company. Name of seam: Douglas.
Ventilating district: West counter-level. Location in mine: Return off West counter-level.
Barometer: 30". Hygrometer, dry bulb F.: 56. Wet bulb F.: 56. Humidity: 100%.
Velocity of air in feet per minute: 430. Volume of air in feet per minute: 23,600.
Pressure on air or water-gauge: 0.75". Average output in tons per day from mine: 150.
From split: 100. Number of men breaking down coal in mine: 48. In split: —.
Mine working: Yes. Date of sample: May 8th, 1915.
Collected by: John Newton. Ottawa Laboratory No.: 47.

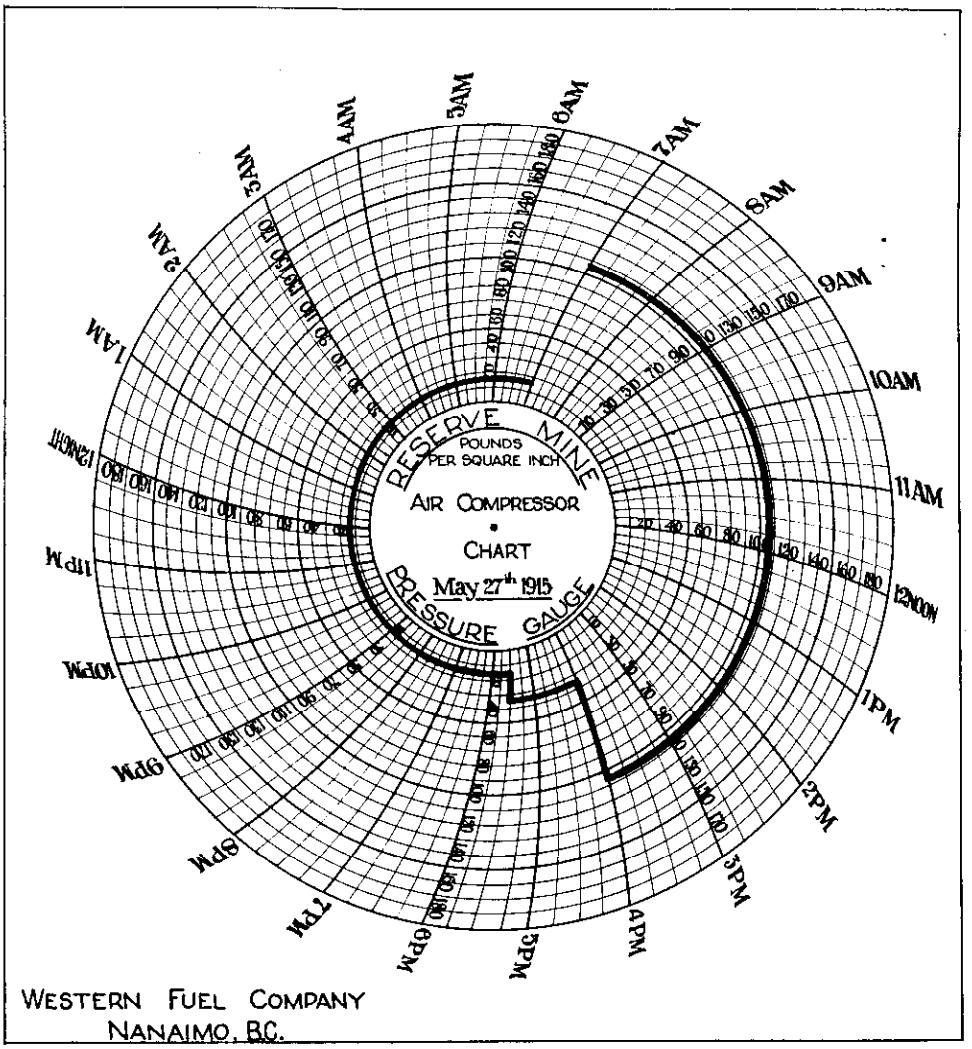
CHEMICAL ANALYSIS.

CO_2.	O.	CH_4.	C.O.	H.	N.
0.06	20.59	0.75	..	..	78.60

TECHNICAL ANALYSIS.

Air.	Fire-damp.	Black-damp.
98.38	0.75	0.87

(Exhibit C.)



(Exhibit D.)

G. S. ELDRIDGE & Co.,
Analytical and Consulting Chemists,
Vancouver, B.C.

VANCOUVER, B.C., June 2nd, 1915.

Dr. O. G. Ingham, Nanaimo, B.C.

DEAR SIR,—We have made a spectroscopic examination of the two samples of blood submitted by you the 31st ultimo, and marked II. and III., and find that both samples contain decided amounts of carbon monoxide (CO).

Faithfully yours,
G. S. ELDRIDGE & Co.
Per G. S. ELDRIDGE.
[Seal.]

(Exhibit E.)

MINE AIR SAMPLE.

Department File No.: 681-716. Sample No.: 10. Mine: Reserve. Situated: Nanaimo. Operated by: Western Fuel Company. Name of seam: Douglas. Ventilating district: —. Location in mine: Cave in No. 5 crosscut. After explosion.
Barometer: —. Hygrometer, dry bulb F.: —. Wet bulb F.: —. Humidity: —.
Velocity of air in feet per minute: —. Volume of air in feet per minute: —.
Pressure on air or water-gauge: 0.75". Average output in tons per day from mine: 150.
From split: 100. Number of men breaking down coal in mine: 48. In split: 30.
Mine working: Idle. Date of sample: June 2nd, 1915. Collected by: John Newton.
Ottawa Laboratory No.: 58.

CHEMICAL ANALYSIS.

CO_2.	O.	CH_4.	CO.	H.	N.
0.49	3.07	41.03	..	..	55.41

TECHNICAL ANALYSIS.

Air.	Fire-damp.	Black-damp.
14.67	41.03	44.30

(Exhibit F.)

June 2nd, 1916.

EXAMINATION OF DUST AND COAL COLLECTED FROM THE RESERVE MINE.

Sample No. 1.—Collected from post 2 x 4 inches on No. 2 crosscut on the West level. Sample taken from the inside of post. Sample shows distinct cindering.

Sample No. 2.—Collected off timber in counter-level inside of No. 5 crosscut of the West level. Sample shows no sign of cindering.

Sample No. 13.—Collected at the top of No. 4 crosscut, West level. Sample shows very slight cindering.

Sample No. 3.—Collected from top of timber at the bottom of No. 5 crosscut. Dust very fine. Sample shows very slight evidence of heat and cindering.

Sample No. 10.—Collected on the West level inside of door off No. 1 East, at back end of triangle. Sample shows evidence of heat, grains rounded, and colours under microscope very distinct.

Sample No. 11.—Collected on the West counter inside of No. 2 crosscut. Sample shows evidence of heat, grains rounded.

Sample No. 12.—Collected on West counter on top of No. 3 crosscut. Sample shows evidence of heat, grains rounded, evidently more intense heat than on previous sample.

Sample No. 14.—Collected on West counter, West side, of No. 4 crosscut. Dust very fine. Sample shows rounded corners. Dust adhering in fine particles; large grains do not show this so distinctly.

Sample No. 15.—Collected on West counter on outside top of No. 5 crosscut. Sample shows same condition as No. 14.

Sample No. 21.—Collected from piece of underclothing found on cave at the West of No. 5 chute when looking for bodies. Sample of cloth shows burning, and dust cindering in the fibre of the cloth. Also colours on the particles of coal show heat.

Sample No. 4.—Collected from timber half-way down slope off West level. Dust was damp. Sample does not show very distinctive evidence of cindering.

Sample No. 5.—Ribbon from carton of Monobel powder. Ribbon shows signs of being singed. Sample collected on slope, between face and No. 1 lower counter, at station where men kept explosives. Dust shows evidence of heat.

Sample No. 6.—Collected from lagging at entrance of lower counter off slope. Dust shows cindering in the rounded particles of dust; but not much adherence.

Sample No. 7.—Collected from piece of brattice near road close to where No. 14 body was found. Piece of paper slightly discoloured.

Sample No. 16.—Collected from end of car, face of lower West counter off the slope. Dust was so fine that it might be designated as soot. No sign of cindering, nodules just rounded.

Sample No. 17.—Collected from buffer on the same car, face lower West counter. Dust shows signs of cindering slightly. Also shows soot; nodules structural and rounded.

Sample No. 8.—Collected from mine-car at face of West level; large pieces of slate.

Sample No. 18.—Collected from inside of safety-lamp belonging to John Davis, when it was examined in lamp-room on the surface. Davis's body is marked No. 10 and found at No. 4 crosscut on West level. Dust does not show any cindering; slightly rounded.

Sample No. 19.—Collected from outside of the lamp described above. Piece of paper was jammed into lamp-shield; distinctly shows the most evidence of cindering which has been examined.

Sample No. 20.—Collected from the bottom of Mazs' lamp. Dust just shows nodules of coal. Possibly due to action of heat.

EXAMINATION OF DUST COLLECTED IN NO. 6 CHUTE, WEST LEVEL, RESERVE MINE.

(Dust was collected on Friday morning, June 4th, 1915. This date was the first time the chute had been entered (on account of gas) since the accident.)

Sample No. 22.—This sample was taken from the arm of Bewley's body. This body was found in No. 5 crosscut, West level, up towards the face, and was buried under the coal, and found on Wednesday night, June 2nd. This dust showed distinct signs of cindering and coking.

Sample No. 23.—Sample taken from top of oil reservoir of Bewley's lamp, No. 18, found in No. 5 crosscut, upper counter, West level. This dust was affected by heat and demonstrated by the rounded particles of dust.

Sample No. 24.—Taken from lamp No. 27, of F. Leschek's body, No. 18; taken off shield of lamp. Dust shows evidence of cindering.

Sample No. 25.—This sample was collected from the upper set of timber in No. 6 chute, 4 feet from the end of the shot-hole. Sample shows evidence of heat, but not enough to turn it into the silvery appearance of ordinary coke.

Sample No. 26.—This sample was taken from the roof as described in No. 25 sample, and at a higher point. Sample shows perceptible evidence of coking; seen with the naked eye, and under the magnifying-glass, showed the evidence of heat, tar, and globular bubble form. This sample was solid coal and not dust.

Sample No. 27.—This sample was taken from a box about 20 feet lower down than the face. Samples shows distinct rounded corners. Tar-bubbles and coking.

Sample No. 28.—This sample was a piece of resin taken off timber; heat had been sufficient enough to melt the resin, and particles of heated dust had burned and showed rings when the tar had bubbled and burst.

Sample No. 28A.—The rope which hung in the No. 6 chute was tied at the top of the chute. This sample was taken from the knot end where the manila was frayed out. This sample showed evidence of coking; noticeable silvery appearance of one particular piece.

Sample No. 29.—Sample was taken from a board at the bottom of the chute and air-box, close to where the mine-car was standing with coal in it. This sample was very fine dust, some grains burst, and showing signs of heat. Another sample was collected in the same box and showed distinct evidence of heat by the tar-bubbles and congealed particles.

Sample No. 30.—Sample collected by side of the third prop from the slope. Sample shows evidence of fine dust and some particles cindering.

Sample No. 31.—Taken from timber near face of upper West level.

Sample No. 32.—Taken from inby side of prop on West level, inside of No. 4 crosscut.

Sample No. 33.—Taken from side of entry at curve coming out of West level on to the shaft-bottom.

(Exhibit G.)

DEPARTMENT OF MINES,
OFFICE OF PROVINCIAL MINERALOGIST,
June 17th, 1915.

Thomas Graham, Esq.,
Chief Inspector of Mines, Victoria, B.C.

DEAR SIR,—I enclose analyses of samples of coal and dust submitted by you as having been taken from Reserve mine after the explosion. I enclose two extra copies, as you will probably want to send a copy each to Mr. Ashworth and Mr. Hudson.

I have calculated out the ratio of F.C. to V.C.M. in each case, which will be a better guide than the straight analysis.

I am,
Yours truly,
W. F. ROBERTSON.

P.S.—I return the unused portion of the samples.

GOVERNMENT ASSAY OFFICE,
June 17th, 1915.

ANALYSES OF SAMPLES, RESERVE MINE EXPLOSION.

(Samples received from Chief Inspector Graham.)

Our No.	Mark.	Moisture.	V.C.M.	F.C.	Ash.	Ratio of F.C. to V.C.M.	Remarks.
9043	Aver.	1.6	36.1	52.9	9.4	1.46	Sample normal coal from face of counter-level off slope.
44	No. 1	2.4	19.3	52.2	26.1	2.70	
45	" 2	1.8	32.0	48.9	17.3	1.53	
46	" 6	3.1	24.2	53.1	19.6	2.20	Partly coked.
47	" 12	2.6	27.0	43.8	26.6	1.81	
48	" 13	2.2	29.4	44.4	24.0	1.51	
49	" 14	2.4	21.8	50.0	25.8	2.29	Partly coked.
50	" 15	2.0	32.2	45.8	20.0	1.42	
51	" 16	2.0	..	..	16.5	..	Partly coked; sample too small to complete analysis.
52	" 19	..	..	..	..	..	Clothing; no assay.
53	" 21	1.8	30.8	53.2	14.2	1.73	
54	" 22	1.5	..	..	16.0	..	Partly coked; sample too small to complete assay.
55	" 24	5.0	..	..	21.0	..	Ditto.
56	" 25	1.5	36.0	51.0	11.5	1.41	
57	" 26	1.5	37.7	53.0	7.8	1.40	
58	" 27	1.6	24.6	57.2	16.6	2.33	Partly coked.
59	" 29	2.5	17.3	46.4	33.8	2.68	Partly coked.
60	" 30	2.0	28.0	46.5	23.5	1.66	
61	" 31	1.6	35.5	52.8	10.1	1.48	
62	" 32	2.2	27.2	46.2	24.4	1.70	
63	" 33	2.0	29.8	43.4	24.8	1.46	
64	Special	1.6	35.5	49.6	13.3	1.40	Special sample from face of upper counter-level inside of No. 5 crosscut.

D. E. WHITTAKER,
Government Analyst.

(Exhibit M.)

LIST OF PERSONS KILLED, RESERVE MINE, MAY 27TH, 1915.

Report of Dr. O. G. Ingham.

No. on Map.

1. William Ball—No injuries; gas-poisoning.
2. Ephraim Walishvil—Gas-poisoning.
3. Robert McMillan—Face completely battered in; all bones in face broken and badly cut; five or six ribs on left side broken from shoulder down.
4. Robert Kirkbride—Face and body badly burned; right shoulder shattered; left arm broken above elbow; right leg broken below knee; burns and shock.
5. Robert Haddow—Upper part of head blown off; big hole in pelvis from front; big hole in front of neck.
6. Alfred Williams—Hands burned; gas-poisoning.
7. Hiram Guffog—Slight burns on legs; gas-poisoning.
8. James L. Mazs—Face and body badly burned; inside of mouth and tongue badly burned; burns on thighs; burns.
9. Frederick Crew—Badly burned over face and entire body; teeth blown out; lower jaw fractured; punctured wound in right side; right lung punctured; both bones of right leg broken; left arm broken near wrist; thighs scorched; hands badly burned; burns and shock.
10. John Leach—Slightly burned about face, hands, and shoulder; gas-poisoning.
11. J. W. Davis—Face and body badly burned; burns and gas.
12. Lewis Shaw—Badly burned about face and body; burns and gas.
13. Edmund Beck—Face and wrists burned; gas-poisoning.
14. James McEwan—Chest slightly burned; superficial injuries to forehead; gas-poisoning.
15. William McEwan—Gas-poisoning.
16. Robert Broom—Hands and face slightly burned; gas-poisoning.
17. Nick Selek—Slightly burned about head and shoulders; gas-poisoning.
18. Fred Leschek—Slightly burned about face and body; gas-poisoning.
19. Thomas Harker—Badly burned all over; burns and shock.
20. Thomas Bewley—Body badly burned; hands badly burned; left side of face from eye to chin crushed; lower jaw fractured on left side; death from burns and injuries.
21. Paul Vittar—Face crushed; hands, face, and head burned; body burned; death from injuries and burns.
22. Thomas Sutter—Badly burned on head, face, chest, and hands; both ankles broken; left thigh broken near hip; face crushed in; death from burns and crushing.

EXPLOSION AT RESERVE SHAFTS, NANAIMO, MAY 27TH, 1915.

REPORT BY JAMES ASHWORTH.

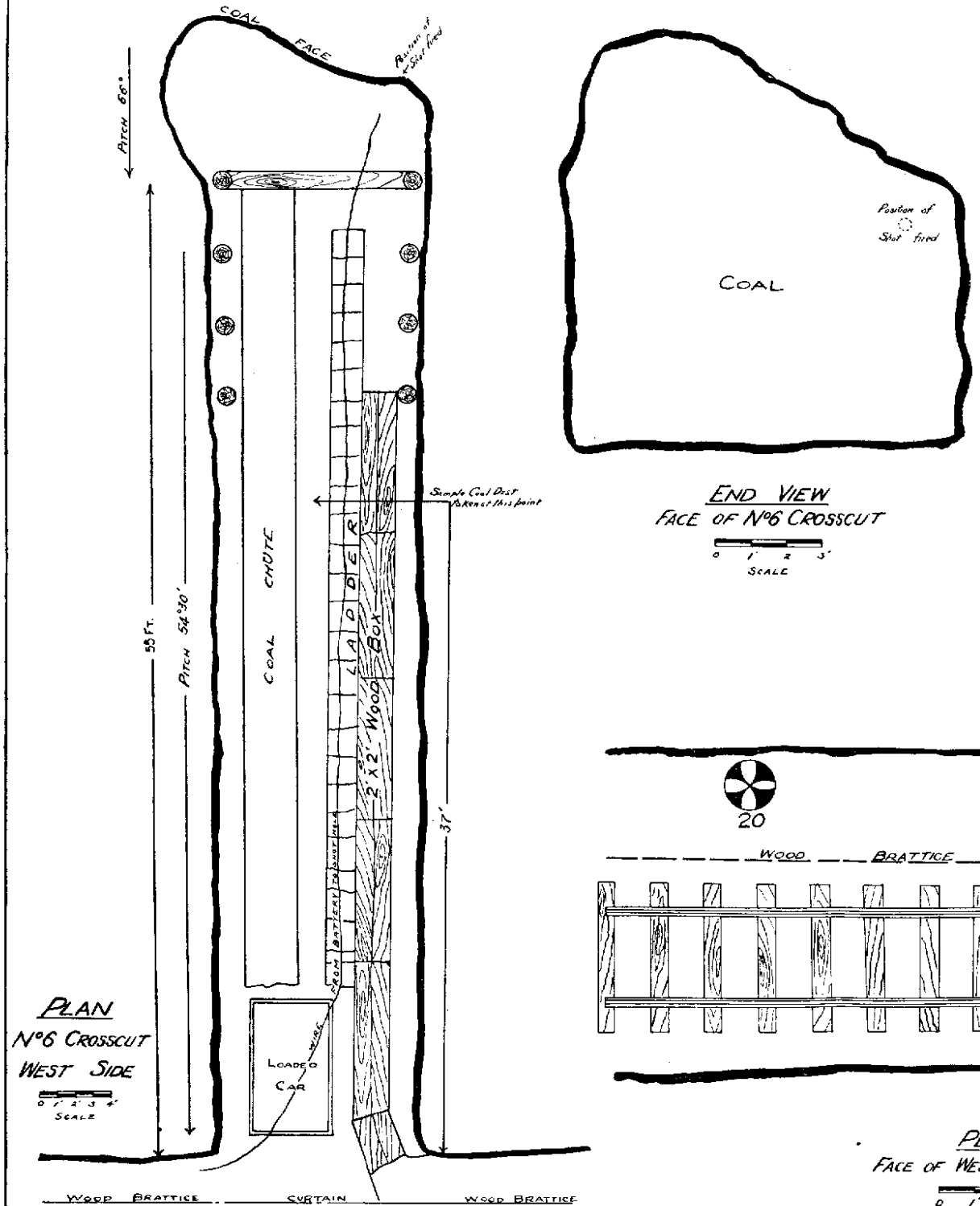
I have the honour to report to you as follows in reference to the explosion at the Reserve mine belonging to the Western Fuel Company, Nanaimo, which occurred on the 27th ultimo:—

On May 28th I received verbal instructions from the Hon. W. J. Bowser, K.C., M.L.A., the Attorney-General, to go to Nanaimo with the least possible delay to investigate and, if possible, to ascertain the cause of the disaster which had occurred at the Reserve mine of the Western Fuel Company, Nanaimo, and that I should find written instructions from the Deputy Minister of Mines with letter of introduction to Thomas R. Stockett on my arrival at the Windsor Hotel, Nanaimo.

WESTERN FUEL COMPANY
RESERVE MINE
DETAILS AT FACES

Scales as shewn

June 8th 1915

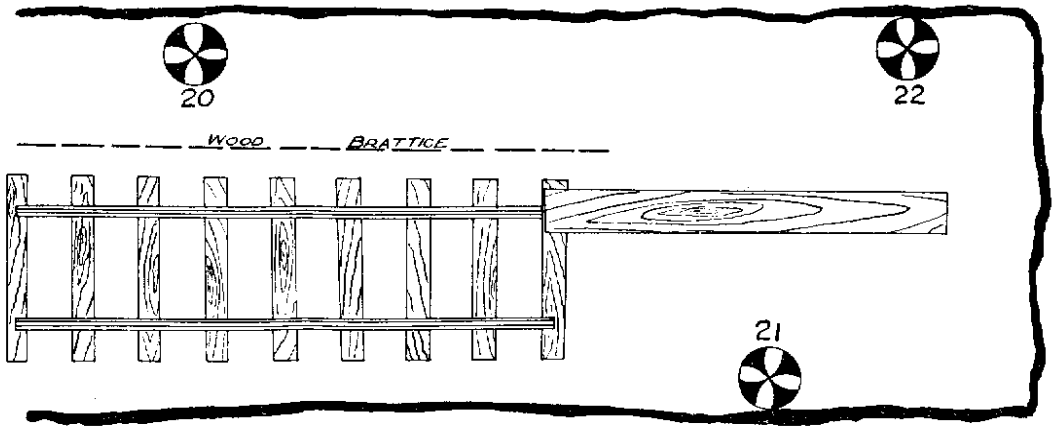


PLAN
N°6 CROSSCUT
WEST SIDE

0 1' 2' 3' 4'
SCALE

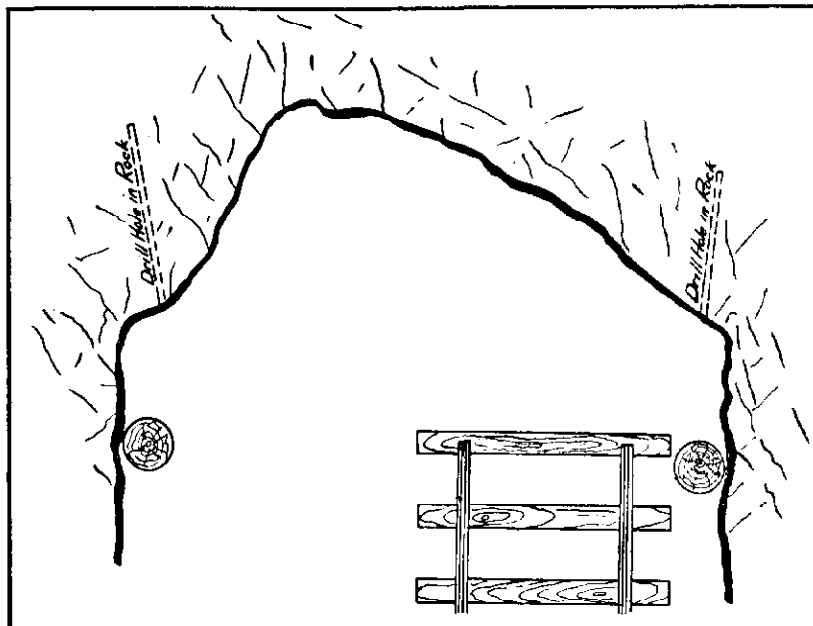
END VIEW
FACE OF N°6 CROSSCUT

0 1' 2' 3'
SCALE

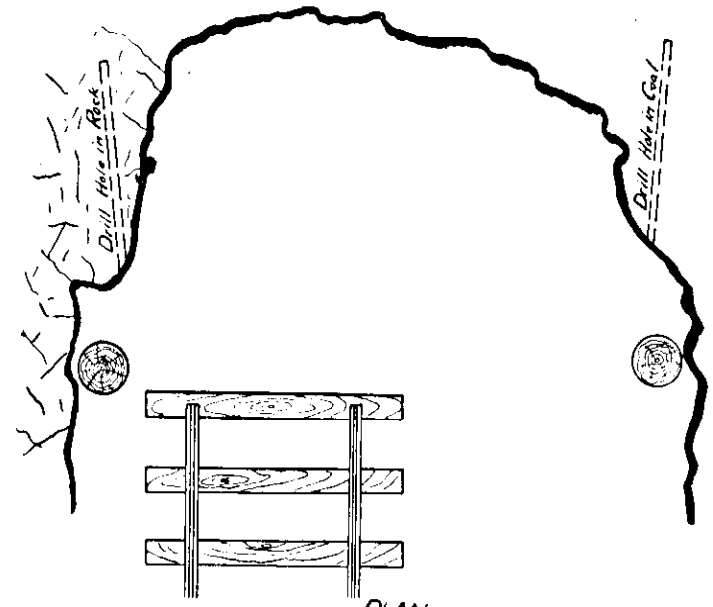


PLAN
FACE OF WEST HEADING COUNTER

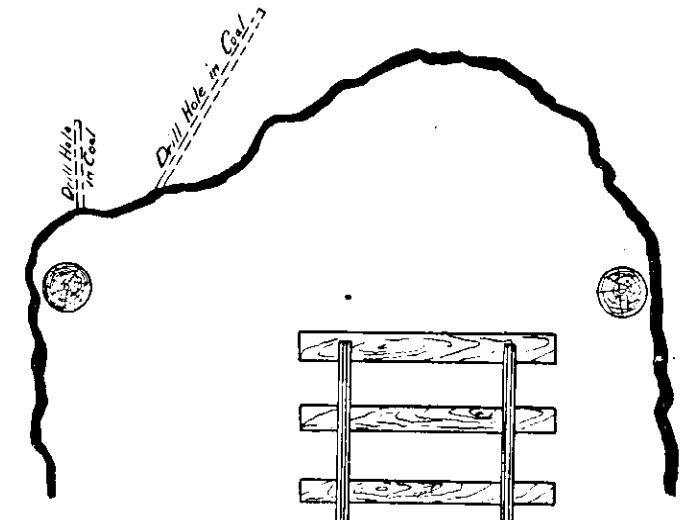
0 1' 2' 3'
SCALE



PLAN
FACE OF WEST HEADING



PLAN
FACE OF SLOPE COUNTER

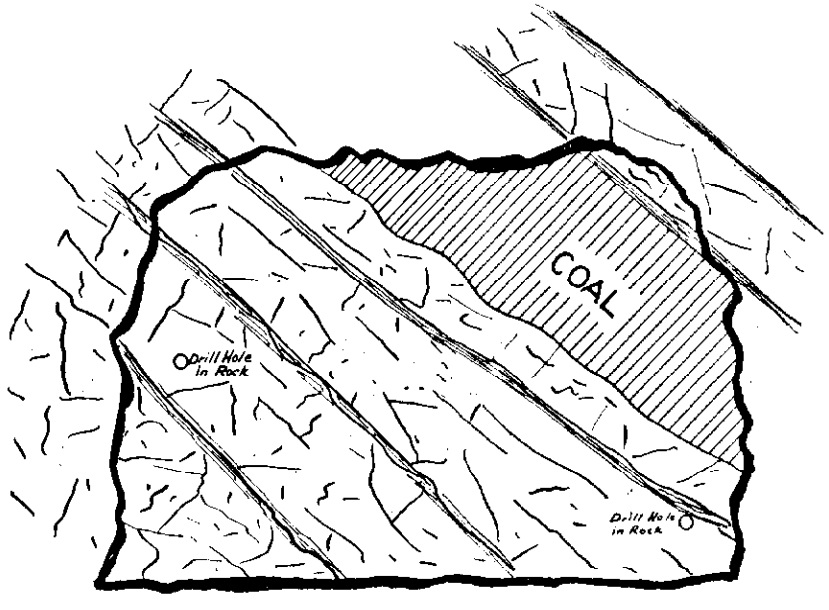


PLAN
FACE OF SLOPE

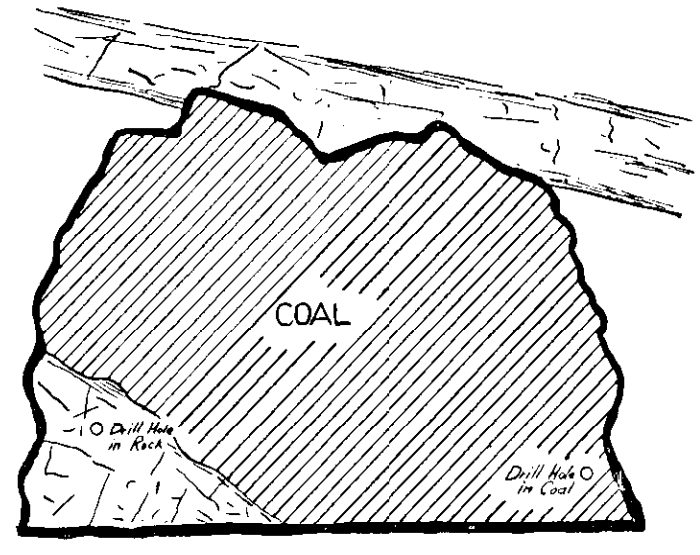
WESTERN FUEL COMPANY RESERVE MINE DETAILS AT FACES

SCALE 0 1' 2' 3' 4'

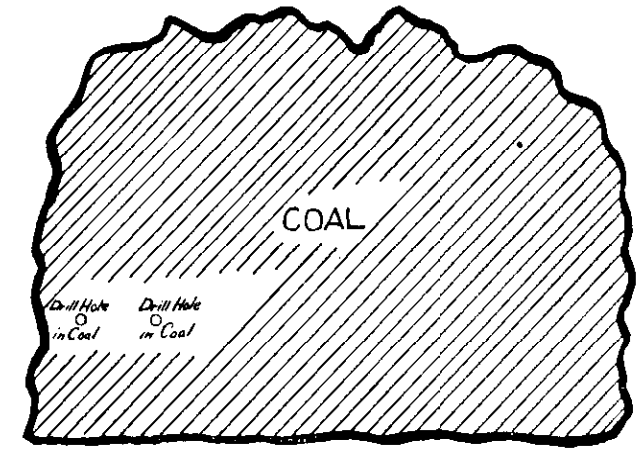
MAY 27th 1915.



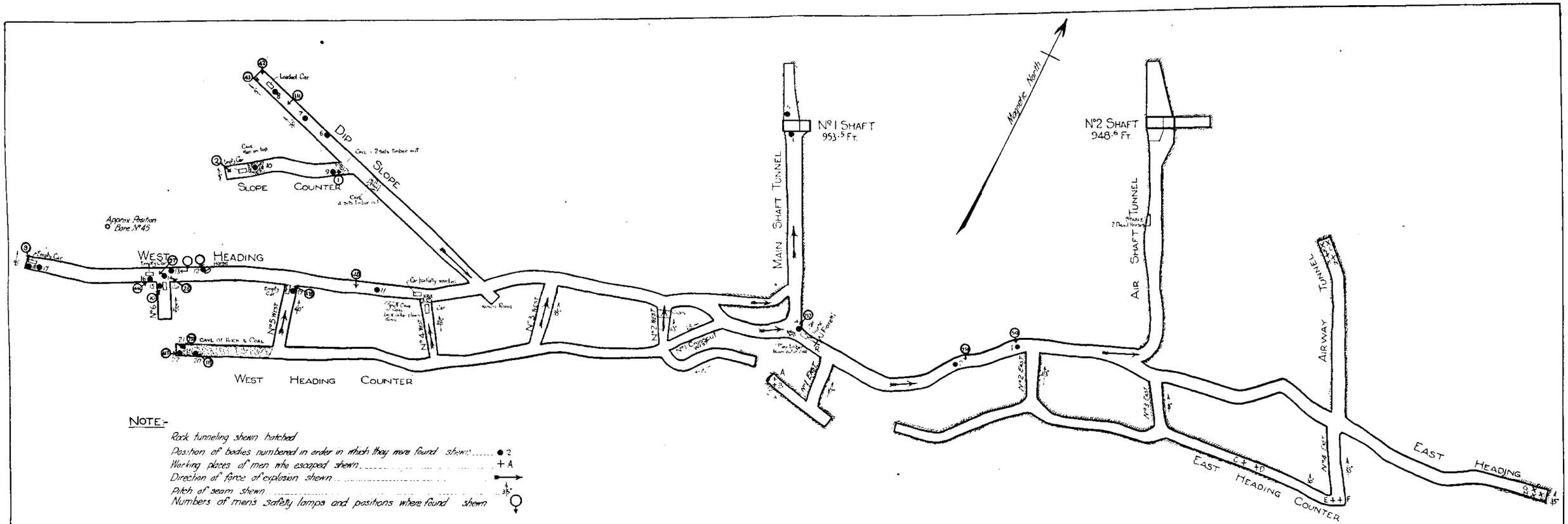
END VIEW
FACE OF WEST HEADING



END VIEW
FACE OF SLOPE COUNTER



END VIEW
FACE OF SLOPE



NOTE:-

Rock tunneling shewn hatched
Position of bodies numbered in order in which they were found shewn ..... ● 2
Working places of men who escaped shewn ..... + A
Direction of force of explosion shewn .....
Pitch of seam shewn .....
Numbers of mens safety lamps and positions where found shewn

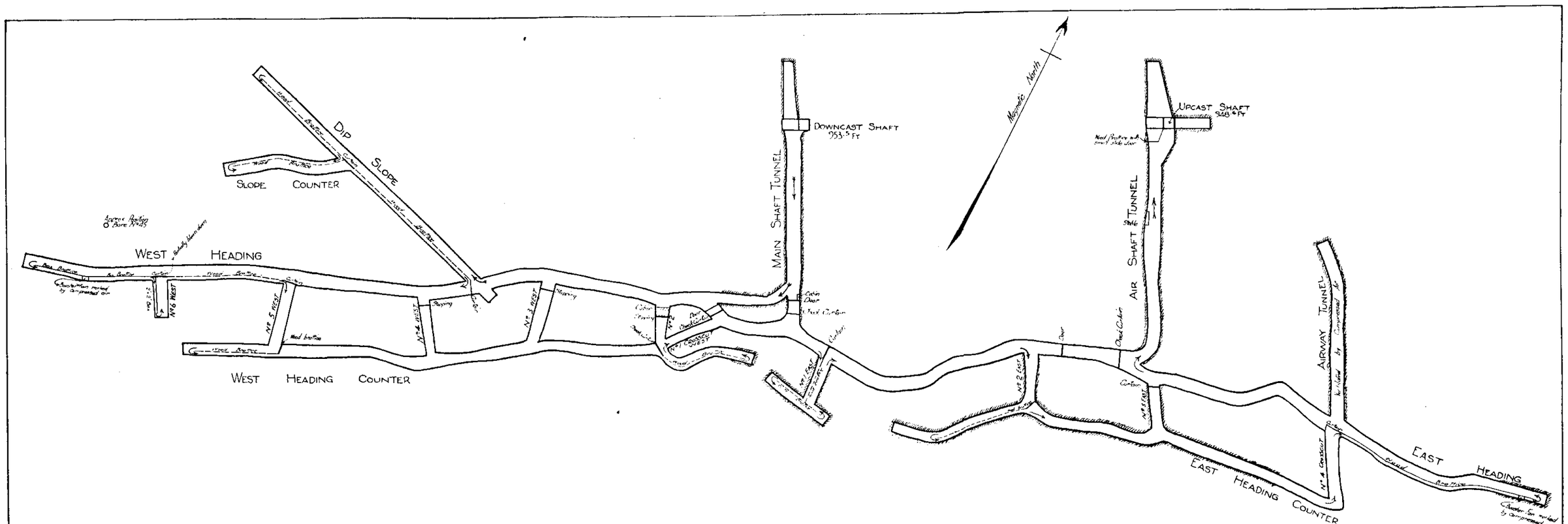
Bodies Found			Safety Lamps	
Names		Date Found	Lamp Numbers	Positions
1.	Wm Ball	May 27th 1915	50	With body
2.	Eph. Walisbyil	" "	734	" "
3.	Robt. MacMillan	" "	715	Not found
4.	R. Kirkbride	" "	737	With body
5.	R. Haddow	" "	427	Not found
6.	A. Williams	" "	42	Hanging on prop at face
7.	H. Gutteridge	" "	43	" " " " "
8.	J.L. Mairs	" "	111	15 ft up Slope from body
9.	Fred. Crew	May 28th	1	18" from body towards slope
10.	John Leach	" "	2	Hanging on prop at face
11.	John Davis	" "	J.D.	20 ft from body toward No 5 Crosscut
12.	L. Shaw	" "	No Number	Hanging on his belt
13.	Ed. Beck	" "	No Number	With body
14.	Jas. McEwan	" "	9	Hanging on prop at face
15.	Wm. McEwan	" "	10	With body
16.	Robt. Broom	" "	444	In his hand
17.	N. Selleh	" "	29	Found beside body of Jas McEwan
18.	F. Leschack	" "	27	Found at ribside near Jas McEwan
19.	Thos. Harker	" "	698	With body
20.	T. Brierley	June 3rd	18	In his hand
21.	P. Vitter	June 5th	733	With body
22.	T. Sutter	June 5th	413	Hanging on his belt

Men Escaped	
Names	
A.	A.L. Mairs
B.	H. Clark
C.	T. Patterson
D.	J. Davis
E.	J.S. Jones
F.	J. Yukovic
G.	John Graham
H.	F.R. Cook
J.	A. Cook
K.	J.T. Neen
L.	Fred. Wilson
M.	Wm Thompson
N.	A. Gould
R.	J. Fiorelli

WESTERN FUEL COMPANY
RESERVE MINE PLAN

Scale 50 ft = 1 in. June 8th 1915.

Certified a correct map of Reserve Mine
M.W. Garman Mst. Engr.



NOTE:-

Brattice left standing after explosion shewn by solid line thus ——

Position of Brattice before explosion shewn by dotted line - - - - -

Blue arrows shew intake air current ⟹

Red arrows shew return air current ⟶

WESTERN FUEL COMPANY
RESERVE MINE PLAN

Scale 50 ft. = 1 in.

May 27th 1915.

Certified a correct map of Reserve Mine — Ventilation System.

M. W. Freeman. Mt. Engr.

WESTERN FUEL COMPANY

PLAN OF

RESERVE MINE

SHEWING VENTILATING SCHEME

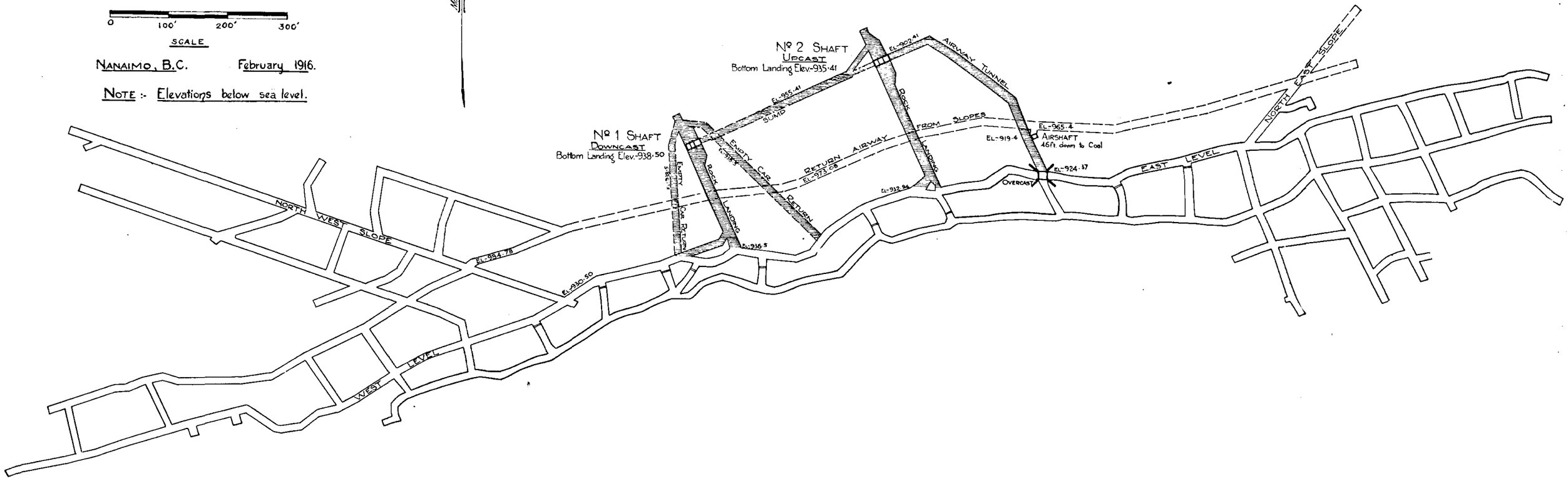
0 100' 200' 300'

SCALE

NANAIMO, B.C. February 1916.

NOTE :- Elevations below sea level.

Magnetic North



I duly left by the first steamer for Nanaimo, and on arrival received the letter of instructions from the Deputy Minister of Mines, dated May 28th, also a letter of introduction to Thomas R. Stockett, as follows:—

SIR,—Following your appointment under the provisions of section 73 of the "Coal-mines Regulation Act" to make a special investigation and report upon the mining operations at the Reserve mine, Nanaimo, owned by the Western Fuel Company, so far as they relate to the safety of life and property therein, I have the honour to enclose a letter introducing you to T. R. Stockett, general manager of the said company, which should ensure your admission to the said mine.

I have, etc.,

R. F. TOLMIE,
Deputy Minister of Mines.

I met Thomas Graham, Chief Inspector of Mines, shortly after my arrival, who informed me generally as to what had been done and what was being done, and I arranged to go out to the mine at 8 o'clock the next morning.

The same evening I also met J. G. S. Hudson, who was present on behalf of the Mines Branch of the Dominion Government, Department of Mines, also the District Inspectors of Mines, Messrs. Newton and Devlin, all of whom had been in the mine. I also met them on many occasions during my visits to the mine.

DESCRIPTION OF THE MINE.

Some years ago the Western Fuel Company, being desirous of extending their mining operations and output, put down a series of boreholes to ascertain the continuity and thickness of the upper Douglas seam of coal, and finally decided to sink two rectangular shafts and erect the plant now known as the Reserve mine or colliery.

The shafts are lined with concrete from 12 feet above the surface to a depth of 40 feet more, and from thence to the bottom are lined with wood.

Each shaft is divided into three compartments, two of these being 10 x 8 feet, and used for raising and lowering materials, and one of 10 feet square which is used exclusively for ventilation purposes.

No. 1 shaft, which is the westerly one and the downcast, is fitted with adequate winding power and a single-decked cage in each of the two winding compartments. These cages are not furnished with safety-catches to arrest them in the event of the rope breaking. Both cages are furnished with overwinding-hooks.

No. 2 shaft, which is the upcast and 350 feet east of No. 1, is fitted with single-decked cages fitted with safety-catches devised by Mr. Hamilton, the master mechanic, and with overwinding-hooks; it is also furnished with adequate winding power. This shaft is principally used for winding water out of the sump and for ventilation. Only the most easterly compartment is used for the ventilation of the mine.

If an emergency so required, the two winding compartments could be used for a downcast current of air; likewise No. 1 shaft could provide both an upcast and a downcast current of air, providing that the force of an explosion or other disaster did not damage the boarding between the compartments.

No. 1 shaft was sunk to a depth of 1,068 feet, but at the present time the coal is being wound from a depth of 953 feet, from which point a rock tunnel has been driven to the south to intersect the coal.

No. 2 shaft has a total depth of 982 feet, but, as in No. 1, a tunnel has been driven from a depth of 948 feet to intersect the coal-seam.

The upper Douglas coal-seam is, within the area of the present workings, very disturbed by faultings and very damp throughout; the dip of the strata varies from 8 to 66 degrees. The average thickness of the coal is probably about 10 feet.

The colliery is furnished with adequate steam-boilers carrying a pressure of 125 lb. a square inch, and with air-compressors for driving hauling-engines, pumps, and fans underground.

All of the surface works are lighted by electricity, and at the time of the explosion the lighting-wires and lights were in operation as far as the top of the slope on the West side of the mine.

At the present time, staging and screens for sorting and cleaning the coal are about completed, as will be seen from the enclosed photographs.

The ventilation of the mine is secured by a Sirocco double-inlet fan, with rope-drive, operating between the two halves of the fan; practically it is two fans. The capacity of this plant is over 400,000 cubic feet a minute, with a water-gauge of 4 inches; the present water-gauge is only 0.75 inch. The air-current can be reversed when required.

The materials used, and being used, are all of first-class character; safety-lamps are adequately cared for (*see* photograph). The ambulance and first-aid arrangements of the company are excellent.

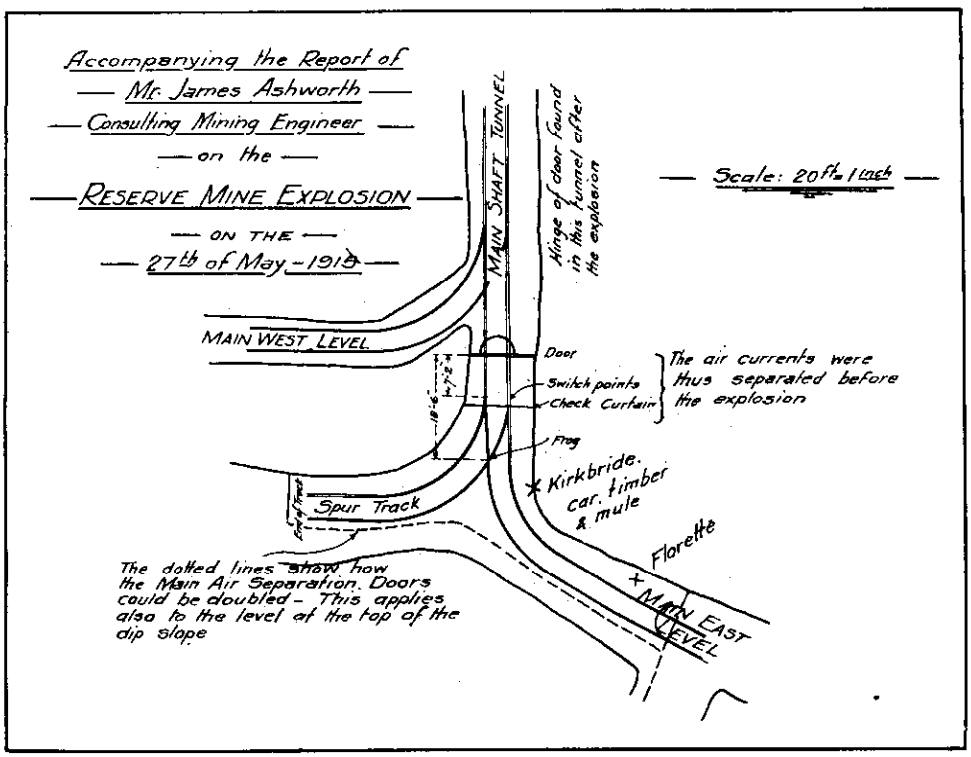


Fig. B.

FIRE-DAMP.

The first outburst of explosive gas at this colliery occurred on June 27th, 1914, about 5.30 p.m., in a prospect-place at the extreme bottom of No. 1 shaft. This fouled the shaft up to No. 1 pump-station, which is placed at a depth of 248 feet below the surface. It was later found to have displaced 25 to 30 tons of coal. Mr. Broom, who was killed in the explosion of May 27th, was in the place at the time of the outburst and was buried by the fine coal up to his shoulders. The dip of the place was 27 degrees. On the following day the morning fireboss found that the gas had drained off.

The second outburst took place in No. 3 West crosscut of the present workings about 8.30 a.m., displacing from 75 to 100 tons of coal. It fouled the intake air-current to No. 2 crosscut and cleared away in two hours.

Other and smaller bumps have occurred since; for instance, one, not reported by the fireboss, occurred on the morning of the explosion which displaced a few tons of coal in No. 6 crosscut and gave off some gas.

The firebosses' reports show that gas had been detected in the face of the West level on May 2nd at 3 p.m., on the 3rd at 7 a.m., on the 11th at 11 p.m., on the 12th at 3 p.m., on the 13th at 11 p.m., on the 14th at 7 a.m., on the 14th at 11 p.m., also that gas was found on the 14th in the slope on the 7 a.m. shift; and in No. 1 level off the slope on the 13th at 11 p.m., again on the 3 p.m. and 11 o'clock shifts on the 14th ultimo, again on the 7 o'clock shift of the 15th, on the 19th ultimo at 11 p.m., on the 20th at 3 o'clock p.m., on the same day at 11 p.m.,

on the 21st by the 7 o'clock shift, on the same day by both the 3 p.m. and the 11 p.m. firebosses, and, lastly, on the 22nd by the firebosses of both the 7 a.m. and the 3 p.m. shifts. On the 27th ultimo "no gas" was reported by any fireboss on any shift up to the time of the explosion.

A very careful examination of the safety-lamps recovered from the mine since the explosion has shown that two of them had had gas burning inside the inner gauze—viz., Leach's (No. 10 body), lamp No. 2; and Vittar's, lamp No. 733, body No. 21.

On May 10th, 1915, a sample of the return air from the West side was taken by Mr. Wilkinson and sent to Ottawa by the Western Fuel Company to be tested, with the result that it was found to contain 0.75 per cent. of methane, 0.16 per cent. of carbon dioxide, 20.59 per cent. of oxygen, and 78.60 per cent. of nitrogen; the technical analysis of this chemical is 98.38 per cent. of air, 0.75 per cent. of methane, and 0.87 per cent. of black-damp. In reference to the day on which this sample was taken, the firebosses did not report gas on any of the shifts, and the barometer was steady at 30 inches.

From the foregoing statement it may be safely assumed that the mine was liable to sudden outburst of gas of which the height of the barometer gave no indication; thus at the time of the explosion it stood at 30.14.

WHAT THE MINERS AND WORKMEN WERE DOING AT OR ABOUT THE TIME OF THE EXPLOSION.

The cager at the pit-bottom had just finished talking to the winding engineer over the phone. The pumpman was also at the pit-bottom with the cager.

Close to the door in the first crosscut leading into the East level a mule-driver named Floretti and a man named Kirkbride were moving a flat car loaded with probably 9-foot props to take into the East level, and, as will be seen by a reference to the enlarged plan of this part of the mine (Fig. B), they were compelled to bring it from the spur track through the door before they could switch it on to the main East level. How long this door was open there is no evidence to show, but just when the mule was round the corner the explosion occurred (*see* plan B).

In the West counter-level of No. 1 East crosscut two men were at work; in the West counter of No. 2 East crosscut one man was returning from the rock tunnel where he had been to fetch some oil. It is assumed that both he and his partner were somewhere in the crosscut at the time of the explosion. The rest of the men on the East level and counter were near by or in their working-places and got out alive, as did the two men out of No. 1 crosscut.

At the south end of the Main tunnel there was a door and canvas and a similar arrangement in No. 1 West crosscut also, but the door was so arranged that it could be opened only sufficiently wide for a man to pass through. In No. 2 crosscut the bottom part was used as a mechanic's cabin. The stoppings on this level, Nos. 3 and 4, were board stoppings. Between Nos. 3 and 4 crosscuts a Dip slope was driven to the north-west, and on the opposite side of the level the winding-engine for the slope was placed. From the pit-bottom to this point electric lighting was in use. The man who operated this engine was farther inby along the level assisting a pusher. The next man (Day) was a bratticeman and was on his way outby to fetch some brattice into the face; his saw was found at the face of the level. The next man (Harker) was at the foot of No. 5 crosscut and was just about to attach a tally to the empty car standing there. In the West counter of No. 5 crosscut two timbermen and a miner who worked in this place were taking a stringer into the heading, and were close to the face of the counter, with the stringer between them. Near No. 6 crosscut, Shaw, the winchman from the dip, was probably coming out with a horse. At the foot of No. 6 crosscut, Robert Broom, the overman, had just fired a shot near the face of the crosscut, and a pusher and the men from the face were somewhere near by. Beck, whose working-place was in the counter from No. 5 crosscut, had probably gone to see the overman. Two other men were at work at the face of the West level. The men had clearly been at work at the moment of the explosion, as a scraper was found in the left-hand hole and a wooden rammer in the right-hand hole. *It is probable that a Monobel cartridge was part way down the right-hand hole.*

Down the dip the rope-rider was probably at the end of the wire of the signal-bell, as the rope was attached to a fully loaded car ready to haul out. Two men were at work at the face drilling a hole on the left-hand side, and their lamps hung one on each side of the heading.

In the slope counter, or No. 1 Dip level, two men were at work, Leach at the face, and his lamp hung on a prop. Two holes had been drilled in the face, one on the left-hand side and the

other on the right, and spades, pick, and auger were also at the face, with an empty car behind. The other partner, Crewe, would appear to have been doing something near the dip.

THE EXPLOSION.

Very little evidence of force was demonstrated on the surface, but quite sufficient to show that an explosion had occurred. The phone at No. 1 shaft was put out of use, the explosion-doors over No. 2 upcast shaft were slightly lifted, and the double doors at the entrance to the fan forced open, the inner one remaining open.

The men from the rock tunnel, which was ventilated by compressed air, and some of the men from the East side workings were the first to reach the surface, led by Thompson, who described the noise of the explosion as being like a rock-blast with heavy concussion, which seemed to block the ears. Their lamps were extinguished. Thompson greatly distinguished himself during the rescue-work, and practically all the men inside of No. 2 East crosscut were got out through his and John Graham's efforts, as the latter induced some of the men to take refuge in the rock tunnel. Two other men, A. L. Mazs and H. Clark, having escaped out of No. 1 East to shaft No. 1, signalled to the No. 1 engineer, but as they got no answer they returned to try and find Mazs' son, but the smoke was too dense, and whilst resting they heard a groan and were fortunate in finding J. Floretti, whom they helped to the No. 1 pit-bottom, and then to No. 2 pit, whence they took him to the surface. This man Floretti certainly owes his life to the bravery of these two men.

No lives were saved by the Draeger apparatus, and it was only used for one exploratory expedition, which satisfied its users that no one was alive inside the West level and slope.

All the separation doors, stoppings, and brattices were blown out along the whole length of the haulage-road from the shaft to No. 6 crosscut, and also from the top of the Dip slope to the face of the slope and the face of the No. 1 Dip level. The direction in which some of these were blown is a little uncertain; there is no doubt, however, but that the force coming outby from the dip traversed both the main haulage-road from the dip and also along the counter-level from Nos. 4 and 5 crosscuts.

To ascertain where the demonstrated forces originated, it is necessary to consider the whole of the indications of the happenings which may have contributed to the result.

THE PLACE OF ORIGIN OF THE EXPLOSION.

Without any doubt whatever, the force which came up the Dip slope was the most violent. It brought along with it a large percentage of the wooden brattice out of the dip and piled it in the form of kindling-wood against the hauling-engine, and some of it was forced into the spaces over the roof timbering. The brattice in the No. 1 level of the Dip slope was also blown down.

From the top of the dip the force was deflected both east and west and, in the opinion of the writer, passed up both No. 4 and 5 crosscuts into the counter on the West side and direct to the shaft-bottom in an easterly direction.

At the top of No. 5 crosscut the counter had been driven almost far enough to connect with No. 6 crosscut, and, judging from the appearance of the gauzes of Vittar's safety-lamp, the severe burns on the bodies of the three men who had just hauled a stringer into the place, also the report that the coal was soft and inclined to bump, the writer believes that the return air from this place added fuel to the flame, particularly as there was a considerable quantity of dust. It is, however, an undoubted fact that the injury to the lamp of Sutter, which was found hanging on his belt, could only have been caused by horizontal force from the east. Sutter's body entirely protected the lamp from a vertical force; and, moreover, the injuries to the lamp as pictured in the photograph No. 14 are such that they could not be produced by a vertical force. The position of the man Davis (No. 11) is strongly suggestive that the main force went up No. 4 crosscut, because two stringers at the top of it were twisted at their easterly ends towards the south. Davis was found on his knees with his head facing outby and resting on his arms, and his lamp a few feet behind him. The man Harker, at the foot of No. 5 crosscut, was about to fix a tally on a car and was very badly burned all over.

From No. 5 crosscut and inby towards the West face the force of the explosion gradually decreased, and from No. 6 crosscut inwards no damage whatever was done to the brattice; in

fact, had not the compressed-air pipe been broken near the shaft, it is not improbable that some of or all the seven men in this part might have survived.

A most notable feature of this disaster is that a shot was fired by the overman (Broom) in No. 6 crosscut only a few seconds before the explosion. What is of still greater importance is the fact that it lighted an accumulation of gas which had collected between the time that he and the miners came out from the face and the firing of the shot. This occurrence might have raised a doubt as to the carefulness of the examination, had not a similar thing occurred during my examination. When we were up at the face it was clear from gas, but after going down to the level we found it necessary to return to the face for further facts, and the leading man had his lamp extinguished by the gas which had accumulated in that short interval. This ignition of gas by a Monobel shot fired by an electric detonator proves without any doubt that the class of Monobel now being used is not a flameless explosive. It is absolutely certain that, although there was an undoubted ignition of gas, yet there was very little explosive force developed. Two tons of coal were displaced by the shot. Broom ran a few yards inby before falling, and the two miners out of the crosscut ran to the face of the level, whereas the two men working at the face ran outby as far as No. 6. The horse was singed on its hind-quarters and the driver was burned on the face and body. Another man just behind the latter was burned only on the face, hands, and wrists. Only one of the two men, Nos. 15 and 14, was slightly burned, and both died from gas-poisoning. The two men who ran to the West face were slightly burned and died from gas-poisoning. It may here be noted that there had been an outburst of gas in No. 6 crosscut and some tons of coal displaced on the morning of the explosion, but this is not reported in the fireboss's report-book.

Returning to the Dip slope, the position of the first body met with was that of Williams (No. 6), burned only on the hands; the next one was his partner, Guffog, who was slightly burned on the legs; and below him was James Mazs, the rope-rider, who was found feet first under the loaded car which was attached to the hauling-rope. Mazs was badly burned on the face and body; in fact, burned down to his thighs; and the inside of his mouth and tongue were badly burned. A noticeable feature of this body was that the eyes and mouth were wide open and could not be closed, doubtless the result of a terrible nervous shock. The glass of Mazs' safety-lamp was broken when found, but there was no sign of gas having been burning within the gauzes. The leg-burns on No. 7 (Guffog) were probably due to the ignition of a small blower of gas which was active on the left-hand side of the floor of the heading.

In the No. 1 level out of the slope gas had been reported by the firebosses, and I am firmly convinced that it was in this level where the heaviest force originated. There were two men working here, and at the time of ignition one of them, Leach, was working at the face with his lamp hanging on the 7-foot prop, 27 inches below the stringer. This lamp when examined showed that gas had been burning in the top of the inside gauze, but otherwise the lamp was intact. The lamp was not disturbed by the explosion, and Leach was only comparatively slightly burned on the head and shoulders, his death being due to gas-poisoning. His body was found on the top of a small cave on the lower side, and therefore it is clear that the cave occurred previously to the explosion and was not there at the conclusion of the previous shift. The body of F. Crewe was found outby and within a short distance from the Dip slope and inby of a fall of roof. This fall was not there when he went to work, because a car of coal had been loaded out and an empty car brought in. Crewe was found badly burned on his face and his whole body. His lower jaw was fractured and teeth blown out. Both bones of the right leg were broken, his left arm broken near the wrist, thighs scorched, and hands badly burned. He had a punctured wound on the right side of his neck and his right lung was also punctured. Neither he nor his partner wore their caps when at work, hence all the hair was burned off their heads.

His body was found facing the dip and laid across the roadway close to the place where he kept his store of explosive, and inby of the roof fall above named. The difficulty which arises in fixing on this point as one point of origin of the explosion is in discovering what Crewe was doing at the time. The class of injury he received points most convincingly to an accident from detonator-caps or combined with some explosive. Although I saw the body before burial, yet the importance of the punctured wounds was not then realized, and, his clothes having been burned by the undertaker, no further direct evidence could be obtained.

After taking all the facts and occurrences into most careful consideration, the principal of which are: (1) That the door which separated the main intake air-current from the return

air-current at the end of the Main tunnel from No. 2 shaft had been open for some unknown period of time immediately before the explosion; (2) that the ventilation of the West side of the mine ceased entirely during that period of time, excepting only the compressed-air exhaust from the West side "booster" fan near No. 6 crosscut; (3) that whilst the door was open the overman (Broom) was preparing to fire a shot in No. 6 crosscut, where there had been an outburst of gas and coal a few hours before, and of which he might not have been aware; (4) that Broom did fire a shot which ignited gas and the flame travelled down the crosscut without explosive violence; (5) that one or more falls of roof occurred in No. 1 level of the Dip slope before the disaster, and released fire-damp into the air-current; (6) that whilst the released fire-damp was passing over Crewe he either caused one or more detonators to explode, or a fall of rock from the roof effected the same result.

In this regard I would direct your attention to the injuries to Crewe's safety-lamp, a photograph of which (No. 10) shows one small indent in the shield as its sole injury outside, but inside the effect of a different force is disclosed—viz., by the crushing of the outer wire gauze over the copper ring at its base. The copper ring is shown in position on the top of the glass part. The gauze is not otherwise damaged, and such an effect could only be obtained by a strong air-blast or one mixed with dust entering in a diagonal direction through the opening at the top of the lamp. A detonator-wire was found amongst the debris sent out from this part of the mine, but it is no positive evidence of its connection with the explosion.

THE INQUEST AND REMARKS THEREON.

In accordance with your instructions to attend the resumed inquest on the twenty-two bodies of men killed by the Reserve Mine explosion, if subpœnaed, and having received a subpœna, issued, I understand, by the Coroner at the request of Thomas Graham, the Chief Inspector of Mines, I left Vancouver on the evening of the 15th instant and returned on the evening of the 18th instant, and was present throughout the inquiry.

At the outset I did not intend to do more than watch the case, with the object of finding out important facts which were material to my report on the mine, the explosion phenomena, and the future safety of the mine; but, after I had been called by Mr. Graham, given evidence, and been cross-examined, Mr. Graham called J. G. S. Hudson, a Dominion Government official from Ottawa, to give expert evidence, based on what he had seen.

The latter's views, as expressed during his examination by Mr. Graham, were such that I found myself compelled to put a question to him through the Coroner. On the opening of the Court the following morning, having realized the difficulty of putting each question through the Coroner, I asked that in view of my instruction from you, dated the 28th ultimo, I be allowed to cross-examine the witnesses. This request having been granted, I immediately asked for the recall of Mr. Hudson. My questions were mainly directed to the system of ventilation; the cause, direction, and effects of the explosion; and the importance of the fact that the main separation door in the tunnel from No. 1 shaft had been open for an unknown period of time *immediately* prior to the explosion—viz., whilst a car of 9-foot timbers, in course of being shunted, was twice taken through the door. Mr. Hudson had stated in his evidence that he did not attach much importance to this fact, and later Mr. Graham also gave a similar opinion.

I believe that this door having been open was one of the important factors which made this explosion possible.

Mr. Newton, District Inspector of Mines, said that there was not room enough between the headings to place two doors, but Plan B will show that there was no practical difficulty in doing so. Too much reliance was placed in the "booster" fan on the West level, which was only capable of ventilating the mine *inside* of No. 5 crosscut through a wooden pipe 24 inches square, and had practically no influence on the main air-current.

The calling of the witnesses appeared to have been in the hands of Messrs. Graham and Newton. The Western Fuel Company did not call any witnesses, and their barrister, Mr. Yarwood, did not examine any of them in chief.

No evidence was called to show who took charge of the mine immediately after the explosion, nor of the damage done to the fan, nor as to why the speed of the fan was not increased. This latter was of the greatest importance, seeing that the volume of air could have been readily increased from, say, 25,000 cubic feet to 400,000 cubic feet a minute. Mr. Newton said that he

had not been made aware of the damage done to the doors leading into the fan-drift, nor of the lifting of the explosion-doors on the top of the upcast part of the No. 2 shaft.

No evidence was called to describe what damage was done by the explosion to the housing round the winding compartment at the foot of No. 2 shaft. One or two boards were, however, knocked off, and, as was admitted by Mr. Hudson, if this housing had been a little more seriously damaged, the whole of the ventilation of the mine would have been cut off, and what volume of air was exhausted by the fan would have gone down one part of the shaft to return immediately up the other side, and every man in the mine would have been lost. A similar state of affairs was in evidence at the Courrières disaster, and was one of the principal causes of the great loss of life after that explosion.

This arrangement of the ventilation is a positive danger to the safety of the Reserve mine, and ought to be altered as soon as possible.

The plan put in in evidence by Mr. Gorman shows that the "booster" fan placed inside the wood brattice on the West level was for the purpose of ventilating the West level and No. 6 crosscut, but otherwise it did not assist in the ventilation of the mine. If, however, for any reason the compressed-air engine driving the fan was stopped, the two above-named places would be rendered airless.

As regards the "booster" fan on the East side, also driven by a compressed-air engine, the curtain at the foot of No. 4 crosscut might be dispensed with and be of advantage, through reduced friction, to the general ventilation of the mine.

The separation door and curtain in the Main level west of the return air-drift to the upcast shaft ought to have the curtain replaced by a door.

The new tunnel for the return air to No. 2 shaft is now ventilated solely by compressed air, and up to date this appears to have been sufficient, but, in view of the fact that this is a mine subject to outbursts of gas, the non-ventilation of this tunnel by brattice does not appear to be a good policy.

Some evidence was given with regard to the use of explosives and the quantities which had been taken into the mine, particularly by the men on the 3 o'clock shift in No. 1 counter-level off the Dip slope. It was shown that these men on the day of the explosion had at least one 4-lb. case of powder, eleven sticks of Monobel, and six electric detonators inside a box without a lid, four loose, and two sticks of Monobel ready fuzed outside the box; also two sticks of Monobel were found 16 feet just outside the above, where the cave of roof was. One loose detonator was also found amongst the rock and coal which was loaded up from a cave where Crewe's body was found. The man Crewe was the partner of Leach, and was in the habit of preparing the explosives used by them in the face of this counter-level, and, as two holes had been bored ready for charging, it is assumed that at the time of the explosion of the mine Crewe was preparing the explosive for use. The evidence proved that near Crewe's body, and in front of him, a cave of roof had occurred, that another small cave of roof had occurred where Leach's body was found, and also a third one in the Dip slope about half-way between the counter and the top of the slope. The force of the explosion was from Crewe's body inby to Leach's body, and from Crewe's body to the foot of the slope, and also up the slope to the main West level. Crewe's lamp was found in front of him, practically undamaged as far as its outward appearance indicated, but showing by the injury to the gauzes inside that it had been subjected to a considerable air-blast or force which did no mechanical injury to the frame of the lamp. This is distinctly shown by the photographs marked 10, 11, and 13. The importance of the damage to this lamp was pointed out by myself to the Court. Probably the most important feature of the indications at this point are afforded by the injuries to Crewe's body, which are described by Dr. Ingham as follows: "Badly burned over face and entire body; teeth blown out; lower jaw fractured; punctured wound on right of neck; right lung punctured; both bones of right leg broken; left arm broken near wrist; thighs scorched; hands badly burned; burns and shocks."

It will be seen that these injuries were of an entirely different character to any others throughout the mine, especially the punctured wounds in the neck and chest, and the broken wrist, which were undoubtedly such as might have been caused by an explosive force generated close to Crewe. Leach's body found near the face of the level was not burned or injured so severely as Crewe's; in fact, he had been able to move outby several feet. The force and flame also went down the slope until they cushioned against the face, and in their course caught Mazs

and burned and injured him so severely that he was instantly killed, and his eyes and mouth frozen wide open and could not be closed. Guffog, who was working at the face, was singed below the knees, probably by the ignition of gas which was bubbling through the water at the face. The other man was also slightly singed. Some blood from both of these bodies was submitted to spectroscopic examination by G. S. Eldridge & Co., and showed that death was due to carbon-monoxide poisoning.

With all these indications of flame and force, it is remarkable that no one suggested that the explosion originated from the breakage of Mazs' safety-lamp glass. It was absolutely demonstrated that there was gas in the air-current, as Leach's lamp showed that it had been burning inside the inner gauze, and therefore there was just as much reason to suppose that the explosion originated from the breakage of Mazs' lamp as to say that it was due to the breakage of Sutter's lamp. Within the last few days an explosion has been reported to have occurred in a suit-case filled with dynamite, but the detonator failed to fire the charge and only the suit-case was blown to bits. There is, therefore, nothing astonishing or impossible when proposing that the Reserve Mine explosion originated from an accident with a detonator.

Mr. Hudson theorized that there was *no* explosion of gas in the Dip slope; Mr. Graham acknowledged that there was; but the officials of the mine did not attempt to explain the burning and force effects in the Dip slope.

The most fatal argument against the above-named theorists is the fact that the cubic contents of No. 5 crosscut counter was only about 8,000 cubic feet, and also that there was ample oxygen close at hand to make a complete combustion without having to go so far away as the Dip slope. If Mr. Hudson's theory had had any basis to stand on, the injuries to the men in the slope ought not to have exceeded those of the men on the inside of No. 6 crosscut on the West level. Further, Mr. Hudson's theory was not supported by Mr. Graham, who was certain that there was an explosion of gas in the Dip slope.

The bodies found in No. 5 crosscut counter did not indicate in any way that the men had been alarmed by the breaking of timber or of falling coal, but just as if they had laid down the stick of timber which they had carried up to the face. In fact, Vittar still had in his hand the rope he had been using. Again, Vittar's body could not be recovered until his foot had been released from under the timber.

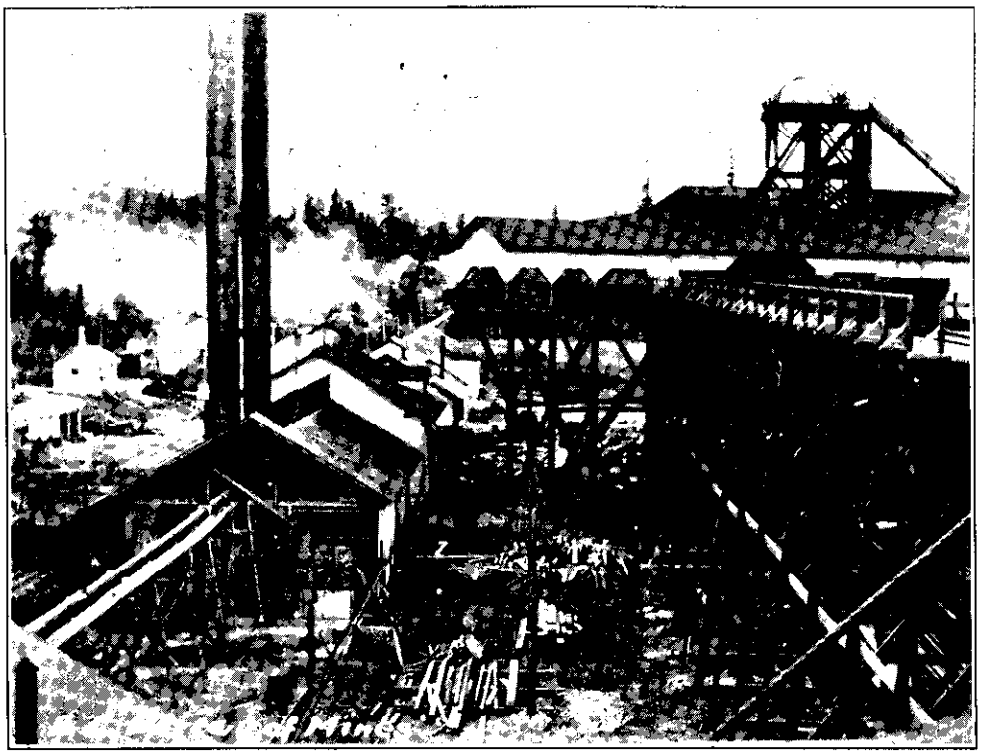
As to the burns and injuries to these men, it will be readily understood that, if a fall of roof took place before the origination of the explosion, the bodies of these three men must have been covered with coal, and therefore could not have been burned. The same force which smashed Sutter's safety-lamp also broke his left thigh. (Photo No. 14.)

None of the theorists ventured to suggest from what height coal or material would have to fall to cause the injuries to Sutter's safety-lamp. I assert, with the utmost confidence, that no force falling vertically from a height of, say, 9 feet could possibly damage Sutter's lamp in the way it was damaged. (*See* photo No. 14.) This convincing fact could not be shown visually to the Coroner and jury, because when the remains of the lamp were called for, and later on produced in Court, the damaged shield was entirely missing, and no other explanation was given than that it had been buried. In confirmation of the supposition that this shield had been damaged by a horizontal force and not by a vertical force, it was noticed, when the lamp was first examined, that a piece of brattice-cloth had become wedged in the broken part of the shield, and that the frayed ends were charred. This was an additional proof that the force came along horizontally.

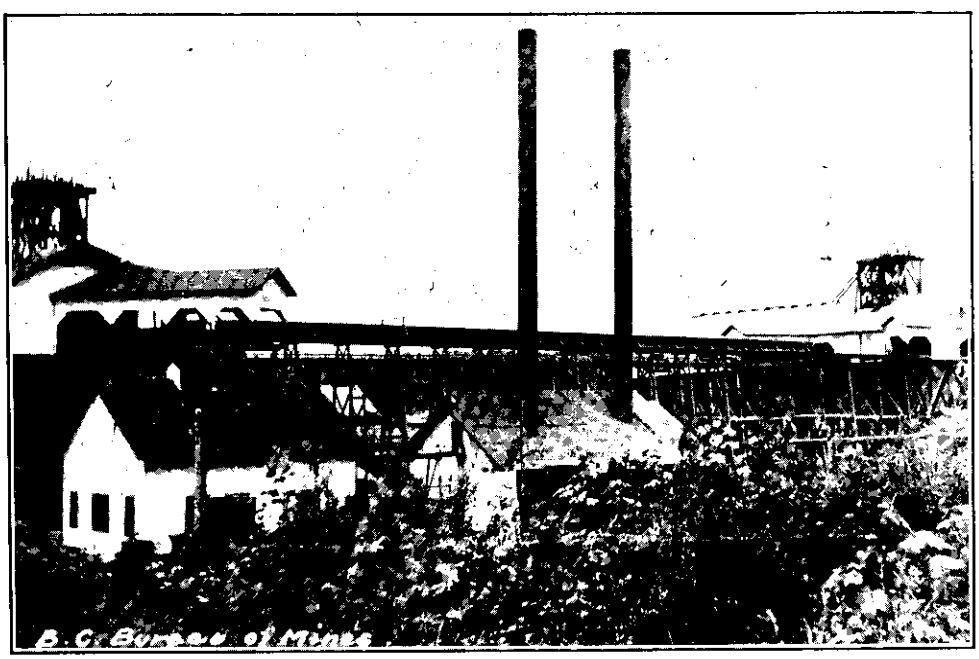
Over thirty samples of dust from various points on the West side of the mine, also two samples of the whole thickness of the coal, were taken and sent to the Government Assay Office at Victoria; these thirty-three samples, and several others, were first examined under the microscope. In some cases the two do not entirely agree, because there were doubtless particles of coal-dust which were added after the explosion. The chemical and microscopical examinations, however, assist materially in the effort to trace out the course of the explosion-flame.

The counter-level on the West side was probably the driest part of the mine, and at the time of the explosion some dust would be present in the air consequent on the men dragging a stick of timber up No. 5 chute.

In No. 6 crosscut a shot had been fired *immediately* before the explosion. Why this shot was fired in a place where there had been an outburst of gas during the previous shift, and where no shot had been fired for many weeks, will for ever remain a mystery. My examination



No. 1 Shaft from No. 2, Western Fuel Co., Nanaimo.



No. 2 Shaft, Western Fuel Co., Nanaimo.

proved to me that a shot had been fired on the right-hand side and had apparently done its work effectually, but gas had been ignited, and from appearances I concluded that the gas was fired by the shot. This being the case, the class of Monobel used was not flameless, or the detonator was not sufficiently strong to properly detonate the charge. There was undoubted evidence of flame at this point, but no appreciable force had been generated to show its effect anywhere in the chute. Cindering, however, could be distinctly felt on the roof-coal.

A sample off the top set of timbers shows just normal conditions; thus sample No. 9056 shows moisture, 1.5; V.C.M., 36; F.C., 51; ash, 11.5; and the ratio of V.C.M. to F.C. to be 1.41.

Comparing this with a sample of the whole seam taken from the face of No. 5 West counter, we have in No. 9064: Moisture, 1.6; V.C.M., 35.5; F.C., 49.6; ash, 13.3; and the ratio 1.40, the only difference being in the F.C. and the ash; when these two are added together the samples are identical, and show no cindering at all.

This analysis does not agree with the microscopical examination made by Messrs. Graham, Hudson, and myself, the record of which is: "This sample was taken from the roof at a higher point than No. 25. Sample shows perceptible evidence of coking; seen with the naked eye, and under the magnifying-glass, showed the evidence of heat, tar, and globular bubble form. This sample was solid coal and *not dust*." The latter sentence undoubtedly explains the apparent discrepancy between the visible results and the assayer's results, the latter having evidently taken a piece of the solid coal for his assay.

A sample of dust taken about 20 feet down the No. 6 chute showed under the microscope distinct rounded corners, tar-bubbles, and coking, and this is confirmed by the assay (No. 9058): Moisture, 1.6; V.C.M., 24.6; F.C., 57.2; ash, 16.6; and the ratio of V.C.M. to F.C., 2.33.

At the bottom of No. 6 chute a sample taken off a board near where the loaded car was standing showed "distinct evidences of heat by the tar-bubbles and congealed particles." This is supported by the chemical analysis (No. 9059): Moisture, 2.5; V.C.M., 17.3; F.C., 46.4; ash, 33.8; and the ratio of V.C.M. to F.C. as 2.68, which is only 0.02 less than the sample (No. 9044) taken from the 4- x 2-inch stick in No. 2 crosscut on the main West level.

There were no distinct evidences of force in No. 6 crosscut, and the assays and microscopical examinations seem to show that there was a point somewhere near to the last settings of timber in this crosscut where there was not as much heat as at either the top or the bottom of it. It may therefore be concluded that the force and flame of the explosion coming inby from the Dip slope ended at No. 6 crosscut, which at the time would be filled by dust from the coal displaced by the shot and rolling down the chute.

Lastly, we have now to consider what assistance is rendered to my conclusion that the explosion originated near to the place where Crewe's body was found in the counter-level out of the Dip slope. A sample of dust was taken off a slab over the timbering near Crewe's body; the analysis of this showed: Moisture, 3.1; V.C.M., 24.2; F.C., 53.1; ash, 19.6; and the ratio of V.C.M. to F.C., 2.20. Under the microscope the dust showed cindering. Cindering was likewise shown on the buffer of the car at the face of the same counter.

The third prop on the West level and inby of the slope showed: Moisture, 2; V.C.M., 28; F.C., 46.5; ash, 23.5; and the ratio of V.C.M. to F.C., 1.66. In the same level near No. 4 crosscut a normal ratio of 1.48. Near Davis's body a ratio of 1.70; so that on the West level the greatest indication of heat was at the second crosscut—viz., 2.70.

In the West counter-level at the top of No. 3 crosscut the ratio of V.C.M. to F.C. was 1.81; at the top of No. 4 crosscut the ratio was 1.51; on the west side of No. 4 West crosscut the ratio was 2.29; at the top of No. 5 West crosscut on the outby side of the crosscut the ratio was 1.42; dust off clothing found on the inby side of No. 5 crosscut counter showed a ratio of 1.73; a sample taken off Bewley's arm was too small for a complete analysis, but showed cindered dust; the first sample taken in the counter inside of No. 5 crosscut showed no signs of cindering, the analysis giving: Moisture, 1.8; V.C.M., 32; F.C., 48.9; ash, 17.3; and the ratio, 1.53.

Not a single one of these samples showed the effects of flame coming out of the counter where Bewley's, Vittar's, and Sutter's bodies were found, and do not support the theory propounded by the Western Fuel Company's officials, supported by Messrs. Graham, Hudson, and Newton. They do, however, show that the flame *did* reach the counter up No. 4 crosscut, and probably up No. 3 also; that it passed along the West level as far as No. 6 crosscut, and outby easterly as far as the mechanic's cabin, and to where Kirkbride was found.

The coking and cindering effects which would have been produced by the violent explosion of an outburst of gas and dust in the far end of the West counter, past No. 5 crosscut, are entirely missing, and prove, as far as it is possible to prove, that the flame and force went up No. 4 crosscut into the west end of the counter, and thereby, as shown by Sutter's safety-lamp, broke the shield, gauzes, and glass by a horizontal force; the back-lash from which caused the large cave which delayed the recovery of the last three bodies. Most of the timber supporting the roof at this place was twisted; that is to say, one end was forced outwards and the other end inwards—"it reeled."

On the conclusion of Thomas Graham's evidence and cross-examination, Mr. Coroner Jeffs, of Vancouver, shortly instructed the jury as to their duty, and after a retirement of about an hour they brought in the following verdict: "We, the jury empanelled to inquire into the cause of the death of William Ball, Robert Kirkbride, and twenty others, find that they came to an accidental death on May 27th by an explosion of gas in the Reserve mine of the Western Fuel Company, Nanaimo; and after hearing the evidence of thirty-three witnesses we cannot attach blame to any person. We also find that every precaution and care has been fully exercised by the management of the said company."

Mr. Coroner Jeffs thanked the jurymen for their services, and expressed the belief that they had come to the only possible verdict on the evidence submitted to them. He also congratulated the jurymen on the harmonious proceedings, and also on the high intelligence shown by all the witnesses, it not having been found necessary to have an interpreter.

Conclusion and Suggestions.

(1.) In the body of my report I have already referred to matters in connection with the ventilation of the mine which in my opinion require prompt attention—viz., the upcast shaft and double doors.

(2.) *Wolf Safety-lamps.*—The arrangement for testing these before being issued to the miners is entirely inefficient. In the tests made for me by the lampman it was impossible, from lack of explosive gas, to test the bottom ring gauze, and the generation of gas in the apparatus was far too slow. Hence the tests I desired to make on some of the safety-lamps recovered from the mine could not be made. The safety lamps were well looked after and in good order. (*See* photo of the lamp-room.)

(3.) *Gas.*—The reports by the mine officials with regard to gas are of a too condensed character; for instance, the reports say "a little gas," or "a small quantity of gas," or "gas"; but there is no indication to show what percentage of gas is implied, neither do the reports say if the gas reported is in the ventilating-current or only in the roof, or where.

In the case of an outburst of gas during the shift, as in No. 6 crosscut on the morning of the day of the explosion, this does not seem to have been reported at all, and there is therefore no evidence to show whether or not the overman (Broom) was aware of the fact when he fired the shot in that crosscut.

Further than that, there is no evidence to show what course was adopted by the officials in the case of gas found in No. 1 level off the slope; thus, gas was reported in this place by each fireboss examining it on *every* shift from 11 p.m. on May 19th to the 3 p.m. shift on May 22nd, making eight consecutive shifts. Presumably miners were at work and using on an average probably all or most part of 4 lb. of explosive a shift. Under these conditions, I consider that it is of the greatest importance to the future safety of this mine that the word "gas" should be more intelligently understood, and that when the off-going fireboss reports gas, the on-coming man should indicate what he did to remove it. The importance of "gas" in this particular place will be realized when it is stated that the fresh air had only passed one working-place in the slope before passing into the No. 1 level, and that it had then to pass through *every* working-place in the mine. It was a surprise to me when in the witness-box to find myself asked the question: "Where did the gas come from, which I assumed was ignited at or near the point where Crewe's body was found?"

The report-book does not indicate what course was adopted when the outburst of gas took place in No. 6 crosscut; were the men withdrawn from the places on the return-air side until the gas was drained off?

(4.) *Explosives and Detonators.*—The conditions under which these are stored in the mine are very dangerous. For instance, in the No. 1 level out of the Dip slope (Crewe's place)

Monobel and detonators were stored in open wooden boxes by two shifts, and in a bucket by the other. The detonators were not separated from the explosive and were in some cases ready fixed in the Monobel cartridges. It would seem advisable, therefore, that each shift should take its own unused explosive out of the mine, and that the fireboss should carry the detonators with him, *also that the rules regarding the charging of shot-holes should be strictly enforced.*

(5.) *Ambulance.*—In this department the arrangements for doing all that is possible to save the lives of the men who may be injured from time to time are a great credit to the Western Fuel Company and the men who are trained for the work of rescue. One man named Floretti was the only man rescued alive from the area of the mine affected by flame and force, and this man owes his life primarily to the pluck of two men named Mazs and Clark, and, secondly, to the Western Fuel Company's hospital on wheels, in which he was transported to Nanaimo, and thence to the Nanaimo Hospital. (*See* photo 18.) At first there appeared to be no hope for his recovery, but now there is practically no doubt but that he will pull through.

(6.) I append a full copy of the description of: (*a*) The samples of coal-dust taken from various parts of the Reserve mine, and (*b*) of the microscopical examination by Messrs. Graham, Hudson, and myself; (*c*) of the assays of the most important samples made by W. Fleet Robertson, Provincial Mineralogist and Assayer; (*d*) a copy of a report from the Mines Department at Ottawa of a sample of mine-air taken from the West return of the Reserve mine on May 8th, 1915, which shows a content of 0.75 per cent. of methane (on this date no gas was reported to be in any working-place in the mine, nor for two days afterwards); (*e*) copy of Dr. Ingham's report on the injuries to and cause of death of twenty-two men; (*f*) copy of G. S. Eldridge & Co.'s report on the spectroscopic examination of blood from Guffog and Williams; (*g*) also five blue-print plans marked A, B, C, D, E; and (*h*) album of photographs.

(7.) *Conclusion.*—After the most careful investigation of all the available facts in connection with this explosion, I have no hesitation whatever in stating, firstly, that it was primarily due to carelessness in the use of, or storage of, detonators in the mine; secondly, to a small outburst of gas in No. 1 West level off the Dip slope, and possibly in the Dip slope also, and which, thirdly, became dangerous through the single main air-separation door near No. 1 shaft having been open for an appreciable length of time immediately before the explosion. Each minute meant a lessening of about 13,000 cubic feet in the volume of fresh air ventilating this portion of the mine.

I have pleasure in reporting that I have received every necessary assistance from Mr. Stockett, the general manager, and the officials of the Western Fuel Company; also from Thomas Graham, the Chief Inspector of Mines, and the District Inspector, Mr. Newton.

(NOTE.—Appended to Mr. Ashworth's report is: A and B. List of samples of coal-dust collected. C. List of analyses of samples by Government Laboratory. D. Analysis of mine-air sample (Lab. No. 47) by Mines Branch, Ottawa. E. List of persons killed and injuries found, by Dr. O. G. Ingham. F. Certificate of analysis of blood by G. S. Eldridge & Co. As exactly identical lists, etc., are published in connection with Chief Inspector Graham's report, they are not here repeated.)

INSPECTION OF METALLIFEROUS MINES.

WEST KOOTENAY AND BOUNDARY DISTRICTS.

REPORT OF JAMES McGREGOR, INSPECTOR.

I have the honour to submit my annual report as Inspector of Metalliferous Mines for West Kootenay and Boundary Districts for the year 1915.

SLOCAN DISTRICT.

The various mines of this district that have shipped have not done so continuously the whole year, but, in many instances, development-work has been carried on with vigour during the whole year. Since the condition of the metal market justified the shipping of the ores great activity has been displayed throughout the whole of the district, and a very much increased output has been the result, while several new mines became shippers.

This district has not been so prosperous for many years and the outlook for the future is very bright. Upon inspection of these mines I have found them carefully operated and complying with the requirements of the "Metalliferous Mines Inspection Act."

NELSON DISTRICT.

The number of mines shipping in this district has not increased during the year; those which have been in operation increased their output, with every prospect of a further increase as development proceeds. Upon inspection of these mines I have found them well and safely operated and the requirements of the "Metalliferous Mines Inspection Act" adhered to.

LARDEAU DISTRICT.

The mining conditions remain about the same as last year in this district, very little ore having been shipped during the year. As usual, developing and prospecting is very active.

AINSWORTH DISTRICT.

Great activity exists in this district at present in developing new properties and opening up others which have been idle for years. The number of shipping mines remain about the same as last year, those shipping have increased their outputs considerably over last year, and the outlook for the future of this district is very encouraging.

When making an inspection of the mines of this district I have found them in a safe and sanitary condition, and the requirements of the "Metalliferous Mines Inspection Act" being fully observed.

YMIR DISTRICT.

There has been little change in this district during the year; the mining being carried on at present consists of developing and prospecting, with indications of ore being shipped in the near future.

ROSSLAND DISTRICT.

The mines in this district have been operated continuously during the year, with a large increase in the output over previous years. A great amount of development has been accomplished and permanent improvements completed during the year. I mentioned in my annual report of last year concrete was being used to replace the timbers in the *Centre Star* shaft at Rossland, which is the main hoisting-shaft of the Consolidated Mining and Smelting Company; this work will continue until all timber is replaced by concrete. There has been no change in the system of mining in this district; the square-set system, giving the greatest satisfaction, is consequently followed.

Upon inspecting the mines and machinery connected with them I have always found care taken in keeping every part of the mine and machinery in good condition; I have found the ventilation good, timbering well done and safely placed, and the travelling-ways, cages, skips, and ropes carefully attended to.

BOUNDARY DISTRICT.

This district has, as usual, been the largest producer of tonnage and is still keeping up that reputation. The larger mines have operated continuously during the year. As there are very large stopes in these mines, the management has been filling many of them with waste from other parts of the mine, also by taking down the old waste-dumps from the surface, which was done by driving raises from below, especially for this purpose. In other instances the pillars have been drawn, causing many large worked-out stopes to cave, thereby relieving the pressure on others which are still unfinished.

The quarrying of the ore from the surface is continued in parts of the Granby Company's mines, the loading being done by an electrically operated shovel which is capable of handling large quantities of ore.

Upon the different inspections made by me of these mines I have found care exercised in every way, especially in scaling the walls in the stopes and travelling-ways. The large quantities of powder necessary in these mines I find is carefully handled; low-freezing powder is used, thereby removing the necessity of thawing.

SHEEP CREEK DISTRICT.

There has been an increase in the number of mines shipping in this district during the year, with every indication of a further increase in the near future; the output is steady from the mines which are in operation. As yet, the shortage of water owing to the streams freezing has not affected the operations.

Upon inspection I have found these mines in a safe condition and a desire on the part of the managements to comply with the requirements of the "Metalliferous Mines Inspection Act."

Enclosed you will please find a list of the accidents which occurred in and around the metalliferous mines of the West Kootenay and Boundary Districts for the year 1915.

EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF T. H. WILLIAMS, INSPECTOR.

I have the honour to submit my annual report as Inspector of Metalliferous Mines for the East Kootenay District during the year ending December 31st, 1915.

I made an inspection of the *Sullivan* mine, Kimberley, on August 12th, and found that operations were being carried on in general compliance with the "Metalliferous Mines Inspection Act."

I made an inspection of the *Guindon* and *St. Eugene* mines, Moyie, on September 21st, and found that operations were being carried on in general compliance with the "Metalliferous Mines Inspection Act."

SIMILKAMEEN INSPECTION DISTRICT.

REPORT OF ROBERT STRACHAN, INSPECTOR.

I have the honour to submit my annual report as Inspector of Metalliferous Mines for the Similkameen District during the year ending December 31st, 1915.

The mines operating in the district during the year include the *Nickel Plate*, operated by the Hedley Gold Mining Company, Limited; the *Lake View-Dividend*, operated by the Lake View Gold Mining Company, Limited; both of these are in the Osoyoos Mining Division; the *Maggie* mine, operated by the Golden Gate Mining Company, Ashcroft; the *Iron Mask* mine, operated by the Kamloops Copper Company, Limited, near Kamloops; the *Monarch* mine, near

Field, operated by the Great Western Development Company; and the *Highland Valley* mine, operated by Vosburg & Coulson on Glossie mountain, between Ashcroft and Merritt. All of these were working during the year except the *Lake View-Dividend* mine, which shut down in August, 1914, due to the closing of the smelters, and has not since resumed operations.

Attached is a list of the accidents reported during the year, amounting to three, one of which resulted fatally.

Two of these occurred in the *Nickle Plate* mine, one due to a piece of rock falling, striking the workman on the head, from which he died later; the other a case of a wheelbarrow falling back on the workmen while it was being hoisted out of a chute into which it had fallen.

The other accident occurred at the *Maggie* mine, operated by the Golden Gate Mining Company. In this case the workman attempted to jump across the open shaft, and fell a considerable distance, having several small bones broken in his foot.

The following is a brief description of each of the mines:—

Nickle Plate Mine.—Operated by the Hedley Gold Mining Company, Limited, G. P. Jones, general manager; Wm. Sampson, mine superintendent. This mine is situated at the top of the mountain from which it derives its name, at an altitude of 5,500 feet. It has been developed by tunnels driven through the country-rock until the ore-bodies were reached; No. 4 tunnel is the lowest of these tunnels, and during the year all the ore has been handled through it. A large well-timbered incline called the Dixon incline has now been sunk on the ore for a distance of 800 feet, levels being set off at each 200 feet. An air-shaft connects this to the upper working, thereby effecting a good current of ventilation by natural draught. The method of work is pillar and chamber, and, due to the thickness of the ore, about 35 feet, it is necessary to commence on the foot-wall and work upwards, using the broken ore as a floor for the workmen to stand on; when the top is reached slices are taken across the top, and as ore is taken away the pillar is gradually reduced down to the floor. In this method very little timber is used, great care being taken, in leaving the top or roof, to bar down all loose rocks, and it indicates with what thoroughness this is done that we have very seldom received reports of accidents from this cause.

The mineral is gold, partly free and partly in arsenical iron pyrites carrying gold.

Practically all the output of ore, amounting to about 200 tons a day, has been taken from the Dixon incline; this is dumped into ore-pockets, both sides using the same pockets, and the incline is fitted with double tracks, so that it can deal with large quantities; the skips carry about 2 tons, which is again dumped into ore-pockets at the top of the Dixon incline, from which the cars are loaded and hauled to the top of the gravity-tram, which takes the ore to the mill at Hedley. These cars have a capacity of 2 tons and are hauled by electric locomotives to the large ore-bins at the tram.

The gravity-tram to the mill is operated in two stages; in the first stage the ore, which is loaded into skips carrying about 5 tons, is lowered 4,000 feet; during part of this distance an auxiliary compressed-air engine assists the loaded skip. At the central station the skip is transferred by means of a fast rope to the lower tramway and continues its journey for another 6,000 feet, descending during the trip a vertical distance of nearly 3,800 feet. An automatic dumping arrangement permits of the skip dumping into the ore-bins above the mill, from which it is drawn as required.

The gravity-tram is a three-rail track with a passing in the centre, and is equipped with both bells and telephone. All the ore goes to the mill; there is no waste, and no sorting is done either at the mine or the mill.

During my inspection of this mine I have always found the "Metalliferous Mines Inspection Act" strictly adhered too, and every endeavour seems to be made to protect and select the workmen. Special rules are provided which each workman must read or have some person read to him, and then sign them before being engaged. Good accommodation is provided in the shape of cook-house, bunk-house, large and commodious reading and wash rooms.

Maggie Mine.—Operated by the Golden Gate Mining Company. W. Milne, general manager; J. Goldsworthy, mine foreman. This mine, which is situated about eighteen miles from Ashcroft, on the Cariboo road, resumed work this summer about July with the above officers in charge. A vertical shaft about 375 feet had been sunk, with levels set off at 100, 175, and 275 feet respectively. Owing to the long shut-down, the first work was to unwater

and repair the mine. This was done and all the roadways and levels timbered securely. Very little more than this was done for some reason, and later the mine was closed down. The mineral is copper, mostly as copper pyrites. A 34-horse-power boiler provides steam for the hoist and pumps, and there is fair accommodation in the shape of cook and bunk houses.

Monarch Mine.—Operated by the Great Western Development Mining Company. Newton W. Emmens, manager; J. Oke, mine foreman. This mine, which is situated about three miles east of Field, on the side of the Canadian Pacific Railway track, has been working for the greater part of the year. The mine is situated 1,100 feet above the Canadian Pacific Railway track and 5,100 feet above sea-level.

At the time of my inspection there were fourteen men employed, and the mine seemed to be in very good condition. Generally the "Metalliferous Mines Inspection Act" was being very well complied with.

The mine is worked on a pillar-and-chamber method, practically one large chamber with pillars of ore left here and there to support the roof. The height or thickness of the ore-body varies from 10 to 30 feet, while the width will vary from 50 to 120 feet. The mine has been driven in a distance of about 300 feet.

The values are in silver, lead, and zinc, and the ore is loaded into cars dumped down a winze; then reloaded, run out to another winze on the mountain-side, and again dumped down; then taken by a 2-bucket Riblet aerial tram to the mill. The tram is capable of handling 200 tons a day. The mill is built alongside the Canadian Pacific Railway and a spur provides facilities for shipping the ore.

Power for the greater part of the year is provided by water-power taken from Thomson creek, a stream flowing between Mount Stephen and Cathedral mountain, carried in a 12-inch pipe-line for 1,700 feet to a 4-foot Pelton wheel at the mill. A 100-horse-power steam-boiler, with a 13- x 18-inch engine, furnishes the power during the winter.

Iron Mask Mine.—Operated by the Kamloops Copper Company. A. Wallinder, manager. This mine is situated about seven miles south-east of Kamloops, and the mineral is copper in the form of suphides and carbonates. There are two shafts on the property—namely, the *Iron Mask* and the *Erin;* these are separated by about half a mile, and at present there is no communication between them, although in the future it is intended to raise a main shaft at a point between the two and make it the principal hoisting-shaft for both mines.

The *Iron Mask* shaft has been sunk 750 feet, with levels set off every 100 feet. The method of work is shrinkage stoping, or, in other words, pillars are formed and reduced to the minimum required to support the strata. The power used is electrical, brought from the city of Kamloops at 11,000 volts. At the mine it is reduced to 400 volts, and a 50-horse-power motor operates the hoist. Two air-compressors are driven by 125- and 75-horse-power motors respectively. Machine-shop and other workshops are all operated by electrical power.

At the time of my inspection I did not find the conditions very satisfactory, probably due to the irregularity of the work which has been done on this property, it having been opened in 1902 and worked intermittently since; very little attention has been paid to the "Metalliferous Mines Inspection Act." This applied more especially to ladder-ways, explosives, fences, etc.

The ventilation was fairly good, and from the attention which was paid to my suggestions I expect that all the points complained of will be remedied at an early date, and in future the operations will be conducted in accordance with the Act.

The *Erin* shaft is down a distance of 350 feet on a 70-degree pitch, and so far two levels have been turned off. Although there were only four men employed in this mine, my remarks *re* the *Iron Mask* mine apply in a lesser degree here also.

Glossie Group, Highland Valley.—Operated by Vosburg & Coulson. On December 23rd I visited the *Highland Valley* mine belonging to the *Glossie* group of claims, on Glossie mountain, about twenty-six miles from Ashcroft, on the road between that place and Merritt. During the year there has been a considerable amount of work done on this group, but at the time of my visit all the work was concentrated on one shaft. This shaft was down about 85 feet and is 8 x 10 feet, timbered solid. The method of hoisting was by a horse, and good progress was being made. This shaft is being sunk on a branch and expects to strike the main vein within 20 or 30 feet.

The work done here has been mostly prospecting, and there were several practices which I pointed out were contrary to good and safe mining. I also left copies of "Metalliferous Mines Inspection Act," and pointed out the several sections which, if attention is paid to them, will prevent trouble later on.

The great trouble with these prospects is that work done for prospecting is frequently used later in mining and does not conform with the Act, whereas if attention was paid in the earlier stages, the same work can in the majority of cases be done so as to comply with the Act without incurring any extra expense.

In addition to the shaft which I have mentioned, there are two others, both of which are nearly filled with water; in addition there has been a considerable amount of surface work done, which I was unable to see owing to the snow. All the work done seemed to be very good, and I have no doubt but in the future attention will be paid to the Act.

This mine is at an elevation of 5,200 feet above sea-level, or 4,200 feet above Ashcroft. There were four men employed underground at the time of my visit.

COAST INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report of the metalliferous mines in my inspectorate, together with a list of accidents, for the year ending December 31st, 1915.

TEXADA ISLAND.

The mines operating on this island are *Marble Bay*, *Little Billie*, *Copper Queen*, and *Aladian*.

Marble Bay Mine.—This mine is operated by the Tacoma Steel Company, of which A. F. Eastman is managing director. During the year this mine has been sunk down from what is called the 1,050-foot level to the 1,500-foot-level, making a depth of 1,360 feet vertical. A level from the foot of the shaft has been driven a distance of 760 feet to tap the shaft from the 1,050-foot level, and is expected to be completed shortly. All the levels above this 1,500-foot level are in good ore. The mine is worked on what is known as the shrinkage system.

Machinery installed: One 10-drill Canadian Rand compressor; one 4-drill Ingersoll Rand compressor; one Lidgerwood hoist; two return-tubular boilers, 84 and 96 horse-power; one 10-kw. generator.

When I visited this mine in November I found the same well ventilated and in a safe condition.

Little Billie Mine.—W. Wescott, foreman. This mine was idle the greater part of the year owing to litigation. In April of this year W. Wescott and a party of five others took a lease on the property on a royalty. The shaft is down a distance of 280 feet, with levels running at right angles to one another in good ore at the present time.

Machinery installed: One Lidgerwood hoist; one Canadian Rand compressor; five drills; one return-tubular boiler, 80 horse-power.

When I visited this mine in November I found the ventilation good and in a safe condition.

Copper Queen Mine.—Only three men are working at this mine, working on a royalty. Machinery: One return-tubular boiler, 73 horse-power; one small hoist.

Cornell Mine.—This mine has been closed since May.

Aladian Mine.—J. Forbes, foreman. This mine is situated five miles south-east of the *Marble Bay* mine. A shaft 6 x 6 feet is sunk on the property and down a distance of 200 feet, with a drift 100 feet long, running in a westerly direction. Only four men are employed. A number of small openings are in operation on this island and have very good showings.

Viva Mine.—This mine is situated in the Helmcken district, on Lot 18 of the Esquimalt & Nanaimo Railway Belt, and about five miles west of Cowichan Station, and operated by Boyd & Moore. When I visited this mine I found a shaft 6 x 6 feet down a distance of 30 feet, and only four men employed.

Britannia Mining and Smelting Company, Limited.—J. W. D. Moodie, general manager; W. N. Wyllie, superintendent. This company's property is situated up Howe sound, twenty-eight miles from the city of Vancouver, and is reached by a daily steamer operated by the Terminal Steamship Company.

During the present year a large amount of money has been spent on improvements. A new bunk-house has been erected at the tunnel camp to accommodate all those working in these mines, the old camp having been abandoned, and all operations are directed from this point.

This mine is fully equipped with four sets of rescue apparatus and three pulmotors, also first-aid classes.

When I visited this mine I found it well ventilated and in a safe working condition.

Hidden Creek.—E. E. Campbell, general superintendent. This mine is owned by the Granby Consolidated Mining, Smelting, and Power Company, Limited, and is situated one mile from Granby bay, B.C. The mine is operated by six tunnels, the elevations of each above sea-level being 150, 230, 385, 530, 630, and 700 feet.

The 150-foot tunnel is the shipping-point for ore over the railroad to the smelter. The 230-foot tunnel is the level where the underground crushing plant is situated, the crushed ore going into the pockets extending down to the 150-foot tunnel. The 385-foot tunnel is the present main haulage-level, where about 25 per cent. of the ore from the No. 1 ore-body is mined, and to which the balance of the ore mined is dropped from levels above, through raises which serve as storage-pockets. The ore from this tunnel is trammed to the pockets above the crusher. The 530-foot tunnel is the level from which a large percentage of the ore mined above is transferred to the ore-pockets extending to the 385-foot tunnel. The ore mined on the 630- and 700-foot levels and in the glory-hole on the surface is not handled, but is conducted by gravity through raises to the 385-foot tunnel pockets. All of these tunnels are connected with each other by numerous raises, and each of them have two or more outlets to the surface.

The mining methods used at present consist of the glory-hole or milling method on the surface, and the open-stope method underground, but above the 385-foot level, below this, a shrinkage-stope system is under development.

The mine at present is producing about 3,000 tons of ore a day. Drilling is done on two shifts, while the blasting is done on the third shift.

When I visited this mine I found it well ventilated and in a safe working condition.

Silver Standard Mine.—J. Norris, foreman. This mine is situated about eight miles from the town of Hazelton, on what is called the Nine-mile mountain. When I visited this mine only four men were engaged in unwatering it.

Rocher Déboulé Mine.—D. Williams, superintendent. This mine is situated twelve miles from Skeena Crossing, on Rocher Déboulé mountain, and is opened by two adits; the upper adit, which has an elevation of 5,300 feet above sea-level, intersects the vein at a distance of 40 feet. At this level a westerly drift has been opened up on the vein a distance of 650 feet. About midway between the face of this drift and the adit a raise has been put through on the vein to the surface, a distance of 100 feet measured on a dip of the vein.

Near the face of the drift there is a second raise opened up on the vein, and put through to the surface, a distance of 103 feet measured along the dip of the vein. These two raises afford the necessary ventilation for this level.

At an elevation of 5,100 feet an adit has been driven a distance of 670 feet, where it intersects the vein. This adit lies about 1,000 feet to the west of the upper adit and 200 feet vertically below it.

On this lower level, which is referred to as the 300-foot level, a drift has been driven easterly upon the vein a distance of 800 feet. From this level three raises have been driven on the vein to the 100-foot level. These raises furnish the means of natural ventilation.

Stopes have been opened from the 300- and 100-foot levels. System of stoping is by stulling and back-filling with waste. The walls are very firm and the function of the stulls is chiefly in carrying the shovelling-floors.

The ore is all brought down to the 200-foot level through chutes, where it is transmitted to ore-bins at the portal of the adit.

From here the ore is drawn off into cars of 1½ tons capacity, 24-inch gauge, and transmitted over a narrow-gauge level track, a distance of 2,800 feet, to the ore-bins of the aerial tramway. A small Porter locomotive is installed on this railway.

Two aerial tramways deliver the ore to the Grand Trunk Pacific Railway, a distance of four miles and 4,300 feet below the 300-foot level. The first tramway is 3,000 feet long and is the 2-bucket gravity-tram type. The second tram is nearly three miles and a half long and is the heavy-duty automatic-grip type.

The mine is operated with compressed air furnished by an electric-driven compressor of 700 cubic feet of free air at 100 lb. pressure.

Electricity is furnished by the company's power-house on Juniper creek, a distance of five miles from the mine. For winter work a 175-horse-power oil-engine will be installed, as the water-supply is insufficient during the winter months.

A new bunk-house, steam-heated, electric-lighted, equipped with shower-baths, has been built. This bunk-house will accommodate 100 men.

When I visited this mine I found it well ventilated and in a safe condition.

LIST OF ACCIDENTS IN METALLIFEROUS MINES, 1915.

REPORT BY JAMES MCGREGOR, WEST KOOTENAY.

No.	Mine.	Date.	Name.	Occupation.	Details.
1	Le Roi, Rossland	Jan. 28	J. J. Yill	Shoveller	Rock fell from between stringers, striking him on leg, fracturing same.
2	Granby, Phoenix	Mar. 17	John Johnson	Miner	Instantly killed by falling piece of rock.
3	Granby, Phoenix	" 17	Ben Larson	"	Fracture of base of skull, concussion of brain, cuts on head and neck. Same accident as above.
4	Le Roi, Rossland	" 27	Joe. Gilatti	Machine-runner	Left leg fractured between knee and ankle, caused by fall of rock.
5	War Eagle, Rossland	Apr. 2	Stephen Allen	Blaster	Instantly killed while cleaning out a missed hole.
6	Queen, Sheep creek	" 10	John Viola	Trammer	Fell down chute while dumping car; fatal.
7	Jewel-Denero	" 12	Wm. Bodinner.	Miner	Fracture of cartilage of rib on right side, caused by fall of roof.
8	Granby, Phoenix	May 2	John E. Lee	Nipper	Was unloading steel from a truck, which turned over, fracturing both bones of his right leg.
9	Granby, Phoenix	" 20	Wm. Roberts	Surface labourer	Was picking overburden on Monarch claim when a piece of rock flew from pick-point and injured his eye.
10	Granby, Phoenix	June 2	Frank Galla	Chuteman	Was crushed between a car and side of tunnel, fracturing his jaw, one rib, and bruising his side.
11	Le Roi, Rossland	" 7	John Stevens	Machine-runner	Fell through plank floor in stope, fracturing his skull; fatal.
12	Granby, Phoenix	" 8	Matt Kulju	Miner	Struck on the head by flying rock from glory-hole; fatal.
13	Gold Drop, Phoenix	" 25	Isaac Pinder	Mucker	Knocked by falling rock into a chute. Died five minutes after reaching hospital.
14	Snowshoe, Phoenix	July 31	J. A. Perry	Chuteman's helper	Crushed between car and timber causing both of his legs to be bruised, and right knee to be badly sprained.
15	Hewitt, Slocan	Aug. 20	Leo Ostrom	Timberman	Fall of rock from roof striking his leg, causing Potts fracture of same.
16	Standard, Slocan	" 24	W. J. Feltham	Machineman	Asphyxiated from smoke caused by fire at the tunnel mouth; fatal.
17	Granby, Phoenix	Oct. 23	Thos. Thomas	Mucker	Lacerated cut of scalp 8 inches long and a linear fracture of the skull 2 inches long, caused by a rock falling and knocking him against the wall of drift.
18	Utica, Kaslo	Nov. 7	Mato Kapalka	Miner	Struck on head by a rock while cleaning out bulkhead; fatal.

LIST OF ACCIDENTS IN METALLIFEROUS MINES, WEST KOOTENAY—*Continued.*

No.	Mine.	Date.	Name.	Occupation.	Details.
19	Rambler-Cariboo, Slocan.....	Nov. 8	John Rask....	Shoveller...	Crushed between cage and shaft timber, fracturing his right leg.
20	Granby, Phoenix.....	" 8	W. D. Jones..	Chuteman's [helper	Cracked knee-cap and sprains of left leg, caused by rock coming over chute-gate and striking him.
21	Granby, Phoenix.....	Dec. 2	Wm. Howard.	Miner.....	Rock fell and knocked him off bench, cutting him about the face and head.
22	Motherlode, Greenwood	" 25	Dan McKinnon	"	Struck by falling slab of rock; knocked down chute; fatal.
23	Standard, Slocan	" 28	W. Johnson...	"	Fracture of skull, both legs, and jaw, caused by returning on an unexploded shot. Died 10 p.m. same day.
24	Centre Star, Rossland..	" 31	John L. Bean..	Blaster.....	Returned *too soon after blasting*. Asphyxiated from powder-fumes; fatal.

REPORT BY ROBERT STRACHAN, SIMILKAMEEN DISTRICT.

25	Nickel Plate	Jan. 3	C. Hocking....	Mucker.....	Struck on head by falling rock; died February 27th, 1915.
26	Nickel Plate	Apr. 26	Sam. Sweedling	"	Right shoulder bruised while hoisting a wheelbarrow out of a chute.
27	Golden Gate, Ashcroft .	Aug. 21	M. R. Williams	"	Injuries to arm and foot, caused by slipping off plank and falling 60 feet down shaft.

REPORT BY JOHN NEWTON, COAST DISTRICT.

28	Marble Bay, Vananda..	Jan. 3	R. Jones.....	Shaftman...	Scalp-wound and injuries to shoulder and left hip, caused by staging and men falling 19 feet to bottom of shaft.
29	Marble Bay, Vananda..	" 3	D. Whitten....	" ..	Broken rib, punctured lung, and scalp-wound. Same accident as above.
30	Marble Bay, Vananda..	" 3	G. McLarin....	" ..	Chest-contusion, injured heel and ankle. Same accident as above.
31	Marble Bay, Vananda..	" 3	R. Murray....	" ..	Scalp-wound and internal injury to peroic organs. Same accident as above.
32	Marble Bay, Vananda..	" 17	A. M. McPher- [son	" ..	Fractured skull, caused by being struck by column of rock-machine.
33	Granby, Anyox.....	Mar. 23	A. P. Pearson..	Labourer....	Cut about head, bruised hand, caused by being struck by rock while in chute.
34	Granby, Anyox.....	" 25	H. Hutchinson	Mucker.....	Broken knee-cap, caused by falling while on trail to work.

LIST OF ACCIDENTS IN METALLIFEROUS MINES, WEST KOOTENAY—*Concluded.*

No.	Mine.	Date.	Name.	Occupation.	Details.
5	Marble Bay, Vananda..	May 27	John A. Jones.	Miner	Both collar-bones broken and legs bruised by being struck by falling roof.
36	Britannia.....	" 29	Emil Sinkovich	Miner	Instantly killed by drilling into a missed hole.
37	Britannia.....	" 29	N. Potkonyak.	"	Burned and cut head and eyes. Same accident as above.
38	Britannia	" 29	J. McIntyre...	Mucker.....	Bruised and cut by flying rock. Same accident as above.
39	Granby, Anyox.....	Aug. 30	Joe Agababa..	Chuteman...	Was working in chute when a rock came down, fracturing his arm.
40	Granby, Anyox.....	Oct. 2	Frank Erickson	" ...	Struck by falling rock in chute, fracturing his leg and back; died in hospital on December 1st, 1915.
41	Britannia.....	" 14	John Pradovich	Miner	Head crushed by falling rock; fatal.
42	Granby, Anyox.....	Nov. 13	Joe Agduk....	Loader-[helper	Leg broken by being tangled in cable of winch.
43	Granby, Anyox.....	" 16	F. Cassarato...	Chuteman...	Leg broken by being crushed between rock and gate of chute.
44	Marble Bay, Vananda..	Dec. 4	John A. Jones.	Shoveller....	Left eyeball cut by flying piece of rock while breaking up same with a hammer.
45	Granby, Anyox.....	" 13	John Dublin...	Miner	Mangled body drawn off with muck from chute; actual cause of death unknown.
46	Rocher Déboulé, Omi-[neca	" 17	Pryce Hughes.	Mucker.....	Right thigh fractured and internal injuries from falling rock; fatal.

TABULATED LIST OF ACCIDENTS IN METALLIFEROUS MINES, 1915.

	Cause of Accident.	Extent of Injury.			Total.
		Fatal.	Serious.	Slight.	
A	Blasting	3	..	..	3
B	Defective powder	..	..	..	..
C	Drilling into old holes containing powder	1	2	..	3
D	Powder in muck	..	..	..	..
E	Shafts and cages, accidents connected with	..	3	..	3
F	Falling down shafts, stopes or winzes	1	5	..	6
G	Falling down chutes	4	1	..	5
H	Mine-cars	..	2	1	3
I	Rock falling in stopes, levels, etc	5	6	2	13
J	Rock falling down chutes or openings	1	2	1	4
K	Timbering	..	..	..	..
L	Miscellaneous, underground	1	..	2	3
M	Miscellaneous, surface	1	1	1	3
	Totals	17	22	7	46
Accidents for each 100,000 tons ore mined		0.632	0.818	0.260	1.71
Accidents for each 1,000 men employed		4.40	5.70	1.82	11.91

COAL-MINING IN BRITISH COLUMBIA.

BY WM. FLEET ROBERTSON, PROVINCIAL MINERALOGIST.

During the year 1915 there was mined in the various collieries of the Province 1,972,580 tons (2,240 lb.) of coal, a decrease from the preceding year of 193,848 tons, equivalent to nearly 9 per cent.

This decrease, while it is considerable, can be accounted for, and the cause is only a temporary one which is gradually disappearing, so that the outlook for normal conditions in the near future seems propitious when the upsetting cause is removed.

The decreased coal-output is undoubtedly entirely attributable to the war—not acting directly, but through the allied industries which serve as consumers for the colliery products, an illustration of the interlocking of the modern commercial businesses.

In the interior of the Province the effect of the war was first felt in the complete demoralization of the metal markets, which are essentially "world markets." This led to the immediate shutting-down of all the larger copper-mines and smelters, thus removing an important factor in the market for coal and coke.

In turn, this reacted upon the volume of freight to be handled by the railways, causing thereby a very great reduction in the consumption of fuel in locomotives.

Since the beginning of the year 1915 the metal markets have recovered from the panic, and, due to the great demand for munitions of war, the prices of most of the metals have risen above the normal, the demands for metal being sufficiently great to justify such increased price. Under these conditions the metal-mines have resumed work, and are striving to make a greater than normal output, which will stimulate the coal production eventually.

The high market price of copper has kept the copper-smelting plants of the Interior very busy, with a consequent increased demand for coke, while, on the Coast, the copper-smelting plant of the Granby Company at Anyox has occasioned the restarting of the Canadian Collieries coke-ovens at Comox, where this past year 5,450 tons of coke was made. On the other hand, the market for the Coast collieries was seriously affected by the diminished sales of bunker coal to ocean steamers as a result of war conditions on the Pacific Ocean steamer trade.

The competition of fuel-oil has been keenly felt, and the adoption of this fuel by the three transcontinental railways for use in British Columbia has removed a steady and growing market for coal.

The following table shows, for the past eight years, the output and the *per capita* production of the various districts:—

OUTPUT AND PER CAPITA PRODUCTION OF VARIOUS DISTRICTS.

Year.	District.	Gross Tons of Coal mined during Year.	Total No. of Employees at Producing Collieries.	Tons of Coal mined per Employee for Year.	Number of Men employed Underground in Producing Collieries.	Tons of Coal mined per Underground Employee for Year.
1908	East Kootenay District	883,205	2,524	350	1,746	506
	Coast District	1,226,182	3,549	345	2,686	456
	Whole Province	2,109,387	6,073	347	4,432	476
1909	East Kootenay District	923,865	2,427	380	1,737	532
	Coast District	1,476,735	3,991	370	2,976	496
	Whole Province	2,400,600	6,418	374	4,713	509
1910	East Kootenay District	1,365,119	3,111	439	2,374	575
	Coast District	1,774,116	4,647	382	3,529	502
	Whole Province	3,139,235	7,758	404	5,903	532
1911	East Kootenay District	442,057	2,197	201	1,585	272
	Coast District	1,855,661	4,676	397	3,627	511
	Whole Province	2,297,718	6,873	334	5,212	440

OUTPUT AND PER CAPITA PRODUCTION OF VARIOUS DISTRICTS—*Concluded.*

Year.	District.	Gross Tons of Coal mined during Year.	Total No. of Employees at Producing Collieries.	Tons of Coal mined per Employee for Year.	Number of Men employed Underground in Producing Collieries.	Tons of Coal mined per Underground Employee for Year.
1912	East Kootenay District	1,261,212	2,410	523	1,780	708
	Coast District	1,764,497	4,720	374	3,495	504
	Whole Province	3,025,709	7,130	424	5,275	574
1913	East Kootenay District	1,331,725	2,666	500	1,965	678
	Coast District	1,239,035	3,777	328	2,865	433
	Whole Province	2,570,760	6,443	399	4,830	532
1914	East Kootenay District	955,183	2,397	399	1,749	547
	Coast District	1,211,245	3,335	363	2,518	481
	Whole Province	2,166,428	5,732	379	4,267	508
1915	East Kootenay District	852,572	1,748	488	1,183	721
	Coast District	1,120,008	3,230	347	2,512	446
	Whole Province	1,972,580	4,978	396	3,695	534

While no figures can be given as to the actual cost of mining in the different fields, the *per capita* production of these fields is of interest, as having a bearing upon the working costs and as indicating the mining facilities existing and the improvement made in these conditions from year to year.

It will be seen from the foregoing table that the production *per capita* increased more or less regularly up to the year 1912, but that the years 1913 and 1914 show a decrease, especially in the Coast District. This decreased effectiveness, during the last few years, of the labour employed is largely due to the extension of the workings of the mines, causing a greater length of haulage and greater extent of old workings to be taken care of, but some of the increased labour is undoubtedly on account of the greater number of men employed in safeguarding the mine and workmen. In the year 1915 it will be observed that the *per capita* output of the East Kootenay collieries increased considerably, while that of the Coast collieries shows a further decline.

The market of the East Kootenay field is provided primarily by the railways of the south-eastern part of the Province and of the northern parts of the adjoining States of Montana and Washington, approximately four-fifths of the coal, sold as such, being exported to those States, while the remainder went to supply the demands of the south-eastern part of the Province—its domestic needs, its railways, steamboats, mines, and smelters. The competition of fuel-oil has already been referred to.

Coke, a product of the coal-mines, is sold in the same markets, with the difference that the local consumption—chiefly by the smelters of Trail and the Boundary District—took about 90 per cent. of the product, while 10 per cent. was exported to the States mentioned.

As regards the marketing conditions in this field, the East Kootenay collieries are, however, brought into direct competition with the collieries of Alberta just over the Provincial boundary-line, all these collieries being in the same coalfield, with practically the same grade of coal and working under similar conditions.

This competition has kept the price obtainable for coal at from $2.25 to $2.50 a ton, with little probability of any material increase in price, owing to the facility with which new collieries can be opened up and the very large reserve areas of coal limits in that district; a description of these reserves was given in the Report of this Bureau for the year 1909.

The Coast District may be subdivided into two fields—the Nicola-Princeton field and the Vancouver Island field—in which the markets differ considerably.

In the former field the consumption is chiefly by the local railways, while a small amount finds its way to Vancouver, even under the handicap of what seems to be an excessively high freight charge.

The Vancouver Island coal market is provided by the domestic and manufacturing requirements of the Coast cities, and of the ocean-going steamers calling at these ports.

The demand for coal from the larger coasting steamers and from the railways has in past years diminished, as the Canadian Pacific Railway main line engines are nearly all burning California crude oil, and a large coasting steamer burning coal is now an exception.

Owing to the existing conditions in the Island collieries, prices have been maintained as high or higher than for preceding years; in fact, the high price of coal on the Coast is one of the chief reasons for the marked increase in the use of California oil-fuel. It does not seem at all likely, either, that the present price of coal on the seaboard, of from $4 to $4.50 a ton f.o.b., will decrease for some time.

As in former years, the greater proportion of the coal production was made by three larger companies—the Crow's Nest Pass Coal Company, with two collieries in East Kootenay; and by the Western Fuel Company, of Nanaimo, and the Canadian Collieries (Dunsmuir), Limited (formerly the Wellington Colliery Company), these last two operating on Vancouver Island.

In addition to these large collieries, shipments have been made by the Corbin Coal and Coke Company, in East Kootenay; by the Middlesboro Collieries, the Inland Coal and Coke Company, and the Pacific Coast Coal Syndicate, all of the Nicola Valley; by the Princeton Coal and Land Company, of Princeton; and by the Pacific Coal Mines, Limited, and Vancouver & Nanaimo Coal Mining Company, both operating on Vancouver Island, near Nanaimo.

The details of the shipments made by each of these companies will be found in reports of the Inspectors of the various districts.

During the year 1914 about half of the coal, sold as such by the collieries of the Province, was consumed in British Columbia; and the remaining half was exported to the United States, including Alaska. Of the coke sold, about 90 per cent. was consumed in British Columbia, and the remaining 10 per cent. was exported to the United States.

The distribution of this output of coal and coke is shown in the following table:—

COAL AND COKE PRODUCED, EXPORTED, ETC., BY PROVINCE DURING YEAR 1915.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	665,244		221,365	
" export to United States	636,058		24,597	
" " other countries	22,918			
Total sales		1,324,220		245,962
Lost in washing	124,020			
Used in making coke	361,451			
Used under colliery boilers, etc	168,437		41	
Total for colliery use		653,908		41
		1,978,128		246,003
Stocks on hand first of year	39,156		2,765	
" last of year	33,608		2,633	
Difference taken from stock during year		5,548		132
Output of collieries for year		1,972,580		245,871

Coal (used as such), 1,611,129 tons = $5,638,952. Coke, 245,871 tons = $1,475,226.

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	189		86		275	
Whites—Miners	1,733				1,733	
Miners' helpers	137				137	
Labourers	732		487		1,219	
Mechanics and skilled labour	483		329		812	
Boys	53		57		110	
Japanese—Miners	74				74	
Helpers	42				42	
Labourers	8				8	
Chinese — Miners	111				111	
Helpers	91				91	
Labourers	55		324		379	
Totals	3,708		1,283		4,991	

COLLIERIES OF THE COAST DISTRICT.

The gross output of the Coast collieries, including the Nicola valley, for the year 1915 was 1,120,008 tons (of 2,240 lb.) of coal actually mined, while some 2,053 tons was taken from "stock," making the actual consumption of coal 1,122,061 tons.

Of this gross consumption 871,606 tons was sold as coal, 108,475 tons was consumed by the producing companies as fuel, and 124,020 tons was lost in washing; while 17,960 tons was used in making coke.

Formerly, in 1902, the Coast collieries exported to the United States 75 per cent. of their coal; in 1910 they exported thereto only 24.5 per cent. of their product, 71.3 per cent. of the output being consumed in Canada. In 1911, 76.1 per cent. of the coal sold was for consumption in Canada, 21.6 per cent. was exported to the United States, and 2.3 per cent. to other countries.

In 1912, 71.25 per cent. was sold for consumption in Canada, 21.25 per cent. exported to the United States, and 7.47 per cent. to other countries.

In 1913, 89.8 per cent. was sold for consumption in Canada, and the balance, or 10.2 per cent., was exported to the United States.

In 1914, 77.3 per cent. was sold for consumption in Canada, and the balance, or 22.7 per cent., was exported to the United States.

In 1915, 67 per cent. was sold for consumption in Canada, and the balance, or 33 per cent., was exported to the United States.

The following table gives an aggregate summary of the output of the Coast collieries for the year 1915, and shows the dispositions made of such product:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	582,650		5,383	
" export to United States	266,038			
" " other countries	22,918			
Total sales		871,606		5,383
Lost in washing	124,020			
Used in making coke	17,960			
Used under colliery boilers, etc.	108,475		41	
Total for colliery use		250,455		41
		1,122,061		
Stocks on hand first of year	35,562			
" last of year	33,509		26	
Difference {* added to / † taken from} stock during year		†2,053		*26
Output of colliery for year		1,120,008		5,450

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	138		60		198	
Whites—Miners	1,035				1,035	
Miners' helpers	137				137	
Labourers	628		100		728	
Mechanics and skilled labour	171		196		367	
Boys	35		38		73	
Japanese—Miners	74				74	
Helpers	42				42	
Labourers	8				8	
Chinese—Miners	111				111	
Helpers	91				91	
Indians—Labourers	55		324		379	
Totals	2,525		718		3,243	

The following tables show the output of coal and the disposition made of it in the sub-divisions of the Coast District:—

COAL-OUTPUT, ETC., 1915, VANCOUVER ISLAND SUB-DISTRICT.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	500,180		5,383	
" export to United States	261,312			
" " other countries	22,918			
Total sales		784,410		5,383
Lost in washing	122,560			
Used in making coke	17,960			
" under colliery boilers, etc.	98,048		41	
Total for colliery use		238,568		41
		1,022,978		
Stocks on hand first of year	34,994			
" last of year	32,958		26	
Difference { * added to / †taken from } stock during year		†2,036		*26
Output of colliery for year		1,020,942		5,450

COAL-OUTPUT, ETC., 1915, NICOLA-PRINCETON SUB-DISTRICT.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	82,470			
" export to United States	4,726			
" " other countries				
Total sales		87,196		
Lost in washing	* 1,460			
Used in making coke				
" under colliery boilers, etc	10,427			
Total for colliery use		11,887		
		99,083		
Stocks on hand first of year	568			
" last of year	551			
Difference taken from stock during year		17		
Output of collieries for year		99,066		

COLLIERIES OF THE EAST KOOTENAY DISTRICT.

The gross output of the collieries of the East Kootenay District for the year 1915 was 852,572 tons (2,240 lb.) of coal actually mined, while 3,495 tons was taken from stock, making the actual consumption of coal, 856,067 tons. Of this gross consumption of coal, 452,614 tons was sold as coal, 52,962 tons was consumed as fuel by the producing companies, while 343,491 tons was converted into coke, producing 240,421 tons, while 158 tons was taken from stock, making the coke sales for the year 240,579 tons.

The East Kootenay collieries exported to the United States about 82 per cent. of the coal sold and about 10 per cent. of the coke.

The following table gives an aggregate summary of the output of the East Kootenay collieries for the year 1915 and shows the dispositions made of such product:—

SALES AND OUTPUT FOR YEAR	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	82,594		215,982	
" export to United States	370,020		24,597	
" " other countries				
Total sales		452,614		240,579
Used in making coke	343,491			
" under colliery boilers, etc	59,962			
Total for colliery use		403,453		
		856,067		
Stocks on hand first of year	3,594		2,765	
" last of year	99		2,607	
Difference taken from stock during year		3,495		158
Output of colliery for year		852,572		240,421

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	51		26		77	
Whites—Miners	698				698	
Miners' helpers						
Labourers	104		387		491	
Mechanics and skilled labour	312		133		445	
Boys	18		19		37	
Japanese						
Chinese						
Indians						
Totals	1,183		565		1,748	

INSPECTION OF COAL-MINES, 1915.

VANCOUVER ISLAND AND COAST DISTRICT.

This district, comprising, as it does, the coalfields of Vancouver Island and the Coast, as well as those of the Nicola and Similkameen valleys, has been subdivided, for inspection purposes, into three Inspection Districts, each under the charge of a District Inspector.

The headquarters of the Inspectors of both the Nanaimo and Comox Inspection Districts is at Nanaimo, which permits of one of the Inspectors being constantly at headquarters while the other is making inspections; it also permits of the interchanging of inspection duties, so that each Inspector knows both districts.

NANAIMO INSPECTION DISTRICT.

JOHN NEWTON, INSPECTOR (OFFICE, NANAIMO).

The collieries operating and producing coal during the year in this Inspection District, including the new mines that have been started, were:—

NANAIMO: The Western Fuel Company—No. 1 shaft, Protection shaft, and No. 4 shaft, Northfield mine, and Reserve Colliery.

EXTENSION: The Canadian Collieries (Dunsmuir), Limited (formerly the Wellington Colliery Company)—Nos. 1, 2, and 3 mines, all worked from what is known as the No. 1 tunnel, and No. 4 mine, worked by a shaft.

Pacific Coast Coal Mines, Limited—Fiddick Colliery, South Wellington, Cranberry District, Nos. 1 and 2 slopes, and the new shafts at the Morden mine.

Vancouver-Nanaimo Coal Mining Company, Limited—New East Wellington Colliery, Mountain District, Nanaimo, No. 1 slope.

COMOX INSPECTION DISTRICT.

HENRY DEVLIN, INSPECTOR (OFFICE, NANAIMO).

The collieries operating and producing coal during the year in this Inspection District, including the new mines that have been started, were:—

CUMBERLAND: The Canadian Collieries (Dunsmuir), Limited—Nos. 4 and 7 slopes, and Nos. 5 and 6 shafts, and two new shafts at No. 8.

Pacific Coast Coal Mines, Limited—Suquash Colliery, Nos. 1 and 2 slopes, and shaft.

NICOLA-PRINCETON INSPECTION DISTRICT.

ROBERT STRACHAN, INSPECTOR (OFFICE, MERRITT).

The collieries operating during the year in this Inspection District, including the new mines that have been started, were:—

NICOLA VALLEY: The Middlesboro Colliery of the Middlesboro Collieries, Limited, Merritt—Nos. 2, 3, 4, 5, 6, and 7 mines.

Inland Coal and Coke Syndicate, Merritt—One shaft and 3 slopes.

Diamond Vale Colliery Company, Merritt—No. 3 mine.

Pacific Coast Colliery Company, Merritt—No. 1 slope and No. 2 shaft, adjoining the Middlesboro Colliery.

PRINCETON: Princeton Coal and Land Company's Princeton Colliery—No. 1 slope.

United Empire Mining Company—One adit-tunnel.

COALMONT: Coalmont Collieries, Limited—Developing only.

MIDWAY: Boundary Mining and Exploration Company—Developing only.

NANAIMO INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report for the year ending December 31st, 1915, on the various coal-mines under my inspection, consisting of the Western Fuel Company, Pacific Coast Coal Mines, and the Vancouver-Nanaimo Coal Mining Company.

A short description is given of each colliery in this district, with names of the certificated officials.

MINE-RESCUE WORK.

I am pleased to say that all the companies in this district have taken up this work in a manner which is a credit to both managers and workmen.

The Western Fuel Company has a fully equipped rescue-station, with Geo. Yarrow in charge, who is the holder of a Government certificate in rescue-work, also the holder of a medallion in first-aid work.

A large number of the officials and workmen have taken a complete course in the Government station and obtained certificates of competency. The Government issued an order that any person that has completed a course in any of the coal companies' rescue-stations, and has obtained certificates from the company, will be granted a Government certificate by taking a two-hour course in the Government station and passing an examination before the Instructor and District Inspector.

When candidates have finished their course in the Government station and have obtained their certificates, the company pays a bonus of $10. In some cases, when the men prefer to take their course directly after coming out of the mine instead of going home to change, a hot lunch is provided by the company.

FIRST-AID WORK.

In connection with this work, first-aid classes conducted by Drs. Ingham and McIntyre during the year have been largely attended. Twenty-seven members obtained first-year certificates, one member a second, and three members medallions.

The company has built a fine ambulance railway-car, standard gauge, of the following dimensions: Inside measurements, 27 x 8 x 8 feet, lighted up by storage-batteries. This car is for emergency at the Reserve mine.

Apparatus on Hand.—Four 2-hour Draeger apparatus, 1904 and 1909 type; four 2-hour Proto apparatus; sixteen storage-batteries, and a complete supply of accessories on hand; two pulmotors; and two new lungmotors.

The Government has a rescue-station on the next lot to the company's station, with J. D. Stewart in charge.

The Western Fuel Company.

Head Office—San Francisco, Cal.

Capital, $1,500,000.

Officers.	*Address.*
John Lawson, President or Chairman,	San Francisco, Cal.
Jas. B. Smith, Vice-President or Vice-Chairman,	San Francisco, Cal.
D. C. Norcross, Secretary,	San Francisco, Cal.
Clarence Schmitt, Treasurer,	San Francisco, Cal.
Thomas R. Stockett, General Manager,	Nanaimo, B.C.
John Hunt, Superintendent,	Nanaimo, B.C.
T. R. Jackson, Mine Manager, No. 1 Mine,	Nanaimo, B.C.
Geo. Wilkinson, Mine Manager, Reserve Mine,	Nanaimo, B.C.

The above company has operated the following collieries at Nanaimo during the past year, namely: No. 1 or Esplanade shaft, Nanaimo; Protection Island mine, No. 4 Northfield mine, and the Douglas slope.

The following returns show the combined output of all the company's mines for the past year:—

RETURNS FROM WESTERN FUEL COMPANY'S MINES FOR YEAR 1915.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	147,842			
" export to United States	211,818			
" " other countries	2,252			
Total sales		361,912		
Used in making coke				
" under colliery boilers, etc.	49,239			
Total for colliery use		49,239		
		411,151		
Stocks on hand first of year	6,913			
" last of year	11,485			
Difference added to stock during year		4,572		
Output of colliery for year		415,723		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	25		19		44	
Whites—Miners	292				292	
Miners' helpers	18				18	
Labourers	297		20		317	
Mechanics and skilled labour	77		64		141	
Boys	34		20		54	
Japanese						
Chinese—Labourers			121		121	
Indians						
Totals	743		244		987	

NANAIMO COLLIERY.

T. R. Jackson, Manager.

No. 1 SHAFT, ESPLANADE.

David Brown, Overman; R. Adam, W. Neave, W. Johnson, D. John, Geo. Bradshaw, W. J. Jemson, T. J. Wood, A. Coombe, T. Parkinson, M. Gunniss, R. Seggie, A. Gould, J. Wallbank, J. Richards, A. Rowan, J. Rowan, E. W. Courtney, J. McMeakin, J. Brown, J. Sullivan, G. Jardine, J. Shipley, J. McGuckie, S. Mottishaw, T. Miles, T. Mills, M. Woodburn, J. Perry, J. Stobbart, J. Weeks, F. Green, J. Dudley, J. Norris, E. Hughes, and G. Oswald, Firemen.

No. 1 mine of the Western Fuel Company is situated at the south end of the Esplanade, in the city of Nanaimo, and has been in operation for many years, with good prospects for many years to come.

The present operations are at a depth of 600 to 1,000 feet below the surface, with a large submarine area. This shaft has three openings—namely, the No. 1 hoisting-shaft, Protection shaft, and Newcastle Island shaft. These shafts are all connected by good travelling-roads, and are all equipped by hoisting apparatus in case of emergency.

The seams worked are the Douglas and Newcastle. The coal produced from No. 1 North level is all from the Newcastle seam, which lies 70 feet below the Douglas, and is penetrated by three slopes—namely, Nos. 1, 2, and 3—varying from 4,000 to 5,000 feet between each slope, and covers an extensive working-face. These slopes are connected one with another, making one continued working-face.

The seam varies from 3 to 3½ feet in thickness, is of a very hard nature, and is worked on the long-wall system, to which it is well adapted. Mining-machines of the "pick quick" (or bar machine) and puncher type, operated by compressed air, are used to undercut the coal, the cut varying from 5 to 6 feet in depth.

A large staff of officials is employed in these sections, as shotlighters, facemen, and timbermen, to look after the safety of the workmen engaged.

For every four loaders there is a certificated coal-miner engaged to break the coal down, and for every eight loaders there is one timberman employed and a certificated fireman, who is in charge of the section; but, in spite of all these precautions, men will risk their lives and the lives of their fellow-men by going into places where they are forbidden.

During the year a new upcast shaft has been put through to the Upper seam (or what is called Lamb's incline), making three upcast shafts in No. 3 slope, two in No. 2 slope, and one in No. 1 slope, which has improved the ventilation of these sections. All this part of the North level is worked by open lights, and only permitted explosives are used.

It is proposed to drive a tunnel 900 feet in length from No. 1 level to a point up the heading of No. 3 slope, to cut out the heavy grade and pick up the coal underlying Newcastle island, or what is commonly called Lamb's incline.

The ventilation for these sections is produced by a Guibal force-fan, 9 x 18 feet, and 100 horse-power, rope-driven, making 70 revolutions a minute, producing 100,000 cubic feet of air a minute, with a water-gauge of 2 inches. There is also an emergency exhaust-fan stationed at Newcastle Island shaft ready for use.

The coal is hauled out of No. 1 level to No. 1 shaft by six electric motors of the trolly type, four Edison, one Westinghouse, and one tandem of the Jeffery type, all doing very efficient work.

On my last examination I found 72,000 cubic feet of air a minute passing into this No. 1 level, divided into three splits.

No. 1 Slope.

There was 9,600 cubic feet of air a minute passing into the section for the use of fifty-five men and six horses, or an average of 131 cubic feet of air for each unit employed.

No. 2 Slope.

There was 25,500 cubic feet of air a minute passing into the section, divided into three splits.

No. 1 Split.—There was 9,000 cubic feet of air a minute passing into the split for the use of forty-two men and seven horses, or an average of 142 cubic feet of air for each unit employed.

No. 2 Split.—There was 7,000 cubic feet of air a minute passing into the split for the use of forty-two men and seven horses, or an average of 111 cubic feet of air for each unit employed.

No. 3 Split.—There was 8,000 cubic feet of air a minute passing into the split for the use of twenty-two men and two horses, or an average of 285 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 3 Slope.

There was 15,000 cubic feet of air a minute passing into this slope, divided into two splits.

No. 1 Split.—There was 3,000 cubic feet of air a minute passing into the split for the use of six men and one horse, or an average of 333 cubic feet of air for each unit employed.

No. 2 Split.—There was 12,000 cubic feet of air a minute passing into the split for the use of forty-one men and seven horses, or an average of 193 cubic feet of air for each unit employed. No explosive gas was found; timbering and roadways are good.

During my inspection I examined the rope inspector's report-book on all ropes and winches, and found all reported in good condition.

Protection Shaft.

This shaft is used for raising and lowering of the workmen on the north side of No. 1 mine. The workmen are conveyed by scow across the bay. The only operations carried on in this mine are pillar-extraction, the coal being used under the boilers on Protection island for generating power for running the mining-machines and winches installed in the long-wall of No. 1 main level. When I made my inspection I found the pillars free from gas, well ventilated, the faces well cogged up. Safety lamps of the Wolf pattern and permitted explosives exclusively are used in these pillars.

Machinery installed on Protection island is as follows: Two Canadian Rand compressors, one supplying 2,500 and the other 1,800 cubic feet of free air a minute; seven return-tubular boilers generating 700 horse-power.

The compressed air generated at this point is conveyed down the Protection shaft through a 7-inch line to No. 1 level, there connecting to a 7-inch line from the plant at No. 1 shaft, making a complete circuit.

Douglas Seam, or South Side.

This part of the mine forms the deepest workings of No. 1 mine. This section was closed in August, 1913, through labour troubles and allowed to fill up with water. A start was made during December, 1913, to unwater the section; this was accomplished in March, 1915. The roadways were in such a condition through caves that it was not until June of this year that a little coal was produced.

This section contained several sealed-off fire areas. After unwatering the district it was found that many of the fire stoppings had been seriously injured by the action of the water, and had to be renewed before operations were resumed. The only stoppings that withstood the pressure were those built of wood blocks.

The Diagonal engine-room has all been remodelled by concrete walls and 12- x 20-inch steel beams, making it 42 x 7 x 18 feet in the clear.

A start has been made to retimber the siding at the foot of the Diagonal slope with 12- x 16-inch sets; the siding will be 7 x 16 feet in the clear.

The South side has been divided into a number of panels by a system of concrete stoppings, so, if a fire was to break out in any of the panels, it could be sealed off in a few hours. Only the intake and return stoppings would have to be put in. All the material for this emergency is always on hand.

The ventilation of the south side is produced by a 72 x 90-inch, double-inlet Sirocco fan, rope-driven, ratio 3½ to 1, running 250 revolutions, producing 195,000 cubic feet of air a minute, with a 4-inch water-gauge, and an engine of 350 horse-power. A second Sirocco fan of the same size, in every way modernly equipped, is kept under steam in case of emergency.

Nothing but safety-lamps of the Wolf pattern and permitted explosives, fired by batteries, are used in the section.

The haulage from this section is by main and tail rope and endless-rope system. The production of the mine is 1,650 tons a day.

On my last examination there was 41,400 cubic feet of air a minute passing into the section, divided into three splits.

South-east Heading—No. 1 Split.—There was 6,250 cubic feet of air a minute passing into the split for the use of nineteen men and four horses, or an average of 201 cubic feet of air for each unit employed.

No. 2 Split.—There was 10,000 cubic feet of air a minute passing into the split for the use of forty-nine men and six horses, or an average of 150 cubic feet of air for each unit employed.

South Heading.—There was 6,500 cubic feet of air a minute passing into this section for the use of sixteen men and four horses, or an average of 232 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

I examined the main return airways from the bull-wheel to the main upcast shaft, and found them in a fairly good condition.

During the above inspections I examined the rope inspector's report-book on all ropes and winches, and found all reported to be in good condition.

The following are the official returns from the No. 1 shaft and Protection Island collieries for the year 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	140,290			
" export to United States	205,951			
" " other countries	2,199			
Total sales		348,440		
Used in making coke				
Used under colliery boilers, etc.	34,690			
Total for colliery use		34,690		
		383,130		
Stocks on hand first of year	6,874			
" last of year	10,753			
Difference added to stock during year		3,879		
Output of colliery for year		387,009		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wag
		$		$		
Supervision and clerical assistance	20		12		32	
Whites—Miners	259	3.46 - 7.00			259	
Miners' helpers	18	3.02			18	
Labourers	261	3.02 - 3.85	12	2.75 - 3.00	273	
Mechanics and skilled labour	63	3.02 - 4 29	38	3.00 - 4.50	101	
Boys	34	1.21 - 2.66	15	0.50 - 1.75	49	
Japanese						
Chinese			77	1.50 - 1.88	77	
Indians						
Totals	655		154		809	

Description and length of tramway, plant, etc.—North side of mine operated 269 days. South side of mine operated 156 days; began producing June 14th, 1915.

RESERVE MINE.

Geo. Wilkinson, Manager; J. Dickson, Overman; J. Renny, E. Wilkinson, A. Challoner, and B. Barris, Firemen.

This mine is situated in what is known as the Cranberry district, about five miles south of No. 1 shaft, Nanaimo, B.C. The coal is reached by two shafts at a depth of 955 feet, from which a rock tunnel 8 x 16 feet in area is driven across the measures on a 1-per-cent. grade to the raise. This tunnel tapped the seam at a distance of 180 feet.

The shaft-bottom is laid out in a most up-to-date method for handling large quantities of coal. All the tracks are laid with 30-lb. rails and on a grade of 1 per cent. from the shaft. All the main tunnels leading to this shaft have been retimbered with 12- x 12-inch timbers.

A description of the surface plant and shaft landings of the mine was given in my last annual report.

During 1915 the following underground development-work has been done: Early in the year a connection was made between the two shafts, then development-work was started. A pair of levels have been driven in a westerly direction for a distance of 1,100 feet from No. 1 shaft landing; at a point 350 feet from the shaft landing along these levels a pair of slopes are turned off at an angle of N. 73° 30′ W. and are down 800 feet. Crosscuts are driven between the levels and between the slopes at intervals of 120 feet; the pillars between are approximately 80 x 120 feet.

A pair of levels have been driven in the opposite direction, easterly, for a distance of 1,350 feet from No. 1 shaft landing and 1,000 feet from No. 2 shaft landing. At a point approximately 1,000 feet from No. 1 shaft landing three headings are driven up to the full pitch of the seam and are up a distance of 200 feet.

The seam worked in this mine is the Douglas, and in the development-work done it shows a thickness of from 1 to 20 feet; it is lenticular in formation, or full of pinches and swells, and is very slickensided. The pitch of the seam varies from 20 to 60 degrees, which makes the handling of the coal very difficult, it being handled at places by chutes and at places by small cars; this causes a good deal of breakage. The pitch also makes it difficult to handle timber. The roof is friable and requires good timbering.

A good deal of permanent work has been done towards the ventilating system. A return airway 14 x 7 feet has been driven from the point where the main splits unite to the upcast shaft, a distance of nearly 350 feet. A good substantial overcast built of concrete throughout has been installed where the air-current crosses the haulage-road on the East level.

Permanent stoppings have been built between the intake and return airways; these stoppings are built with wooden blocks 12 x 12 inches and 6 feet long, laid in mortar, making a solid stopping 6 feet in thickness.

The mine is divided into two splits, one split ventilating the West side and the other the East side of the mine.

A large sump for the storage of water has been started between the two shafts; this consists of a tunnel in the solid rock 16 x 18 feet. The sump is now about one-third completed, and when completed will have a storage capacity of approximately 300,000 imperial gallons.

The haulage at the present time is being done by horses on the levels and hoists driven by compressed air on the slopes. The tracks are 42-inch gauge, and the main haulage-roads are laid with 30-lb. steel. The mine-cars have a capacity of 2 tons.

On the surface a good deal of permanent work has been done on the mine-yard and railroad-tracks during the past year. The tipple building at No. 2 shaft has been finished and trestles connecting it with the tipple building at No. 1 shaft. A concrete powder-house and a small concrete house for the storage of detonators have been built during the year.

The ventilation of the mine is produced by a pair of 90-inch Sirocco fans, connected to a 20 x 30 engine, rope-driven. On the engine is a drive-wheel 17 feet in diameter, and on the fan-shaft a drive-wheel 5 feet in diameter; these fans, running with an engine-speed of 16 revolutions a minute, produce 140,000 cubic feet of air a minute in the fan-drift, with a 3-inch water-gauge. The fan and engine are installed on concrete foundations 80 feet from the shaft.

When I made my last examination there was 57,482 cubic feet of air a minute passing into the mine, divided into two splits.

No. 1 Split.—There was 34,982 cubic feet of air a minute passing into the split for the use of thirty-four men and two horses.

No. 2 Split.—There was 19,500 cubic feet of air a minute passing into the split for the use of sixteen men and one horse. No explosive gas found; timbering and roadways were good.

I examined the rope inspector's report-book on all ropes and winches, and found all reported to be in good condition.

The mine is worked by safety-lamps only; two types of these are in use, the Wolf lamp and the Edison electric lamp.

In blasting, permitted explosives only are used, all shots being fired by electric batteries.

On May 27th, 1915, at 4 p.m. an explosion of gas occurred at the Reserve mine, in which twenty-two men lost their lives.

The following are the official returns of the Reserve Colliery for the year ending December 31st, 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	7,552			
" export to United States	5,867			
" " other countries	53			
Total sales		13,472		
Used in making coke				
" under colliery boilers, etc.	14,549			
Total for colliery use		14,549		
		28,021		
Stocks on hand first of year	39			
" last of year	732			
Difference added to stock during year		693		
Output of colliery for year		28,714		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		
Supervision and clerical assistance	5		7		12	
Whites—Miners	33	3.46 - 7.00			33	
Miners' helpers						
Labourers	36	3.02 - 3.85	8	2.75 - 3.00	44	
Mechanics and skilled labour	14	3.02 - 4.29	26	3.00 - 4.50	40	
Boys			5	0.50 - 1.75	5	
Japanese						
Chinese			44	1.50 - 1.76	44	
Indians						
Totals	88		90		178	

Description and length of tramway, plant, etc.—Mine in operation 296 days. Explosion of gas on West side on May 27th, 1915.

NORTHFIELD MINE.

This mine has been closed down since the strike in May, 1914. In the meantime it was decided by the company to pull out all rails and pumps that could be obtained and abandon the mine for the present.

REPORT BY INSPECTOR DEVLIN.

Canadian Collieries (Dunsmuir), Limited.

Head Office—Victoria, B.C.

Capital, $15,000,000.

Officers.	*Address.*
Sir William Mackenzie, President,	Toronto, Ont.
R. P. Ormsby, Secretary,	Toronto, Ont.
A. J. Mitchell, Treasurer,	Toronto, Ont.
J. R. Lockard, General Manager,	Cumberland, B.C.

The Canadian Collieries (Dunsmuir), Limited, during the year 1911 acquired all the holdings of the Wellington Collieries Company, Limited, and during the past four years has been operating the following mines:—

The Extension Colliery, in the Cranberry District (Extension); J. H. Cunningham, manager.

The Comox Colliery, in Comox District; R. Henderson, J. H. McMillan, T. A. Spruston, managers at the several mines.

NOTE.—This latter colliery is in the Comox Inspection District, in which report will be found a description of the property and the details of production.

The following table shows the combined output of all this company's collieries during the past year:—

RETURNS FROM THE CANADIAN COLLIERIES MINES FOR YEAR 1915.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	240,430			
" export to United States	27,294			
" " other countries	20,666			
Total sales		288,390		
Lost in washing	101,699			
Used in making coke	17,960			
" under colliery boilers, etc.	24,267			
Total for colliery use		143,926		
		432,316		
Stocks on hand first of year	21,355			
" last of year	16,851			
Difference taken from stock during year		4,504		
Output of collieries for year		427,812		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	70		23		93	
Whites—Miners	432				432	
Miners' helpers	75				75	
Labourers	208		50		258	
Mechanics and skilled labour	52		68		120	
Japanese—Miners	74				74	
Helpers	42				42	
Labourers	8				8	
Chinese — Miners	111				111	
Helpers	91				91	
Labourers	55		167		212	
Totals	1,218		298		1,516	

EXTENSION COLLIERY.

J. H. Cunningham, Manager, Nos. 1, 2, and 3 Mines.

The general supervision of these mines in this colliery is entrusted to J. H. Cunningham, who has an overman in charge of each mine.

At the Extension mines general conditions showed considerable improvement over the previous year. The production during each month was higher than that of the corresponding month last year. At the latter part of the year the output was being maintained steadily at 1,000 tons a day.

The ventilation of Nos. 1, 2, and 3 mines, which has always been very complicated, has received considerable attention from the management, and has been simplified, and at the same rendered more efficient. In No. 2 mine the air-shaft has been enlarged and retimbered. In No. 3 mine an air-shaft is being driven from underground to the surface. The distance to the surface is about 300 feet, and already 250 feet has been completed.

At the washery at Ladysmith a new 10-inch wood pipe has been laid from the reservoir to furnish power and water for a new Pelton wheel and for an additional washer unit which have been installed.

Among the employees at this colliery a great interest is being taken in "first aid to the injured" and mine-rescue work, and a number of certificates of competency in both branches of work have been obtained. An up-to-date railway ambulance-car supplied with steam heat, hot and cold water, and fitted with electric lights is maintained in constant readiness within a short distance of the mine entrance. In case of accident the same attention can be given to a patient as he would receive in the hospital.

No. 1 OR TUNNEL MINE.

William Wilson, Overman; A. Watson, J. Martin, D. Morris, O. Dabb, J. Michek, D. Gordon, M. Meek, E. John, R. Ewing, and J. Davidson, Firebosses.

When I made my last inspection in December I measured 46,000 cubic feet of air a minute passing into this mine, divided into two splits.

In the East side split there was 16,000 cubic feet of air a minute passing for the use of forty-three men and four mules, or an average of 290 cubic feet of air a minute for each unit employed.

In the West side split there was 12,425 cubic feet of air a minute passing for the use of thirty-four men and four mules, or an average of 270 cubic feet of air a minute for each unit employed.

I found this mine free from explosive gas; the timbering was good and the roadways were in fair order.

There was 46,000 cubic feet of air a minute passing into this mine; the amount passing into the two splits was 28,425 cubic feet, making a loss in leakage through doors, stoppings, etc., of 17,575 cubic feet of air a minute.

No. 2 MINE, EXTENSION.

H. M. Davidson, Overman; W. Cosier, W. Clifford, J. Watson, and J. Nimmo, Sr., Firebosses.

In No. 2 mine the operations have been very light during the year, and were confined to ground adjacent to the Main slope—namely, Nos. 1, 2, and 2½ levels on the West side, and No. 2 level on the East side. Only pillar-extraction is in operation on the West side, and skipping pillars and making new roads to the pillars on the East side. No. 4 East motor-road, which was badly caved, is being cleaned and timbered up, with a view to increasing the output from that section of No. 2 mine.

When I inspected this mine in December I measured 12,980 cubic feet of air a minute passing into this mine, divided into two splits.

In the West side split there was 10,880 cubic feet of air a minute passing for the use of eighteen men and two mules, or an average of 452 cubic feet of air a minute for each unit employed.

In the East side split there was 2,100 cubic feet of air a minute passing for the use of ten men and two mules, or an average of 131 cubic feet of air a minute for each unit employed.

There was no explosive gas found in this mine; timbering and roadways were in good condition. Safety-lamps of the Wolf type are used exclusively in this mine, and all blasting done with permitted explosives, fired with electric battery.

No. 3 MINE, EXTENSION.

James Strang, Overman; P. Malone, H. Mitchell, D. Campbell, G. Smith, D. Fagan, J. Nimmo, Jr., J. McLeod, and D. Davidson, Firebosses.

Practically all operations in No. 3 mine are in the Slope district, which consists of pillar-and-stall work and the extraction of pillars. Safety-lamps of the Wolf type are used in this district, and all blasting done with permitted explosives, all shots being fired by electric battery.

When I inspected this mine in December I measured 27,000 cubic feet of air a minute passing into this mine, divided into two splits.

In the Slope district split there was 15,300 cubic feet of air a minute passing for the use of fifty-four men and eight mules, or an average of 185 cubic feet of air a minute for each unit employed.

In No. 5 West split there was 12,300 cubic feet of air a minute passing for the use of three men and the ventilation of the old workings in this section.

There was no explosive gas found; timbering and roadways were in good condition.

No. 4 MINE, EXTENSION.

William James, Manager.

Thomas Strang, Overman; J. Glen, S. Davis, J. Barclay, J. Wright, and J. McMurtrie, Firebosses.

This mine is situated about one mile and a half from the Extension tunnel to the south, and is worked on the long-wall system, hand-mining being employed. The daily production of this mine is about 400 tons.

During my last inspection in December I measured 36,200 cubic feet of air a minute passing into this mine, divided into two splits.

In the East side split there was 21,000 cubic feet of air a minute passing for the use of twenty-two men and three mules, or an average of 617 cubic feet of air a minute for each unit employed.

In the West side split there was 15,200 cubic feet of air a minute passing for the use of forty-six men and three mules, or an average of 292 cubic feet of air a minute for each unit employed.

I found no explosive gas in this mine; found all places well cogged and timbered and roadways in fair condition.

The company has a rescue-station at Extension of frame construction, 25 x 53 feet, which contains a smoke-room, observation-room, work-room, and dressing-room. The equipment of this station consists of four sets of 2-hour, 1910 model, helmet-type Draeger apparatus, one oxygen-pump, four oxygen-tanks, and four electric safety-lamps (Draeger type).

There has been some training done at this station in mine-rescue work during the year, twelve men having obtained Government certificates of competency in mine-rescue work.

The following are the official returns of the Extension Colliery for the year ending December 31st, 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	86,658			
" export to United States	24,641			
" " other countries	11,206			
Total sales		122,505		
Lost in washing	26,069			
Used under colliery boilers, etc.	13,115			
Total for colliery use		39,184		
		161,689		
Stocks on hand first of year	4,230			
" last of year	9,512			
Difference added to stock during year		5,282		
Output of colliery for year		166,971		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	39		15		54	
Whites—Miners	220				220	
Miners' helpers	15				15	
Labourers	130		7		137	
Mechanics and skilled labour	14		27		41	
Boys						
Japanese						
Chinese	5		45		50	
Indians						
Totals	423		94		517	

Names of seams or pits—Wellington: Mines Nos. 1, 2, 3, and 4.

Description of seams, tunnels, levels, shafts, etc., and number of same—One tunnel connecting Nos. 1, 2, and 3. No. 4 shaft situated one mile south of tunnel.

REPORT BY INSPECTOR NEWTON.

Pacific Coast Coal Mines, Limited.

Head Office—Victoria, B.C.

Capital, $2,000,000.

Officers.	*Address.*
John H. Tonkin, President,	Victoria, B.C.
C. Plummer Hill, Vice-President,	Montreal.
Talbot Schmuck, Secretary-Treasurer,	Victoria, B.C.
John H. Tonkin, Superintendent,	Metropolitan Bldg., Victoria, B.C.
Robert Bonar, Mine Manager,	South Wellington, B.C.

Value of plant, $501,805.

This company includes in its holdings the Fiddick Colliery at South Wellington; the Morden Colliery on Section 11, Range 8, Cranberry District, two miles east of South Wellington; and the Suquash Colliery on the east coast of Vancouver Island, near Malcolm island. Of these, the Fiddick Colliery was the only one to ship coal during the past year, but at the others equipment and development-work were carried out.

The following are the official returns for the Fiddick Colliery, which are also the full returns for the whole company, for the year ending December 31st, 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	69,666			
" export to United States	20,588			
" " other countries				
Total sales		90,254		
Lost in washing	20,861			
Used under colliery boilers, etc.	18,566			
Total for colliery use		39,427		
		129,681		
Stocks on hand first of year	2,173			
" last of year	1,923			
Difference taken from stock during year		250		
Output of colliery for year		129,431		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		$
Supervision and clerical assistance	15	3.45	1	4.60	16	3.52
Whites—Miners	128	3.00 - 3.75	.....	.....	128	3.00 - 3.75
Miners' helpers	22	2.75	.....	.....	22	2.75
Labourers	29	2.86	3	2.75	32	2.85
Mechanics and skilled labour	10	2.86	23	3.42	33	3.25
Boys	.....	.....	.....	.....	.....	.....
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	32	1.40	32	1.40
Indians	.....	.....	.....	.....	.....	.....
Totals	204	3.21	59	2.18	263	3.01

Name of seams or pits—Workings on the upper Douglas seam.

Description of seams, tunnels, levels, shafts, etc., and number of same—At the South Wellington mine coal is reached by means of Slopes Nos. 1 and 2. At the Morden mine coal is reached by means of shafts: Shaft No. 3, 555 feet in depth; Shaft No. 4, 630 feet in depth. No. 3 is 10 x 18 feet in the clear; No. 4 is 10 x 10 feet in the clear.

Description and length of tramway, plant, etc.—At South Wellington mine the plant consists of four return-tubular boilers, 100 horse-power each; one Canadian Rand air-compressor, capacity 500 cubic feet a minute; one Canadian Rand cross-compound air-compressor; two Fairbanks-Morse pumps for supplying water to boilers, 7 x 5 x 12 duplex; one thoroughly equipped machine-shop; double-drum hoisting-engine for hauling coal from slopes, 200 horse-power; one Sheldon fan capable of producing 85,000 feet of air, with 1½-inch water-gauge; one mine-rescue station containing two 2-hour apparatus and one ½-hour apparatus. The underground plant consists of two winches 6½ x 8, two 5 x 7, and one 9 x 11. Pumps, 300-gallon electric turbine-pump; one 600-gallon Cameron piston-pump; two Fairbanks-Morse pumps, duplex, one 5¼ x 3½ x 5 and one 7 x 5 x 7; and three small duplex pumps, one 3 x 2 x 5 and two 4 x 3 x 6; 250 mine-cars and approximately ten miles of narrow-gauge track in mine.

At Morden mine the plant consists of three 150-horse-power return-tubular Goldie & McCulloch 72- x 18-inch boilers, 160 lb. working-pressure; one pair 24 x 36 hoisting-engines equipped with safety overwinding device, steam-reverse and steam-brake; two 10-foot sheaves with collars and boxes and two self-dumping cages; one Gwynnes 5-inch centrifugal pump direct-connected to 250-volt A.C. motor; two 150-kw. electrical generators connected to two Goldie & McCulloch 13 x 20 x 9 high-speed engines; five electrical motors, 400-volt, 1,200 R.P.M.; one Sheldon ventilating mine-fan direct-connected to a 17- x 20-inch Vulcan Iron Works fan-engine; one Marcus screen 65 feet long, one Marcus screen 63 feet long, both with double decks and doors; one Weir feed-pump.

FIDDICK COLLIERY, SOUTH WELLINGTON.

A. Smith, Manager; J. Neen, Overman; J. Black and R. Rallison, Firemen.

This mine is operated by two slopes, Nos. 1 and 2, on the Fiddick and Richardson properties, and is down a distance from 1,200 to 1,400 feet, with levels turned off north and south. The system of working is pillar and stall, and in some places when the coal is low the long-wall method has been adopted.

On February 9th, 1915, water broke in No. 3 North level from the Old Southfield workings, drowning nineteen men and flooding the mine. The coal production in this section was suspended from that date until about the middle of July, when operations began in No. 6 North level.

The coal in this mine lies very close to the surface, and in the extraction of the seam many breaks in the strata reaches the surface. Owing to heavy rains in the latter part of November the mine was again flooded by surface water through breaks in the strata, and operations were suspended, and will so remain for some time.

No. 2 MINE.

Only four places are working in this mine; these are drawing the slope pillars and producing about 150 tons a day, working three shifts.

The ventilation of the mine is produced by a reversible Sheldon single-inlet fan 9½ feet in diameter, driven by a 9½- x 14-inch steam-engine direct-connected to the fan, which is producing 85,000 cubic feet of air a minute, with a water-gauge of 2 inches.

The mine is worked exclusively with safety-lamps of the Wolf pattern, and permitted explosives, fired by batteries, are used.

When I visited the mine there was 5,000 cubic feet of air a minute passing for the use of sixteen men and one horse, or an average of 263 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways were good.

I examined the rope inspector's report-book on all ropes and winches, and found all reported to be in good condition.

RESCUE-WORK.

I am pleased to say that the company has taken up this work and is having men trained weekly in the Government station in Nanaimo. The company has about twelve trained men in all, four of whom hold Government certificates.

A small rescue-station is erected at the mine, with the following apparatus on hand: Two 2-hour Draeger oxygen apparatus and one ½-hour apparatus.

A number of workmen have attended the first-aid classes and obtained certificates of competency in the same.

MORDEN COLLIERY, SOUTH WELLINGTON.

R. Bonar, Manager; W. Roper, Overman; J. Sutherland, T. Taylor, W. Gilchrist, J. Ovington, J. W. Dykes, J. Parrott, and J. Donnachie, Firemen.

This is a new mine, operated by the same company, on Section 11, Range 8, Cranberry District, two miles east of the Fiddick Colliery. Two shafts are sunk; the main shaft is 9 x 16 feet and the air-shaft 9 x 12 feet in the clear, and are sunk to a depth of 600 feet.

The tipple is equipped with a Marcus screen 64 feet long and 5 feet in width. The coal is delivered on a Head-Wrightson jib loader, electrically driven, and from there to the railroad-cars. The entire construction is of reinforced concrete.

The head-frame is all reinforced concrete and is the first of its kind in this district. From the surface this frame is 74 feet high, with braces containing over 50 tons of concrete. The entire tipple and head-frame contains approximately 500 cubic yards of concrete.

The coal is hoisted from the shaft by a pair of 24- x 48-inch engines made by Litchfield Engineering Company, Litchfield, Ill., and fitted with safety attachments and equipped with self-dumping cages. The capacity of the shaft is 1,500 tons a day.

The ventilation is produced by a Sheldon double-entry fan 7 feet in diameter, at from 3- to 3½-inch water-gauge, at 250 revolutions a minute. A 16- x 12-inch engine made by the Vulcan Iron Works drives this fan, the fan being built on reinforced-concrete foundation.

The mine is worked on the pillar-and-stall system, the coal varying from 5 to 20 feet in thickness, of a very good quality for steam purposes.

Two slopes are driven on the pitch of the seam, with levels turned right and left; the stalls breaking off these levels with 60-foot centres. All the coal is handled by a main rope engine, 18 x 30 inches, placed at the head of the No. 2 shaft.

The mine is worked exclusively with safety-lamps of the Wolf pattern, and permitted explosives, fired by batteries, are used.

When I visited the mine I found 46,800 cubic feet of air a minute passing for the use of twenty-eight men and six horses, or an average of 1,017 cubic feet of air for each unit employed. No explosive gas was found; timbering and roadways were good.

I examined the rope inspector's report-book on all ropes and winches, and found all reported in good condition.

SUQUASH COLLIERY.

The mine has been idle the whole of the year 1915.

The Vancouver-Nanaimo Coal Mining Co., Ltd.

Head Office—Vancouver, B.C.

Capital, $1,000,000.

Officers.	*Address.*
H. W. Maynard, President,	774 Hastings Street, Vancouver, B.C.
J. L. G. Abbott, Vice-President,	602 Hastings Street W., Vancouver, B.C.
J. L. G. Abbott, Secretary-Treasurer,	602 Hastings Street W., Vancouver, B.C.
H. N. Freeman, Superintendent,	P.O. Box 283, Nanaimo, B.C.

Value of plant, $500,000.

NEW EAST WELLINGTON COLLIERY.

H. N. Freeman, Manager; W. H. Moore, Overman; Geo. Gray, C. Dickinson, T. Budge, J. Hamilton, A. Bryden, J. Saunders, and R. Reid, Firemen.

The mine is situated about two miles due east from Nanaimo, in the Mountain District. The seam is known by the name of the Old Wellington seam. It is reached from the surface by two slopes running N. 70° E., and pitching at 35 degrees, down a distance of 1,400 feet. At this point headings are turned off at an angle of N. 65° E., which were driven up to the boundary-lines. Dip workings are driven at an angle at N. 15° E. to the boundary. All the solid work being finished, the pillars are now being drawn back.

The coal varies from 4 to 8 feet in thickness and is worked by the pillar-and-stall and long-wall methods; the coal being of a very hard nature and free from impurities, and is all hand-mined, excepting two or three places around the fire-zone, which are being mined by the Siskol mining-machine.

Wolf safety-lamps and permitted explosives, fired by batteries, are used throughout the whole mine.

During the year a new Browing fan 9 feet 3 inches in diameter was installed, with a capacity of 100,000 cubic feet of air a minute, under a water-gauge of 3 inches. The fan is coupled direct to engine, 12 x 16 inches, 74 horse-power, made by Houston, Stanwood & Gamble Company, of Cincinnati, Ohio.

On March 9th, 1915, a fire broke out at the top of the Main heading, a distance of 2,200 feet from the slope-bottom. This was sealed off on March 19th, 1915, by six heavy concrete and timber stoppings. The district was visited on September 4th, 1915, by means of Draeger oxygen apparatus. The temperature was found to have dropped to 58° Fahr. It was then decided to open the district on November 15th, 1915. Up to the present time there has been no signs of fire. Doors have been erected so that the ventilation can be shut off this district at a moment's notice in case of further outbreak of fire.

All coal is shipped over a railway connecting with the company's wharf at Newcastle townsite, Nanaimo, and by the Esquimalt & Nanaimo Railway.

The mine at the present time is hoisting about 400 tons a day. The output for the year decreased about 50 per cent. owing to slackness of trade due to the war and the increased consumption of oil-fuel; however, it is hoped that the output for the year 1916 will be kept steady.

The mine is equipped with two 2-hour and one ½-hour Draeger oxygen apparatus, one pulmotor, and four Ceag electric lamps. They have sixteen trained Draeger men holding British Columbia certificates of competency, and have one more team in training. They have also twenty first-aid men. The mine has a system of training of their own which is carried out underground.

When I examined this mine I found 51,300 cubic feet of air a minute passing into the mine, divided into three splits.

No. 1 Split.—There was 9,000 cubic feet of air a minute passing into the split for the use of thirty-three men and five horses, or an average of 187 cubic feet of air for each unit employed.

No. 2 Split.—There was 16,000 cubic feet of air a minute passing into the split for the use of twenty-one men and three horses, or an average of 5,033 cubic feet of air for each unit employed.

No. 3 Split.—There was 8,250 cubic feet of air a minute passing into the split for the use of twenty-two men and three horses, or an average of 266 cubic feet of air for each unit employed.

Explosive gas was found in Yates's and Wilson's places in No. 0 dip, and the Main and counter headings, No. 4 East level. Timbering and roadways were good.

I examined the rope inspector's repair-book on all ropes and winches, and found all reported to be in good condition.

The following are the official returns from the New East Wellington Colliery for the year 1915:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	42,242			
" export to United States	1,612			
" " other countries				
Total sales		43,854		
Used in making coke				
Used under colliery boilers, etc	5,976			
Total for colliery use		5,976		
		49,830		
Stocks on hand first of year	4,553			
" last of year	2,699			
Difference taken from stock during year.		1,854		
Output of colliery for year		47,976		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		$
Supervision and clerical assistance	6		4		10	
Whites—Miners	59	4.35			59	4 35
Miners' helpers						
Labourers	30	3.23			30	3.23
Mechanics and skilled labour	2	3.40	11	3.68	13	3.51
Boys	1	1.50	1	1.50	2	1.50
Japanese						
Chinese			14	1.90	14	1.90
Indians						
Totals	98		30		128	

NORTHERN DISTRICT OF VANCOUVER ISLAND.

REPORT OF HENRY DEVLIN, INSPECTOR.

I have the honour to submit my annual report as Inspector of Mines for the Northern District of Vancouver Island for the year ending December 31st, 1915, together with a list of all accidents and colliery returns.

Canadian Collieries (Dunsmuir), Ltd.*

COMOX COLLIERIES.

These mines were formerly operated by the Wellington Colliery Company, but were taken over by the Canadian Collieries (Dunsmuir), Limited, in 1910. The mines are situated in the Comox district, about seventy miles from Nanaimo. A railway about twenty miles in length connects the various mines to a shipping-point at Union Bay, over which the whole output is conveyed.

This company is operating in Cumberland mines known as Nos. 4 and 7 slopes and Nos. 5, 6, and 8 shafts. The new railway has been extended to connect with the various mines in this district, thus doing away with the heavy grade on the old line. These mines, with the exception of Nos. 5 and 8 shafts, have been operated continuously during the year, but with a good deal of broken time through the year.

The company has a rescue-station at No. 6 mine, 40 x 24 feet, with smoke, dressing, and work rooms, while a room for teaching "first aid" is attached. The equipment of the station consists of four 2-hour sets, 1910 model, helmet-type Draeger apparatus; one recharging oxygen-pump; four oxygen-tanks; four electric safety-lamps (Draeger type). Twenty-eight men have been fully trained at this station during the year, and all have obtained Government certificates of competency in mine-rescue work.

The hydro-electric plant has been in continuous operation throughout the year, and some additions and extensions made to the transmission system.

Electric power is now in use for the complete operation of the Comox mines, and has superseded the use of steam entirely, excepting locomotives on the railway.

At the general offices and outbuildings at Cumberland the steam-heating system has been replaced by electric heating. These offices have been completely renovated and a new system of electric lighting and telephones installed.

* *See also* page 390.

At Union Bay the coke-ovens have been put into service; 100 bee-hive ovens have been rebuilt and are producing about 120 tons of coke a day. An electrically driven larry has been installed, and motors for driving the coal-elevating machinery have also been installed. Improvements have also been made to the coal-washing plant, new jigs of a special type having been installed, resulting in a greatly improved quality of washed coal.

No. 4 MINE.

R. Henderson, Manager; C. Parnham, Overman; T. Mordy, J. Furbow, J. Dando, J. Comb, S. Horwood, A. Odgers, J. Reid, M. Broderick, S. Jones, J. Bennie, and D. Marsh, Firebosses.

This mine is situated about two miles from Cumberland and about eighteen miles from the shipping-point at Union Bay.

The ventilation is produced by a Sullivan reversible fan driven by a 350-horse-power direct-coupled motor, running at 245 R.P.M., and capable of delivering 196,000 cubic feet of air a minute, with a 5¾-inch water-gauge.

The plant at this mine has been in continuous operation during the year. A new wheel was installed in the Sullivan fan, giving a slightly increased water-gauge. A new single-stage pump has been installed in No. 1 slope of a capacity of 100 gallons a minute under a 100-foot head. The installation of a 100-horse-power electrical hoist in No. 2 slope has been completed and in operation during the year.

The underground pumping system put into operation in 1914 has been running without interruption during the year and has proven very satisfactory.

All the motors and electrical equipment used underground at this mine are flame-proof, and all electric lamps are fitted into gas-proof globes.

Safety-lamps of the Wolf-type are used exclusively in this mine, and all blasting is done with permitted explosives, fired by electric battery.

The coal-seam is reached by two slopes, Nos. 1 and 2, a direct haulage system being in use.

No. 1 Slope.

This slope is down a distance of 7,000 feet, running due north. A diagonal slope, 4,000 feet from the entrance of the mine, running N. 45° E., is down a distance of 3,400 feet, where levels are turned off east and west—Nos. 15, 16, 17, 18, 19, and 20 on the West side, and Nos. 17, 18, and 19 on the East side.

No. 15 West level and Nos. 17 and 18 East levels are extracting pillars; No. 17 West level is being worked on the long-wall system; all the other levels are worked on the pillar-and-stall method. No. 19 East level is driven through on to No. 17 West level off No. 2 slope, and is used as a travelling-road.

All the levels are in good coal ranging from 4 to 5½ feet in thickness, with a band of rock running in the centre from 10 to 12 inches thick and having a fairly good fireclay roof.

No. 1 Slope is being driven ahead to make connections with No. 8 shaft, and when this is completed it is proposed to haul all coal from No. 4 mine to No. 8 shaft, and use the slopes as return airways. During the year, owing to lack of shipping, and consequently a lot of idle time, No. 1 slope has only been driven about 400 feet.

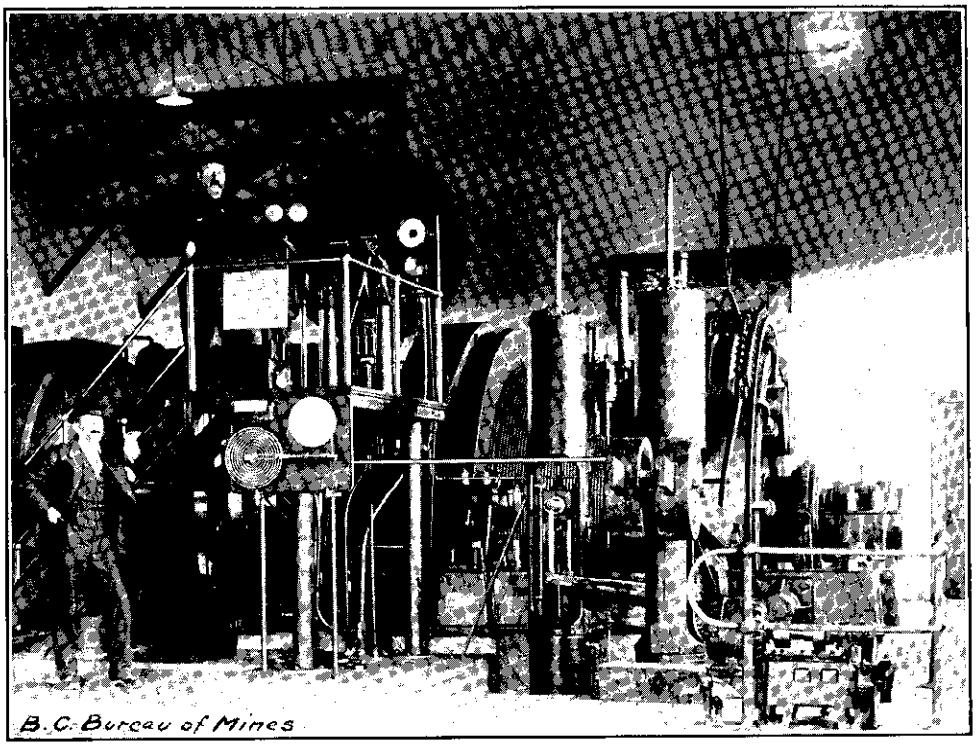
During my inspection in December I measured 27,900 cubic feet of air a minute passing into No. 1 slope, divided into two splits.

In No. 1 split there was 5,220 cubic feet of air a minute passing for the use of thirteen men and two mules, or an average of 274 cubic feet of air a minute for each unit employed.

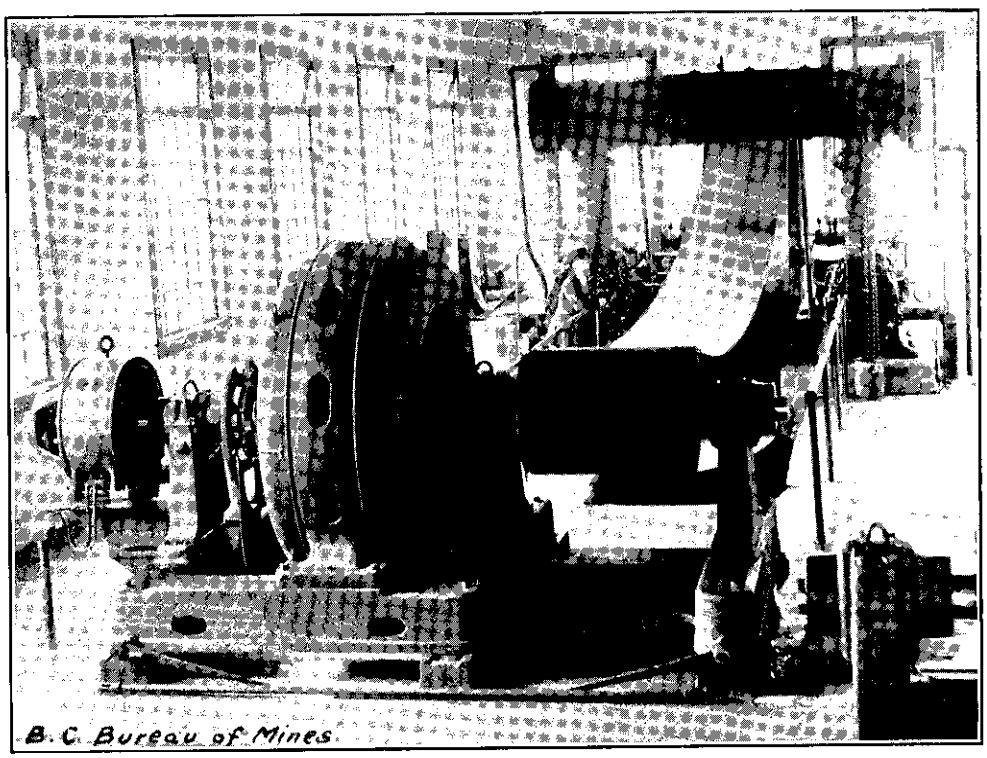
In No. 2 split there was 22,680 cubic feet of air a minute passing for the use of fifty-nine men and nine mules, or an average of 332 cubic feet of air a minute for each unit employed. I found a ½-inch gas-cap in the inside pillar in No. 15 West level, but found no explosive gas in No. 1 slope. I found timbering good and the roadways in fair condition.

No. 2 Slope.

This slope branches off No. 1 slope a short distance from the mouth of the tunnel, running N. 45° E., and is down a distance of 8,000 feet, forming the deepest workings of the mine.



Hoisting Plant, Canadian Collieries, Comox.



Compressor Plant, Canadian Collieries, Comox.

This slope has not advanced any during the year owing to an inrush of water, which the old system of pumping could not cope with, and owing to the idle time it has taken all year to clean up No. 18 West level, which was badly caved, and is to be used as a pumping or water level.

Levels are turned off this slope east and west—namely, Nos. 15, 16, 17, 18, and 19 on the East side, and Nos. 13, 14, 15, 16, 17, 18, and 19 on the West side. No. 15 on the East side and Nos. 13, 14, 15, and 16 on the West side are extracting pillars; Nos. 16 and 17 on the East side are being worked on the long-wall system; all other levels are worked on the pillar-and-stall system.

The levels that are advancing are all in good coal ranging from 4 to 6 feet in height, with a band of rock in the centre from 12 to 15 inches in thickness. The roof is of shale and fireclay and requires careful timbering.

When I made my inspection in December I measured 55,200 cubic feet of air a minute passing into No. 2 slope, divided into two splits.

In the East side split there was 14,500 cubic feet of air a minute passing for the use of thirty-two men and seven mules, or an average of 254 cubic feet of air a minute for each unit employed.

In the West side split there was 20,350 cubic feet of air a minute passing for the use of forty-seven men and eight mules, or an average of 286 cubic feet of air a minute for each unit employed.

Timbering was in good condition and roadways in fair order, with the exception of Nos. 15 and 16 West levels, which were in a rough condition owing to the mine being idle so long. I found No. 2 slope free from explosive gas.

There was 55,200 cubic feet of air a minute passing into No. 2 slope in the main intake; the amount passing into the two splits was 34,850 cubic feet a minute, making a loss in leakage of of 20,350 cubic feet of air a minute.

No. 5 MINE.

J. H. McMillan, Manager of Nos. 5 and 6 Mines; J. Gillespie, Overman, No. 5 Mine; R. B. Gascoyne, Jno. Brown, and E. L. Saunders, Firebosses.

This mine is temporarily closed down on account of the state of the coal trade, and no development of any kind has been done during the year.

At this mine a new pit-head frame has been built and a new and improved screening and picking plant is being installed; this screening plant will be electrically driven.

A new Sirocco fan has been installed at the mouth of the rock tunnel, connecting the workings of No. 5 mine with the surface, south of the shaft. This fan has a capacity of 270,000 cubic feet of air a minute at a 5-inch water-gauge. This fan is driven by a 350-horse-power motor running at 245 R.P.M., and is equipped with an automatic restarting controller. This fan will ventilate the entire workings of Nos. 5 and 6 mines, and displaces the Guibal fan at each of these mines.

The rock-drift formerly used as a travelling-road has been widened out, and a force of men has been busy for several months cleaning up the airways and building overcasts and stoppings to cope with the new method of ventilation.

This mine has been inspected every month during the year. When I made my last inspection in December I measured 38,000 cubic feet of air a minute passing around the workings.

No explosive gas found in this mine; the timbering and roadways were in fairly good condition.

No. 6 MINE.

Hugh Sloan, Overman; H. King, J. E. Spicer, T. Leeman, H. Leighton, T. Richards, and R. McNeil, Firebosses.

The installation of a 250-horse-power motor for converting the steam hoisting-engine at this mine has been completed and is in successful operation. Electric power for this mine is transmitted from the step-down sub-station at No. 5 mine, about one mile distant. No. 6 mine is now entirely operated by electricity and the old steam plant removed.

Two Sullivan type C.E. 7, short-wall mining-machines are being installed, also one 100-horse-power electric hoist. Several single-stage electric pumps have also been installed for dip pumping. The old Guibal fan at this mine has been displaced by the new Sirocco fan installed at No. 5 mine.

The workings of this mine consist of pillar and long-wall work. The long-wall section recently opened looks very promising and is situated to the raise of the shaft. Mining in the long-wall section is done by a Sullivan electric coal-cutter, type C.E. 7, alternating current, and has proved a success as regards operation and production.

The average thickness of the seam is 4 feet, but the coal contains several bands of rock and is of a hard nature, with sand-rock roof and floor. Sufficient height is obtained by brushing up 3 feet of bottom. A 50-horse-power electric hoist has been installed, which lowers the coal from the long-walls to the shaft-bottom direct.

A rock tunnel has been commenced north of the shaft to cut a 50-foot upthrow fault, and it is expected a good field of coal will be tapped here in the near future.

Pillars are being extracted on the No. 1 incline west of the shaft, also on the main East level. Considerable repairs have been done on the pit-head frame, which is in good order at present.

When I made my last inspection in December I measured 42,700 cubic feet of air a minute passing into this mine, divided into three splits.

In No. 1 split there was 13,500 cubic feet of air a minute passing for the use of forty-three men and seven mules, or an average of 210 cubic feet of air a minute for each unit employed.

In No. 2 split there was 16,000 cubic feet of air a minute passing for the use of sixty-four men and six mules, or an average of 195 cubic feet of air a minute for each unit employed.

In No. 3 split there was 13,200 cubic feet of air a minute passing for the use of forty-four men and five mules, or an average of 223 cubic feet of air a minute for each unit employed.

I found a little explosive gas issuing from a feeder in the bottom in a crosscut off the rock tunnel, all other places being free from explosive gas; the timbering and roadways were in good condition.

No. 7 MINE.

T. A. Spruston, Manager; F. Jaynes, Overman; N. Huby, P. Myers, J. Monks, W. Williams, J. Elliott, W. Keenan, F. Harwood, A. D. Allan, and J. G. Biggs, Firebosses.

This mine is situated at the town of Bevan, about five miles from Cumberland and fifteen miles from Union Bay, the shipping-point.

This mine is entered by means of two slopes running N. 35° E. and is down a distance of 7,000 feet. The method of mining is the long-wall system, with the exception of a small section in No. 3 West level, which is worked pillar and stall owing to the thin surface covering. The seam varies from 2½ to 3½ feet in thickness and is of a very hard nature, being well adapted to this method of mining.

No. 1 Main Slope.

From this slope levels are turned off east and west—Nos. 3, 6, 7, 8, 9, and 10 on the West side, and Nos. 3, 7, and 9 on the East side. Development-work during the year consists of driving a rock tunnel through a fault in No. 3 West level, where the coal has been struck, and a pair of levels are ready for turning off.

A rock tunnel is being driven through a fault in the face of No. 7 West level, and is in a distance of 220 feet. A new water lodgment has been made at the bottom of the slope for the installation of a 18- x 7- x 18-inch Prescott duplex pump; this is almost completed.

There has been considerable repair-work done on the main haulage-roads and return airways during the year.

No. 3 East Diagonal Slope.

This slope is driven off No. 3 East level at a distance of 500 feet from the Main slope and a distance of 2,000 feet from the entrance to the mine, running north-east. Levels are turned off on the East side of the slope only, owing to a fault running parallel to the slope on the West side; these levels are in good coal ranging from 3 to 3½ feet in thickness.

The electrical plant at this mine has been in continuous operation during the year. The principal plant consists of a Sirocco fan with a capacity of 270,000 cubic feet of air a minute at a 5-inch water-gauge, driven by a 350-horse-power motor; one Rand compressor, 2,700 feet of air a minute, driven by a 500-horse-power motor; and one electric haulage-engine driven by a 750-horse-power motor. This plant is complete and operates successfully, and no additions or improvements were required during the year.

During my inspection in December I measured 108,000 cubic feet of air a minute passing into this mine, divided into four splits.

In No. 1 West split there was 20,400 cubic feet of air a minute passing for the use of forty-six men and four mules, or an average of 351 cubic feet of air a minute for each unit employed.

In No. 2 West split there was 10,000 cubic feet of air a minute passing for the use of thirty-four men and three mules, or an average of 232 cubic feet of air a minute for each unit employed.

I found no explosive gas on the West side; the timbering was good and the roadways in fair order.

In No. 1 East split there was 25,000 cubic feet of air a minute passing for the use of fifty-four men and three mules, or an average of 396 cubic feet of air a minute for each unit employed.

In No. 2 East split there was 9,080 cubic feet of air a minute passing for the use of thirty men and two mules, or an average of 252 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in a pot-hole in the face of No. 1 gateway, off No. 1 slant, No. 7 East level.

The timbering is in good condition, with the exception of some broken stringers in the Diagonal slope, off No. 3 East level, which were ordered replaced; the roadways were in fair order.

Safety-lamps of the Wolf type are used exclusively in No. 7 mine; blasting is done with permitted explosives, and all shots are fired by electric battery.

The total quantity of air passing into this mine in December was 108,000 cubic feet a minute, and the quantity passing into the several splits was 64,480 cubic feet a minute, making a loss in leakage of 43,520 cubic feet a minute through doors, stoppings, etc.

No. 8 MINE.

This mine has been closed down during the year, and no improvements or additions have been made. The plant is, however, operated at intervals to keep same in operating condition.

The following are the official returns from the Comox Colliery for the year 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	153,772		5,383	
" export to United States	2,653			
" " other countries	9,460			
Total sales		165,885		5,383
Lost in washing	75,630			
Used in making coke	17,960			
Used under colliery boilers, etc.	11,152		41	
Total for colliery use		104,742		41
		270,627		5,424
Stocks on hand first of year	17,125			
" last of year	7,339		*26	
Difference {*added to / †taken from} stock during year		†9,786		*26
Output of colliery for year		260,841		5,450

By-products—Clay, 670 tons.

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		
Supervision and clerical assistance	31	3.63 - 9.00	8	4.00 - 7.00	39	
Whites—Miners	212	3.30 - 5.50			212	
Miners' helpers	60	3.30			60	
Labourers	78	2.50 - 3.30	43	2.50 - 3.30	121	
Mechanics and skilled labour	38	3.30 - 4.00	41	3.30 - 4.00	79	
Boys						
Japanese—Miners	74	3.50			74	
Miners' helpers	42	1.75			42	
Labourers	8	1.75			8	
Chinese—Miners	111	3.50			111	
Miners' helpers	91	1.75			91	
Labourers	50	1.75	112		162	
Totals	795		204		999	

Name of seams or pits—Comox: Mines Nos. 4, 5, 6, and 7; No. 4 shaft. Description of seams, tunnels, levels, shafts, etc., and number of same—No. 4 slope; Nos. 5 and 6 shafts; No. 7 slope; No. 4 shaft.

NICOLA-PRINCETON INSPECTION DISTRICT.

REPORT OF ROBERT STRACHAN, INSPECTOR.

I have the honour to submit my annual report as Inspector of Coal-mines for the Nicola-Princeton Inspection District for the year 1915.

The principal companies in the Nicola section are the Middlesboro Collieries, Limited; the Inland Coal and Coke Company, Limited; the Pacific Coal Syndicate (formerly the Pacific Coast Colliery Company); and the Diamond Vale Colliery Company. The first two operated during the entire year; while the Pacific Coal Syndicate has maintained a small force at work, the Diamond Vale Colliery Company did not operate during any part of the year.

In the Princeton section the Princeton Coal and Land Company operated during the entire year; development-work was continued at Coalmont until June, when operations were suspended; neither the United Empire Mining Company nor the Boundary Mining and Exploration at Midway did any active work during the year.

Attached is a list of the accidents reported during the year, amounting to thirteen, and it is very gratifying to be able, for the second year in succession, to report that none of these proved fatal.

All of the accidents occurred in the collieries in the Nicola District—seven in the Middlesboro Colliery and six in the Inland Coal and Coke Company's colliery. Six of these accidents were serious; seven slight; four were due to an ignition of gas while attempting to seal off an incipient gob-fire in No. 4 mine, Middlesboro; two were due to fall of rocks; five to haulage; one due to carelessness in handling an axe; and one due to an engineer falling off a fence or rail on to which he had climbed, this fence having been erected to prevent him coming in contact with a driving-belt.

While the workmen and officials at the collieries are to be congratulated on the freedom from fatal accidents during the past two years; I think a little more care and forethought would, to a great extent, reduce the number of non-fatal accidents.

I again wish to thank the workmen and officials of the collieries for their cordial co-operation during the past year, and trust that during 1916 this will be continued; it is only

by a ready compliance on the part of the workmen and the strict enforcement on the part of the officials of the rules and regulations that we can hope to maintain our freedom from fatal accidents and reduce the number of non-fatal.

No prosecutions either under the "Coal-mines Regulation Act" or the special rules have been found necessary during the year, reflecting, I think, the enforcement of stricter discipline of the mine managements than in former years.

During the year the "inspection of the mine on behalf of the workmen," as required by section 91, Rule 37, has been carried out at the Inland Coal and Coke Company's mine by workmen elected by the employees. At Middlesboro Colliery, Nos. 4 and 4 East mine, by Geo. Archibald and Jas. Dunnigan; at No. 7 mine, by Robt. Dobbie and Jno. Clarke; these having been appointed by you for this purpose as provided by the above rule. At those inspections conditions have generally been found very favourable, and no complaints have been reported as to the existence or apprehended existence of any danger. At the other collieries in the district so far no election or appointment for this purpose has been made.

MINE-RESCUE WORK.

In this work during the year ten certificates were granted for efficiency, making a total of thirty-nine certificates granted since the inauguration by the Department of Mines of these certificates. Of these, fifteen have left the district and one has died, leaving twenty-three competent workmen of this class here, eighteen being in Middlesboro Colliery, four in the Inland Coal and Coke Company, and one in the Pacific Coal Syndicate. In addition to those who have obtained certificates, the other holders have maintained their efficiency.

The equipment of self-contained breathing apparatus, which is all of the Draeger type, is practically the same as reported last year, except for the addition of two 2-hour type apparatus to those already owned by the Department and stationed at Middlesboro Colliery, also the acquisition of two of the ½-hour type by the Pacific Coal Syndicate. The following is the equipment owned by each colliery:—

Middlesboro Colliery.—Two 2-hour type, with spare oxygen cylinders, 1912 type; one pulmotor, with recharging-cylinder; one recharging-pump; 640 cubic feet of oxygen; forty-three ½-hour potash cartridges; eight 1-hour cartridges; 115 2-hour potash cartridges; electric lamps; and testing apparatus for the Draegers.

At Middlesboro Colliery a very complete training-station is maintained where, in addition to their own apparatus, that of the Department of Mines is stationed, consisting of four 2-hour type Draegers, 1914 type, and two ½-hour type.

Inland Coal and Coke Company.—Two 2-hour apparatus, two ½-hour apparatus, and one pulmotor, all having spare cylinders for oxygen; 280 cubic feet of oxygen; four ½-hour, forty 1-hour, and forty 2-hour potash regenerators; also two Wolf electric safety-lamps.

Princeton Coal and Land Company.—One 2-hour apparatus and one ½-hour apparatus, each equipped with spare oxygen cylinder; one recharging-pump; eight ½-hour and six 2-hour potash regenerators; electric hand-lamps; testing apparatus; and 120 cubic feet of oxygen.

Coalmont Colliery.—Three 2-hour apparatus, one ½-hour apparatus, and one pulmotor, all equipped with spare oxygen cylinders; one recharging-pump; 200 cubic feet of oxygen; six ½-hour and twenty 2-hour potash regenerators; three electric lamps; measuring-bag; and water-gauge.

Pacific Coal Syndicate.—Two ½-hour apparatus; six potash cartridges; eight cubic feet of oxygen.

All of the apparatus has been kept in fairly good condition, but, as I reported last year, so far, except the Middlesboro Colliery, none of the companies has seen the necessity of erecting proper training-stations. In this connection I should like to suggest that arrangements might be made in the proposed amendment to the "Coal-mines Regulation Act" making provision for joint stations in districts like this—namely, where a number of small collieries are operating, either with or without the assistance of the Government.

I have regularly attended the examinations for coal-miners held in Merritt and a few times at Princeton, where, owing to lack of candidates, the examination has been held very irregularly; and in May I acted as examiner at the request of the Board of Examiners at the examination for first-, second-, and third-class certificates for mine officials under the "Coal-mines Regulation Act" held at Merritt.

In office-work 340 letters were received and 312 sent out, while the distance travelled on duty was 3,901 miles.

Considerable trouble has been experienced during the past year with "gob-fires" in several of the collieries. In the Nicola District at the No. 3 mine of the Inland Coal and Coke Company this necessitated the erection of a large number of stoppings, thereby sealing off a considerable portion of the mine for some time. In Middlesboro Colliery another gob-fire caused an ignition of gas while arrangements were being made to seal it off, resulting in the slightly burning of four men engaged in preparing for a stopping. In this case the idea of sealing off was abandoned, and instead water was pumped in to the mine, drowning the fire out. This mine has since been reopened and no trace of fire has been discovered.

In the Princeton District, in addition to the fire reported last year, at least another active fire has been successfully sealed off, and the sealing-off of other two districts has effectively prevented the development of fire in both cases.

In the Nicola District these fires seem to occur in and around faulty ground, especially where weak pillars have been left, and the action of "creep" sets in. In the Princeton District, owing to the nature of the coal wherever duff or machine minings are left, it only requires a cave and partial stoppage of air, then we can expect a fire; therefore it is evident what steps should be taken to avoid the causes of these fires, which are a constant source of danger and expense.

During the year every mine has been inspected as required by the "Coal-mines Regulation Act." Every accident has been investigated promptly after notice has been received and reports made thereon.

Samples of mine-air have been taken from almost all the mines and sent to the Department of Mines, Ottawa, for analysis, and the following table shows the results:—

No.	Chemical Analysis.						Technical Analysis.		
	Carbon Dioxide.	Oxygen.	Methane.	Carbon Monoxide.	Hydrogen.	Nitrogen.	Air.	Fire-damp.	Black-damp.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.		Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1.47	18.92	0 16	0.13	..	79.32	90.40	0.29	9.31
2	2.05	17.95	0.75	Trace	..	79.25	85.76	0.75	13.49
3	0.19	20.48	0.30	..	..	79.03	97.85	0.30	1.85
4	0.06	20.76	0.18	..	..	79.22	99.19	0.18	0.63
5	0.08	20.64	0.02	0.04	..	79.22	98.61	0.06	1.33
6	2.32	16.52	..	..	..	81.16	78.93	..	21.07
7	6.68	9.48	0.23	..	..	83.61	45.29	0.23	54.48
8	0.26	20.38	0.12	..	..	79.24	97.37	0.12	2.51

NOTE.—In calculating the technical analysis from the chemical analysis, the assumption is made that atmospheric air contains 20.93 per cent. oxygen, 79.04 per cent. nitrogen, and 0.03 per cent. carbon dioxide. The excess nitrogen and carbon dioxide are reckoned as black-damp and the inflammable gases as fire-damp.

No. 1 sample was taken from old workings where fire was suspected to exist, and afterwards did show up.

No. 2 sample was taken from another mine under similar circumstances as No. 1.

No. 3 sample was taken from the return air, Princeton Colliery.

No. 4 sample was taken from return air, No. 7 mine, Middlesboro Colliery.

No. 5 sample was taken from return from old abandoned workings.

No. 6 sample was taken from inside a fire area after six months.

No. 7 sample was taken from inside a fire area after twelve months.

No. 8 sample was taken from return air, old workings, where fire was apprehended.

The production of coal, especially in the Nicola District, has fallen off to a considerable extent, due principally to the increased use of fuel-oil on the railway.

The following is a brief description of the collieries operating during the year 1915.

Middlesboro Collieries, Ltd.

Head Office—Vancouver, B.C.

Capital, $1,107,700.

Officers.	*Address.*
E. W. Hamber, President,	Vancouver, B.C.
Thomas Sanderson, Managing Director and Secretary,	Vancouver, B.C.
Robert Fairfoull, Mine Manager,	Middlesboro, B.C.

Value of plant, $250,000.

MIDDLESBORO COLLIERY.

Robert Fairfoull, Manager.

The Middlesboro Colliery of the Middlesboro Collieries, Limited (formerly the Nicola Valley Coal and Coke Company, Limited), is situated about one mile from Merritt, and is reached by a branch line of the Canadian Pacific Railway. The colliery consists of the Nos. 2, 4, 4 East, and 7 mines, the first being operated in the Upper or Coldwater Hill series of coal-seams, the others in the Lower or Coal Gully series.

No. 4 MINE.

Thos. Brace, Overman; Wm. Hallinan and Alec Ewart, Firebosses.

The No. 4 mine, which includes Nos. 4 and 6 seams, is operated by a crosscut tunnel, cutting Nos. 4, 5, and 6 seams. Sections of Nos. 4 and 6 seams are as follows:—

No. 4 Seam.	*No. 4 Seam.*	*No. 6 Seam.*
5" bony coal.	2" bone.	51" coal.
5" coal.	2" coal.	8" bony coal.
1" bone.	1" bone.	9" coal.
17" bony coal.	21" coal.	
32" coal.	12" bone.	
10" bony coal.	4" coal.	
21" coal.	7" bone.	
2" bone.	12" coal.	
9" coal.	6" bone.	
	60" coal.	

The pitch or inclination of the seams is 25 degrees, dipping to the south. The method of work is pillar and stall, pillars 30 x 60 feet, stalls 12 feet wide. The haulage inside is by compressed-air hoist to top of slope, then by horse to the tipple.

The ventilation is provided by a Sheldon fan 8½ feet in diameter, driven by an engine of the same make, using a continuous rope-drive, geared 1 to 1.2. This fan is capable of producing 91,000 cubic feet of air a minute running at a speed of 215 revolutions a minute.

I have generally found the conditions in this mine very good, and only on one occasion found explosive gas during the year; there was always a good current of air circulating around the faces, brattice wall up to the face, and doors and stoppings in good condition. Roads and airways were well timbered and in good condition, and the "Systematic Timbering" order well complied with.

In May, owing to heating in the gob, which had been under observation for some time, an attempt was made to seal off a part of the mine, and in doing so it was found necessary to repair an old roadway. This, I believe, provided the necessary oxygen and fanned the fire, resulting in an ignition of gas, which slightly burned the four workmen engaged on the work.

An inspection the following day showed that very little damage had been done, the flame having been almost spent when it reached the point where the workmen were engaged.

After a consultation the management decided to abandon the idea of sealing this district off, and flood the mine, the water being turned in eight hours later.

In July, about two months later, the mine was reopened, when no trace of fire or explosive gas was found; work has since been resumed on a small scale, and so far, due to natural ventilation, it has not been found necessary to start up the fan, about 26,000 cubic feet of air a minute circulating for the use of nineteen men and four horses. I have found no trace of explosive gas since the mine was reopened.

No. 4 East Mine.

Thos. Brace, Overman; Jas. Fairfoull and L. Clarke, Firebosses.

This mine is also on the No. 4 seam and is situated a short distance to the east of No. 4 mine; the main dip and slant are down a distance of 650 and 850 feet respectively.

The inclination of the coal-seam is about 15 degrees, dipping to the east. The method of work is pillar and stall, pillars being left 30 x 60 feet, while the stalls are driven 12 feet wide.

The haulage is by a compressed-air hoist situated outside, while the cars are brought to the main haulage by horse.

Ventilation is produced by a small fan 3 feet in diameter, made in the machine-shop at the colliery, driven by 10- x 12-inch Sheldon engine, and is capable of producing 40,000 cubic feet of air when required. At the time of my last inspection it was producing 10,800 cubic feet of air a minute for the use of twelve men and one horse. Speed of fan, 160 revolutions a minute; speed of engine, 110 revolutions a minute; water-gauge, ¼ inch.

During the year I have not found any explosive gas in this mine; there has always been a good current of air circulating around the faces, and the brattice, doors, and stoppings have been maintained in good condition. All the roadways and airways have been well timbered, and the "Systematic Timbering" order has been strictly attended to.

No. 7 Mine.

L. Warburton, Overman; Jno. McDonald, Jas. Blair, and Thos. Bullen, Firebosses.

This mine is situated in the Coal Cully series and is about 300 feet higher than the tipple and the entrance to Nos. 4 and 4 East mines. The Main slope has been driven down for a distance of about 1,600 feet in the coal at an angle of 25 degrees, dipping to the south. The following is a section of the coal-seam:—

Roof, sandstone.
12" bony coal.
1" sandstone.
108" coal.
1" clay.
69" coal.
2" soft coal.

The method of work is pillar and stall, pillars being left 50 x 50 feet, stalls driven 12 feet wide. So far all the work has consisted of blocking out the coal, the levels taking almost the entire thickness of the seam, the stalls only working about 8 feet of the top coal.

The haulage is by horse to the slope, then a compressed-air hoist situated outside hauls them to the outside; from there they are lowered by a gravity-plane about 300 feet long to the tipple.

The ventilation is produced by a small fan of the Guibal type, driven by a compressed-air engine. Fan is 52 inches in diameter by 24 inches wide, and is built reversible. This is driven by belt from a Goldie-McCulloch 8- x 10-inch engine driven by compressed air.

I have generally found the mine very well ventilated, and only on one occasion have I found trace of explosive-gas. The air-current is kept well up to the face; doors and stoppings I have always found in good condition.

At my last inspection I found 32,400 cubic feet of air a minute for the use of twenty men and one horse. Speed of fan, 270 revolutions a minute; speed of engine, 170 revolutions a minute; water-gauge, 0.4 inch.

All the roadways and airways are well timbered, and the "Systematic Timbering" order is well enforced; generally the mine is maintained in very good condition.

Safety-lamps are used exclusively in all the mines of the Middlesboro Colliery, except for the rope-rider in No. 7, who uses an open light from No. 6 level to the outside. The safety-lamps

are of the Wolf type, with internal igniter, and are cleaned and tested in the lamp-room situated near the tipple, and are again examined by the fireboss before being permitted in the mine.

The coal is all mined by hand, Monobel being the only explosive used for blasting, with electric detonators; certificated officials are the only persons allowed to carry or use the igniter or battery. All the coal is brought to a common tipple in cars having a capacity of 1.5 tons. These cars are all built at the colliery of 2-inch plank, with iron fittings and a door at one end. They are dumped by a Phillips crossover dump, a switchback and car-haul arrangement bringing the empty cars back, so that they can be sorted into trips for whatever place required.

The coal passes to a shaking screen, which allows all under 2½ inches to pass into a hopper, the lump passing over a picking-table 42 feet long, where the waste is picked out, then it is carried by a conveyor to the lump-coal bin.

The coal under 2½ inches is fed to a Stewart washer, erected by Roberts & Schaefer, of Chicago, capable of handling 100 tons an hour. In the washer three grades of coal are sorted, each being taken by a separate conveyor to its separate bin. During the cold winter months this washer is not used, a dry-cleaning method taking its place.

A Christy box-car loader is used to facilitate the loading of box cars. Close to the tipple is situated the main power plant, consisting of four return-tubular boilers, each 150 horse-power; a Canadian Rand cross-compound air-compressor, with a capacity of 2,000 cubic feet of free air a minute; and a 27½ kw. generator for lighting purposes. In addition to this, at the No. 2 mine is placed an auxiliary steam plant consisting of one 150-horse-power boiler and a 14- x 18-inch Rand compressor.

There is also a well-equipped machine-shop, under the charge of Jno. Crawford, master mechanic, capable of dealing with all the work around the mine, carpenter and car-repair shop, locomotive-shop, and offices.

A small though well-equipped mine-rescue training-station is maintained, in which the mine-rescue apparatus is kept and the training of the workmen is carried out. Through the courtesy of the Middlesboro Collieries, Limited, the rescue apparatus of the Department of Mines is also kept here, consisting of four 2-hour type and two ½-hour type. The Department apparatus has been brought to the 1914 type, by being changed from the negative to the positive type, by Dudley Michell during the year.

The apparatus is all in good condition and is examined every month by those who have already taken the course of training.

Copies of the "Coal-mines Regulation Act," special rules, plans of mine, and "Systematic Timbering" order are posted at all the mines.

The following are the official returns of the Middlesboro Collieries for the year ending 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	43,500			
" export to United States				
" " other countries				
Total sales		43,500		
Used in making coke				
" under colliery boilers, etc.	4,300			
Total for colliery use		4,300		
		47,800		
Stocks on hand first of year	268			
" last of year	271			
Difference added to stock during year		3		
Output of colliery for year		47,803		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		
Supervision and clerical assistance	12	4.00	5	3.50 - 5.00	17	.....
Whites—Miners	40	3.30 - 5.00	.....	.....	40	.....
Miners' helpers	15	3.00	.....	.....	15	.....
Labourers	35	2.75 - 3.50	12	3.00 - 3.50	47	.....
Mechanics and skilled labour	.....	.....	10	3.50 - 4.00	10	.....
Boys	.....	.....	13	2.00	13	.....
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	.....	.....	.....	.....
Indians	.....	.....	.....	.....	.....	.....
Totals	102	.....	40	.....	142	.....

Name of seams or pits—Nos. 2 and 3 seams, one mine; Nos. 4 and 6 seams, one mine; No. 4 East mine operating in No. 4 seam; Nos. 7 and 8 mines.

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 2 and 3 seams: No coal was mined from these seams during the past year. No. 4 seam: This seam is operated from Nos. 4, 4 East, and No. 7 mines; thickness of seam, 14 feet. No. 6 mine: No coal has been taken from this seam during the past year, except that which it was necessary to remove while making repairs. Nos. 4 and 6 mines: These are operated by a main tunnel crosscut from No. 5 seam to No. 4 seam, and from No. 4 to No. 6 seam. No. 4 East: This is a new slope operating No. 4 seam and has reached a point about 900 feet from the surface. The direction of the dip of No. 4 seam in this mine is nearly south-east. No. 8 seam: No coal was taken from this seam during the past year.

Description and length of tramway, plant, etc.—The main power plant consists of four return-tubular boilers, each 150 horse-power; one Canadian Rand cross-compound air-compressor with a capacity of 2,000 cubic feet a minute. No new equipment has been added to the plant during the past year.

Inland Coal and Coke Company, Ltd.

(FORMERLY THE COAL HILL SYNDICATE.)

Head Office—Merritt, B.C.

Capital, $1,500,000.

Officers.	*Address.*
Geo. I. Wilson, President,	530 Seymour Street, Vancouver, B.C.
W. L. Nichol, Vice-President,	530 Seymour Street, Vancouver, B.C.
Stanley Carr, Secretary-Treasurer,	530 Seymour Street, Vancouver, B.C.
Joseph Graham, Vice-Pres. and Gen. Man.,	Merritt, B.C.
Andrew Bryden, Mine Manager,	Merritt, B.C.

Value of plant, $90,000.

COAL HILL COLLIERY.

The property of this company is situated south-west of the Middlesboro Colliery, and at an elevation of 500 feet higher up.

No. 3 MINE.

Andrew McKendrick, Assistant Manager and Overman; Geo. Hudson and Thos. Archibald, Firebosses and Shotlighters.

No. 3 mine, which is the only one at present working, consists of the Nos. 3 and 5 seams. The Main slope has been driven in the No. 3 seam for a distance of about 1,200 feet, practically reaching the boundary of the field; crosscut tunnels at No. 3 East and No. 6 West reach the No. 5 seam, which is higher up in the coalfield by about 140 feet. The coal-seams pitch at an angle of 30 degrees to the south-east and are 12 feet thick. The method of work is pillar and stall, pillars being left about 30 feet square; stalls are driven up full pitch, about 15 feet wide.

The coal is run down chutes and loaded into cars, then pushed to the slope, from where it is hoisted up by a steam-hoist situated outside the mine.

The No. 5 seam is 5½ feet thick, practically the same inclination and direction as the No. 3 seam. The method of work is double-stall, stalls being driven up full pitch, 30 feet wide, leaving a pillar 30 feet thick. As in the No. 3 seam, the coal is run down chutes, then loaded into cars and delivered to the landing at the slope.

The ventilation is produced by a Sheldon fan of the single-inlet type, 6 feet diameter, running at 310 revolutions a minute, and driven by a 14- x 16-inch steam-engine running at a speed of 100 revolutions a minute. At my last inspection the fan was producing 35,000 cubic feet of air a minute for the use of fifty men. A split off this circulating around the No. 5 seam workings measured 9,000 cubic feet a minute for the use of twenty-five men. Water-gauge showed ½ inch.

During the year a gob-fire developed in the West side of the No. 3 seam, necessitating the sealing-off of a large part of the mine for some time. In all, nineteen stoppings were erected, all of concrete, and since the completion of these the fire has been effectively under control. This reduced the extent of the mine, and also caused for the time being the loss of the lower No. 5 seam tunnel.

Apart from this, I have generally found the conditions around this mine fairly good; at none of my inspections have I detected explosive gas, and the air-current has been well circulated around the faces. Brattices, doors, and stoppings have all been maintained in good condition, while all the roadways are well timbered. The "Systematic Timbering" order has been very well complied with, and generally the mine conditions have been very good.

All the blasting is done with either Giant coal-powder or Monobel, electric detonators being used, and all shots are fired under the supervision of certificated shotlighters.

Following the development of the gob-fire, safety-lamps were introduced and are exclusively used in both seams; these are cleaned and tested at the lamp-station near the entrance, and re-examined by the fireboss before being allowed into the mine.

The cars in use are built of 2-inch plank with iron fittings at the mine, and have a capacity of 1 ton. These are lowered from the mouth of the slope, a distance of 1,500 feet to the top of a gravity-tramway by a tail-rope engine which hauls the empty cars back.

The gravity-tramway is a three-railed track with passing in centre, 2,000 feet long, operated by a Stine wheel, capable of handling 1,000 tons a day, using a 1-inch steel cable, and running six cars to the trip.

The cars are dumped on an ordinary tip-dump, and the coal is picked before going into the bunkers, which have a capacity of 500 tons, and from which it is drawn as required to load the railway-cars. The tipple is connected to the Kettle Valley Railway (formerly the Canadian Pacific Railway) by a standard-gauge track one mile long.

The power plant at the mine consists of two Leonard type boilers, each 40 horse-power, which furnished steam for the fan, hoists, lighting, engine, and wash-house. An auxiliary plant at the tipple consists of a 25-horse-power boiler which furnishes steam for a small hoist used to haul the cars on the tipple, also for the pump used to deliver water to the mine plant.

The surface equipment at the mine consists of machine-shop, under charge of J. T. Lawes, car-repair shop, office, and wash-house.

As required by the Act, mine-rescue apparatus as already described is maintained; copies of the "Coal-mines Regulation Act," special rules, plan of mine, and "Systematic Timbering" order are posted at the mine.

The following are the official returns of the Inland Coal and Coke Company, Limited, for the year 1915:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	32,800			
" export to United States				
" " other countries				
Total sales		32,800		
Used in making coke				
Used under colliery boilers, etc.	1,960			
Total for colliery use		1,960		
		34,760		
Stocks on hand first of year	300			
" last of year	250			
Difference taken from stock during year		50		
Output of colliery for year		34,710		

Number of Hands employed, Daily Wages paid, etc.

Character of Labour.	Underground.		Above Ground.		Totals.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	6	4.50	3	5.00	9	
Whites—Miners	60	3.30 - 5.00			60	
Miners' helpers						
Labourers	20	2.75 - 3.00	10	2.75 - 3.00	30	
Mechanics and skilled labour	20	3.00 - 3.50	12	3.00 - 4.00	32	
Boys						
Japanese						
Chinese						
Indians						
Totals	106		25		131	

Name of seams or pits—Nos. 1, 2, 3, 4, and 5 seams. Nos. 1, 2, and 4 seams have not been operated during the year; the output was won from Nos. 3 and 5 seams.

Description of seams, tunnels, levels, shafts, etc., and number of same—The major portion of the output came from No. 3 seam, which has furnished almost all the tonnage for the past four years. The seam is 12 feet thick on an average, with sandstone roof and floor. The Main slope is down 1,400 feet on an average pitch of 36 degrees. No. 5 seam is operated through a rock tunnel from No. 3, lying above and separated from No. 3 by 175 feet of sandstone. This seam is 5½ feet thick, of good blocky coal.

Description and length of tramway, plant, etc.—There were no additions of consequence made to the plant, as business was in a depressed state during the whole of the year. The main boiler plant consists of two 40-horse-power Leonard type boilers. The fan is Aelos type, with a capacity of 50,000 cubic feet, belt-driven by a 60-horse-power engine. The winding-engine on the Main slope is a 60-horse-power Ottumwa hoist, and there is an 18-horse-power Beatty engine on the haul-back from the tramway. The gravity-tramway is three-rail, 1,800 feet long, with a Stine headgear, handling six 1-ton cars to a trip on a 40-degree slope. The water is obtained from the Coldwater river, pumped one mile and three-quarters against a 600-foot head of a Marsh pump.

Pacific Coast Coal Syndicate.

(FORMERLY PACIFIC COAST COLLIERY CO. OF B.C.)

Head Office—Merritt, B.C.

Officers.	*Address.*
Geo. I. Wilson, President,	Vancouver, B.C.
W. L. Nichol, Vice-President,	Vancouver, B.C.
Stanley Carr, Secretary-Treasurer,	Vancouver, B.C.
Joseph Graham, General Manager,	Merritt, B.C.
Andrew Bryden, Mine Manager,	Merritt, B.C.
Howell John, Overman and Fireboss,	Merritt, B.C.

This property is situated nearly west from the Middlesboro Colliery, and includes that area of land lying between Middlesboro and the Coldwater river.

Two shafts and a slope have been sunk on the property, but all the work during the year has been confined to the slope. The Main slope has been sunk to a distance of about 500 feet, with three levels set off to the right, with an average distance of about 150 feet.

The thickness of the coal-seam is about 5 feet, but, owing to its proximity to the outcrop, the height has been very irregular and considerable trouble has been experienced with faults.

During the year the ownership of this property was transferred from the Pacific Coast Colliery Company to the Pacific Coast Coal Syndicate, which is connected to the Inland Coal and Coke Company, and a slight increase was made in the amount of work done during this year over the previous.

A small blow-fan was erected for ventilation purposes, and at my last inspection was producing 9,600 cubic feet of air a minute for the use of four men. The fan is driven by a 8- x 10-inch steam-engine, coupled direct, running at a speed of 200 revolutions a minute.

I have regularly inspected this mine and have always found it free from explosive gas; the air is maintained well up to the face, and doors and stoppings are in good condition. The roadways are well timbered and damp, while the "Systematic Timbering" order is strictly complied with.

The power plant consists of two vertical boilers, each 10 horse-power capacity; one 7- x 10-inch double-drum hoisting-engine; and two Fairbanks duplex ram-pumps, respectively 4½ x 3 x 4 inches and 6 x 4 x 6 inches. In addition, there is repair-shop, wash-house, and office buildings.

During the year two rescue apparatus of the half type have been acquired. Copies of the general and special rules, plan of the mine, and order *re* "Systematic Timbering" are kept posted at mine entrance.

The following are the official returns of the Pacific Coast Coal Syndicate's colliery for the year 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	765			
" export to United States				
" " other countries				
Total sales		765		
Used in making coke				
Used under colliery boilers, etc.	240			
Total for colliery use		240		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		1,005		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		$
Supervision and clerical assistance	1	5.00			1	5.00
Whites—Miners	4	3.50			4	3.50
Miners' helpers	1	3.00			1	3.00
Labourers						
Mechanics and skilled labour			1	3.50	1	3.50
Boys						
Japanese						
Chinese						
Indians						
Totals	6		1		7	

Name of seams or pits—No. 1 slope and No. 2 shaft.

Description of seams, tunnels, levels, shafts, etc., and number of same—No. 1 slope, 8 x 10, was continued to a depth of 500 feet, with a view of entering the No. 2 or Lower seam. The No. 3 level was extended in the No. seam by several hundred feet of workings, exposing a considerable body of coal of an average thickness of 5½ feet.

Description and length of tramway, plant, etc.—Plant consists of two 10-horse-power vertical boilers; one 7- x 10-inch double-drum hoisting-engine; and two Fairbanks duplex pumps. The fan is driven by a Climax engine, and is capable of delivering 15,000 feet of air.

Princeton Coal and Land Company, Ltd.

Head Office—15 Great St. Helens, London, E.C.

Capital, $1,000,000.

Officers.	*Address.*
A. St. George Hamersley, Chairman,	London, Eng.
Sheffield Neave, Director,	London, Eng.
Alex. Crerar, Director,	London, Eng.
Arthur Hicklin, Advisory Director,	London, Eng.
Oswald J. Bambridge, Director,	London, Eng.
E. S. Neave, Secretary,	London, Eng.
Ernest Waterman, General Manager,	Princeton, B.C.
Francis Glover, Manager,	Princeton, B.C.

Value of plant, $77,000.

PRINCETON COLLIERY.

Francis Glover, Manager; Robt. Brown, Overman; Robinson Wilson, Robt. Gourley, and A. Orr, Firebosses.

This company's property is situated near the town of Princeton, on the right-hand side of the Similkameen river, near its junction with the Tulameen, and is in the Similkameen Mining Division.

The original working of this coalfield was started by a small adit level on the bank of the Similkameen river, but this was abandoned and a new slope started on the bench land above, with a vertical shaft for ventilation purposes.

The Main slope has been sunk for a distance of 1,100 feet to the No. 4 Right level, and from this level, at a point about 400 feet inside, a new diagonal slope has been started and driven down a distance of 500 feet; this slope will ultimately be connected to the Main slope. During the present year very little development has been accomplished, due to a great extent to trouble experienced with gob-fires.

Following that reported last year, another broke out in the old workings near to the river, and subsequently it was found necessary to seal off other two portions of the mine to prevent further outbreaks. In view of this experience the future work is being laid out along panel lines, so that each district can be sealed off separately after the pillars have been formed, and until such time as it is required to extract the pillars, when it can be sealed off finally and so prevent the development of these gob-fires.

The coal, which is classed as a good lignite, lies dipping at an angle of 12 degrees to the west, and has a thickness of 24 feet, of which only the top 10½ feet is worked.

The method of work is by pillar and stall, pillars being left 50 square and stalls driven 9 feet wide. The coal is mined by coal-cutting machines of the Hardy type, so that a minimum of explosives is required to bring it down, and a maximum of round coal is produced for market purposes. For blasting purposes Monobel is used, with electric detonators; certificated shot-lighters being provided, as required by the Act, to superintend this work.

The haulage inside is by small air-hoists, which raise the empty cars and lower the loads to the levels, along which they are taken by horses to the Main slope, which is operated by a steam-driven hoist situated on the surface.

I have inspected this mine regularly during the year and have found explosive gas five times; in every case only in very small quantities, which was later removed by ventilation. A good current of air was generally circulating around the faces, and measured at my last inspection 36,000 cubic feet a minute for the use of twenty-two men and one horse.

This ventilation is produced by fan of the Guibal type, 30 feet in diameter and 6 feet wide, driven by a 45-horse-power steam-engine running at 220 revolutions a minute, and connected to the fan with a belt, causing the fan to run at a speed of 140 revolutions a minute. This quantity is produced with a water-gauge of ¼ inch.

Apart from explosive gas, I have found at intervals small quantities of non-explosive gas, termed black-damp, at the foot of the stoppings around the fire area; this generally indicates a leakage in the wall and is remedied as soon as the defect is repaired.

All the roads are very well timbered and the "Systematic Timbering" order well complied with, and generally the mine conditions are fair.

Safety-lamps of the Wolf type have replaced the open lights formerly used, and are cleaned and tested at the station, and re-examined before being allowed into the mine.

The surface plant is practically the same as described last year, consisting of a screening plant erected by the Link Belt Engineering Company, of Chicago, capable of dealing with 600 tons a day. The mine-cars, which are built of 2-inch plank with iron fittings, have a capacity of 1.5 tons. The cars are hauled up the Main slope in trips of six by a 50-horse-power hoist on to the tipple, which is situated about 45 feet above the ground-level. Here the cars, after being weighed, are dumped by a rotary dump into a reciprocating feeder, which regulates the supply of coal to the shaking or jigging screens, where three different sizes or grades of coal are sorted—namely, all passing over 4-inch screen is called "lump," all over 2-inch screen called "egg," all over ½-inch screen called "nut"; all under this at present goes either to the boilers or the dump, so far no market having been found for this class. The various grades are taken to separate bunkers by belt-conveyor, and during the journey the waste is picked out. The bunkers have a joint capacity of 240 tons. To facilitate the loading of the box cars, a conveyor runs underneath the chute of each bunker, so that coal can be drawn from either bunker or mixed as required, and then taken to a box-car loader of the Victor type, which places it in the cars.

The power plant consists of two Goldie-McCulloch boilers, each 275 horse-power, and a 50-horse-power boiler of the Grey type. A Rand compressor with a capacity of 744 cubic feet of free air a minute supplies air for the underground hoists, mining-machines, and pumps. A 60-kw. three-phase alternator, driven by a Goldie-McCulloch steam-engine, supplies lights for the town of Princeton and the mine. Two separate engines are used for driving the picking-tables, each being 30 horse-power.

A well-equipped machine-shop, car-repair and carpenter shop, store-room, wash-house, and offices are also provided, and for fire-protection a 30,000-gallon water-tank with a pressure of 200 lb. to the square inch.

Copies of the "Coal-mines Regulation Act," special rules, plan of mine, and order *re* "Systematic Timbering" are all posted at the mine entrance.

The following are the official returns of the Princeton Coal and Land Company for the year 1915:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	5,405			
" export to United States	4,726			
" " other countries				
Total sales		10,131		
Waste	1,460			
Used in making coke				
" under colliery boilers, etc	3,927			
Total for colliery use		5,387		
		15,518		
Stocks on hand first of year				
" last of year	30			
Difference added to stock during year		30		
Output of colliery for year		15,548		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		$
Supervision and clerical assistance	3	4.50	5	4.50	8	4.50
Whites—Miners	16	5.00	.....	.....	16	5.00
Miners' helpers	6	3.00 - 3.30	.....	.....	6	3.00 - 3.30
Labourers	.....	.....	5	3.00	5	3.00
Mechanics & skilled labour.	10	3.50	7	3.50 - 4.00	17	3.50 - 4.00
Boys	.....	.....	4	1.00	4	1.00
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	.....	.....	.....	.....
Indians	.....	.....	.....	.....	.....	.....
Totals	35	.....	21	.....	56	.....

Name of seams or pits—No. 1 slope.

Description of seams, tunnels, levels, shafts, etc., and number of same—The seam is 24 feet thick and dips at an inclination varying from 16 to 9 degrees. The top 9 feet is worked, and is a good-grade lignite and has a jet-black appearance. The slope is down a distance of 1,050 feet, driven on full pitch of seam, with Main and counter levels on strike of the seam, and 500 and 1,000 feet respectively both east and west. There is an air-shaft down to the seam and has a depth of 60 feet. Nos. 2 and 3 levels are in 1,200 feet; No. 4 East counter 1,000 feet; No. 1 West level 600 feet; and No. 2 West level and counter are in 100 feet. The coal is mined by machines, of which six are used.

Description and length of tramway, plant, etc.—The plant consists of tipple having a length of 250 feet, with rotary dump, reciprocating feeder, shaker screens, picking-belts, and box-car loader; two 75-horse-power and one 50-horse-power boilers; machine-shop containing lathe, shaper, pipe-threader, bolt-cutters, hack-saws; blacksmith and carpenter shops with steam-hammer and all necessary outfit. Bunkers have a capacity of 240 tons.

Coalmont Collieries.

(FORMERLY COLUMBIA COAL AND COKE COMPANY, LTD.)

Officers.	*Address.*
Arthur McEvoy, President,	811 Rogers Bldg., Vancouver, B.C.
A. N. Canting, Vice-President and General Manager,	Coalmont, B.C.
A. H. Douglas, Secretary,	Dom. Trust Bldg., Vancouver, B.C.
A. Ford, Acting-Superintendent,	Coalmont, B.C.

(Not incorporated.)

This property was acquired late in 1913 by A. McEvoy, and is now operated by him under the name of the "A. McEvoy, Trustee Operators Coalmont Collieries," with the head office at Vancouver.

This property is situated in the Similkameen Mining Division between the fork of the Tulameen river and Granite creek. As has been mentioned in previous reports, all the operations were discontinued on the Tulameen side, or Fraser gulch, and in 1914 work was confined to the outcrops on the North fork of Granite creek.

In the beginning of the present year work was still continued on the No. 2 tunnel until it reached a distance of 2,000 feet, when it was stopped. From February till June only two workmen were employed in the No. 6 tunnel, and since then no active work has been done on either tunnel.

The No. 2 seam, in which No. 2 tunnel was driven, is 12 feet thick, and while no method of working has so far been adopted, owing to the work being more of an exploratory nature, it will probably be pillar and stall.

The No. 6 tunnel, which is 7 feet high by 12 feet wide, is also on the No. 2 seam, and is expected to be in the main tunnel; it has been driven in for a distance of 300 feet. This tunnel is on the No. 2 seam, about 70 feet lower down, the seam pitching at an angle of 26 degrees. Practically no coal has been shipped during the year.

While these tunnels were operating I examined the mine regularly and found no trace of explosive gas, although later, when the fan was not running, there was a considerable quantity of black-damp in evidence in No. 2 tunnel. Both of the tunnels were maintained in good condition, both as to timber and roadways.

Ventilation was produced in the No. 2 tunnel by a 36-inch Comstock blower, driven by a 8- x 10-inch steam-engine, geared 1 to 3½, and produced 2,700 cubic feet of air a minute for the use of six men and one horse; speed of blower was 600 revolutions a minute; water-gauge, 3½ inches. A 24-inch Comstock blower produced the ventilation in the No. 6 tunnel, driven by a 10- x 12-inch steam-engine, producing easily 1,000 cubic feet a minute for the three men engaged there.

A 25-horse-power boiler supplied steam for the engines. A cook-house, bunk-house, office, and a few residences were also built at the mine, in addition to the workshops and offices in Coalmont.

Copies of the general rules and plan of mine were posted at entrance.

The following are the official returns of the Coalmont Colliery for the year 1915:—

Practically no coal was produced, either for sale or for use in operation, as nearly all work done was of a development character, and of the latter only a small amount of work was done owing to lack of funds.

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

Pay-roll.—Wages were paid as follows: January, 13 men, $1,207.85; February, 2 men, $144; March, 2 men, $211; April, 2 men, $217.50; May, 2 men, $208.50; total, $1,988.85.

Work abandoned after June 1st, 1915.

Names of seams or pits—Nos. 1 and 2 seams.
Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 2 and 6 tunnels.
Description and length of tramway, plant, etc.—None. But we hope soon.

United Empire Mining Co.

Capital, $500,000.

Officers.	*Address.*
W. C. McDougall, President,	Princeton, B.C.
M. H. Whitehouse, Vice-President,	Princeton, B.C.
E. G. Marston, Secretary-Treasurer,	Princeton, B.C.
W. G. Simpson, Mine Manager,	Princeton, B.C.

Value of plant, $1,000.

UNITED EMPIRE COLLIERY, PRINCETON, B.C.

The United Empire Mining Co.'s property is situated on Hunter creek, about a mile and a half from Princeton. The main tunnel is driven through the slide-rock to a point 900 feet inside, where it strikes the coal, and then continues on the coal for a distance of almost 500 feet.

This property was not operated during any part of year 1915.

Boundary Mining and Exploration Company, Limited.

Capital, $1,000,000.

Officers.	*Address.*
A. E. Watts, President,	Wattsburg, B.C.
A. Carney, Vice-President,	Kaslo, B.C.
S. J. Miller, Vice-President,	Grand Forks, B.C.
E. R. J. Forster, Secretary-Treasurer,	Grand Forks, B.C.

MIDWAY COLLIERY.

Ed. Bridge, Manager.

This company's property is situated in the Greenwood Mining Division on the banks of the Kettle river, two miles and a half west of Midway.

This property was not operated during any part of year 1915.

EAST KOOTENAY DISTRICT.

Until within the year 1908 there was only one company actually producing coal in the East Kootenay District—that is, the Crow's Nest Pass Coal Company, although this company operated three separate collieries; but during that year two new companies began to produce—namely, the Hosmer Mines, Limited, at Hosmer, and the Corbin Coal and Coke Company, at Corbin. These new companies began to ship coal towards the latter part of 1908, and, as they have extensive and fully equipped collieries, have now become important factors in the production of the district.

The Hosmer Mines continued operations until about the middle of the year 1914, when all operations were suspended.

The district is divided into two separate Inspection Districts. The Southern East Kootenay District, which was during the year 1915 under Inspector T. H. Williams, with headquarters at Fernie, includes the Coal Creek Collieries and the Carbonado Collieries of the Crow's Nest Pass Coal Company, although this latter colliery has not been worked this past year.

The Northern East Kootenay District, under Inspector George O'Brien, with headquarters also at Fernie, includes the Michel Collieries of the Crow's Nest Pass Coal Company and the Corbin Colliery of the Corbin Coal and Coke Company.

The headquarters of both inspectorates is in the Government rescue-station at Fernie.

SOUTHERN EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF T. H. WILLIAMS, INSPECTOR.

I have the honour to submit the annual report of the inspection of the mines in the Southern East Kootenay District for the year 1915.

The only mines producing coal in this Inspection District are those of the Crow's Nest Pass Coal Company's Coal Creek Colliery.

Crow's Nest Pass Coal Company, Ltd.

Capital, $3,500,000.

Officers.	*Address.*
Elias Rogers, President,	Toronto, Ont.
E. C. Whitney, Vice-President,	Ottawa, Ont.
R. M. Young, Secretary,	Fernie, B.C.
Elias Rogers, Treasurer,	Toronto, Ont.
W. R. Wilson, General Manager,	Fernie, B.C.
Bernard Caufield, Colliery Manager, Coal Creek Collieries,	Fernie, B.C.
Thomas Russell, Colliery Manager, Michel Collieries,	Michel, B.C.

The above company is now operating the following extensive collieries on the western slope of the Rocky mountains in the East Kootenay District, namely:—

COAL CREEK COLLIERY, situated on Coal creek, about five miles from the town of Fernie, on a branch railway to the mines, connected at Fernie with the tracks of the Canadian Pacific Railway and also those of the Great Northern Railway.

CARBONADO COLLIERY, situated on Morrissey creek and connected by a branch railway with the Canadian Pacific Railway and the Great Northern Railway at Morrissey. The colliery is about fourteen miles from Fernie by rail in a south-easterly direction. This colliery has been shut down since 1909.

MICHEL COLLIERY, situated on both sides of Michel creek, on the line of the Canadian Pacific Railway, being twenty-three miles in a north-easterly direction from Fernie. This last colliery is in the Northern Inspection District.

The total gross combined output of all the company's collieries for the past year was 790,028 tons. Of this, 343,491 tons was used in the manufacture of coke, yielding 240,421 tons, and as 158 tons of coke was taken from stock, the amount of the coke sold was 240,579 tons, of which 215,982 tons was sold for consumption in Canada, and 24,597 tons was exported to the United States. The coal exported to the United States amounted to 314,980 tons, while 78,734 tons was sold for consumption in Canada.

The amount and disposition of this combined output of the company's collieries is more fully shown in the following table:—

COMBINED RETURNS FROM CROW'S NEST PASS COAL CO.'S MINES FOR YEAR 1915.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	78,734		215,982	
" export to United States	314,980		24,597	
" " other countries				
Total sales		393,714		240,579
Used in making coke	343,491			
" under colliery boilers, etc.	56,318			
Total for colliery use		399,809		
		793,523		
Stocks on hand first of year	3,594		2,765	
" last of year	99		2,607	
Difference taken from stock during year		3,495		158
Output of colliery for year		790,028		240,421

NUMBER OF HANDS EMPLOYED, INCLUDING THOSE AT COKE-OVENS, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	49		21		70	
Whites—Miners	678				678	
Miners' helpers						
Labourers	104		342		446	
Mechanics and skilled labour	309		128		437	
Boys	18		19		37	
Japanese						
Chinese						
Indians						
Totals	1,158		510		1,668	

COAL CREEK COLLIERY.

Bernard Caufield, Manager.

This colliery is on Coal creek, five miles from Fernie, transportation being afforded by a branch line which makes connection with both the Canadian Pacific and the Great Northern Railways at Fernie.

Owing to depression in trade a considerable amount of time was lost, a total of 151½ days only being worked. There was a marked improvement toward the end of the year, November and December showing an average of twenty-two days, while January and February only averaged ten days.

I am pleased to report that there has not been a fatal accident to an employee of the company during the year. The number of non-fatal accidents reported was eight, a decrease of two as compared with the previous year. Four of these were caused by one accident—that of an explosion in B North mine on January 2nd. The explosion happened at about 7 a.m., when no person was in the mine. The injured men were standing near the entrance at the time and were struck with the flying debris, one being slightly burned. The injuries received by three of the men were very slight, each being able to resume work within two weeks. The regrettable feature of this explosion was the lamentable and untimely death of Inspector Evan Evans, who lost his life by being overcome with carbon-monoxide gas while accompanying an exploring party into the mine about three hours after the explosion.

The mines in operation during the year were as follows: No. 1 North, No. 9, and B North on the north side of the valley, and No. 1 South, No. 1 East, No. 2, and No. 3 on the south side. No. 5 mine, which is on the north side, was operated until the middle of September, when it was permanently closed.

The coal from all these mines is conveyed to a central tipple of steel construction, 340 feet in length, extending across the valley. It is equipped with two revolving dumps, screens, and two picking-tables, all of which are worked by electric power. Underneath the tipple are two box-car loaders operated by hydraulic pistons.

The main boiler-house plant consists of: One water-tube boiler, 125 horse-power; five Robb-Mumford locomotive type boilers, each 175 horse-power; seven return-tubular Erie City boilers, each 200 horse-power; one return-tubular boiler, 175 horse-power. In addition to these, there are two locomotive type boilers, 125 horse-power each, and one return-tubular boiler, 175 horse-power, at No. 1 East mine; and two locomotive type, 125 horse-power each, at No. 5 mine.

The power-house is equipped with: One Ingersoll-Sargeant Class (A), straight-line, piston-inlet compressor, rated capacity 1,442 cubic feet of free air a minute, compressed to 80 lb. to the square inch, speed 80 R.P.M.; one Walker low-pressure, cross-compound, Reynolds-Corliss condensing, two-stage air-compressor, rated capacity 3,500 cubic feet of free air a minute, compressed to 100 lb. to the square inch; one Class (G) Ingersoll-Sargeant two-stage, duplex air-compressor, rated capacity 1,710 cubic feet of free air a minute, compressed to 100 lb. to the square inch; one Rand cross-compound Corliss condensing, four-stage, high-pressure, air-compressor, rated capacity 1,346 cubic feet of free air a minute, compressed to 1,000 lb. to the square inch, speed 85 R.P.M.; one Robb-Armstrong Style (D), left-hand, horizontal, side-crank engine, size 20 x 20 inch, belt-connected to two Eddy 400-ampere, 250-volt generators; one Robb-Armstrong Style (D), left-hand, horizontal, side-crank engine, size 20 x 20 inch, belt-connected to two Eddy 400-ampere, 250-volt generator, and one Crocker-Wheeler 279-ampere, 220-volt generator; two Canada Foundry duplex, outside centre-packed plunger-pumps, size 10 x 7 x 12 inch, rated capacity 400 gallons a minute, speed 100 feet a minute.

The following additions to plant and surface improvements have been made: Steam-hoist installed near scale-house to move railway-cars during very cold weather. Fire-hall station for hose-reel built at the bottom of the tipple (14 x 10 x 8 feet). New wash-house, hot-water tank, and building erected; size of tank, 10 x 18 x 8 feet; size of building, 14 x 24 x 8 feet. A new pipe-line laid from No. 1 East fan-engine to convey the exhaust steam to the wash-house water-tank, so as to heat all the water used in the wash-houses. Lightning-arresters installed on all positive lines leaving the power-house. The power-house has been rewired, 110-volt circuit, replacing the 220-volt circuit formerly used. A new boiler-house built near No. 1 East mine, size 22 x 60 x 18 feet. Engine-house for Danville haulage-engine, with trestle for back balance, and tension carriage at the foot of the outside incline of No. 1 East mine, installed in connection with the operation of the new endless-rope-haulage system.

At B North mine an overman's office, 10 x 12 x 8 feet, has been built, together with a hoist-room for an electric Lidgerwood hoist. A car-haul operated by a 10-horse-power motor has been installed at the top of the outside incline. Direct transmission has been extended from the power-house to the fan, and all starting apparatus removed from the fan-house and placed in a building 100 feet away.

No. 1 North Mine.

R. Adamson, Overman; T. Tully, R. J. Brown, and E. Rutledge, Firebosses.

This mine is situated on the north side of the valley at an elevation of 300 feet above the tipple. The work done during the year has been principally development-work, four main levels and two inclines being the only places in operation. At the time of my last inspection I found it clear of explosive gas, well timbered, and in a general good condition. I measured 18,000 cubic feet of air a minute for the use of twenty-six men and four horses. Speed of fan, 512 R.P.M.; water-gauge, 1 inch; size of fan, 2 x 5 feet, belt-connected to a 30-horse-power motor.

A new tunnel, 8 x 9 feet, has been driven from the surface and connected with the inside workings so as to form a new airway, which will enable the present location of the ventilating machinery to be changed to a more desirable place. It is the intention of the management to effect this change as early in the spring as weather conditions will permit.

The old slope, which forms part of the return airway, has been enlarged and retimbered for a distance of 550 feet, and a new return airway 950 feet in length has been made between No. 2 and No. 3 inclines. The Main level has been brushed and retimbered for a distance of 600 feet; average thickness of brushing, 6.8 feet. The total amount of development-work done amounts to 8,400 feet.

No. 9 Mine.

W. Commons, Overman; J. McPherson, Fireboss.

This mine did not produce any coal during the year, the operations being confined to the repairing and brushing of the Main level and general repairs to the main return, three men being constantly employed on this work. At the time of my last inspection I found the part of the mine that could be examined in a good condition. I measured 16,000 cubic feet of air a minute for the use of three men and one horse. Speed of fan, 77 R.P.M.; water-gauge, 1 inch.

B NORTH MINE.

W. Commons, Overman; J. Worthington, W. Watkins, and W. Brown, Firebosses.

This mine is situated about 1,800 feet north-east of the tipple, and is opened by two 8- x 10-foot tunnels which struck the coal at a distance of 150 feet from the surface. The seam is 10 feet thick, but only about 5 feet of the upper portion is being worked, the method of working being pillar and stall.

Considerable damage was caused by the explosion which I have already mentioned, and the work done during the first nine months of the year consisted mainly in the repairs necessary to recover the working-places and to again place it in a producing condition. At the time of my last inspection I found a small quantity of explosive gas in one place. The mine was well ventilated, and the conditions throughout were generally good. I measured 23,000 cubic feet of air a minute for the use of fifty-six men and six horses. This is produced by a 3- x 10-foot double-inlet, two-compartment, reversible Brazil fan, belt-connected to a 30-horse-power Westinghouse motor. Speed of fan, 160 R.P.M.; water-gauge, 1 inch. The total amount of development-work done is 2,600 feet.

No. 1 SOUTH MINE.

Adam Watson, Overman; J. Lane, W. Stockwell, and W. Joyce, Firebosses.

This mine is situated 2,500 feet south-west of the tipple and at an elevation of 200 feet above it. It is opened by an adit-tunnel driven on the strike of the seam, inclines being turned off it to the full rise, and level rooms driven from these inclines. Both horse and mechanical haulage is employed to haul the coal to the surface, where it is lowered to the tipple elevation by a gravity-plane, compressed-air locomotives being used to convey it from the bottom of the plane to the tipple. At the time of my last inspection I found it clear of explosive gas, well ventilated, and in a general good condition. I measured 23,500 cubic feet of air a minute for the use of sixty men and eight horses. Speed of fan, 162 R.P.M.; water-gauge, 1.3 inches.

At a point 460 feet from the tunnel-mouth a drift 130 feet in length has been driven to cut No. 2 seam, which is now being developed in this mine by a pair of entries. The quantity of air in this drift is 10,000 cubic feet a minute for the use of six men and one horse. The total quantity of air going into the mine is 36,000 cubic feet a minute. This is produced by a 3- x 10-foot double-inlet, two-compartment, reversible Brazil fan, belt-connected to a 30-horse-power, shunt-wound, General Electric motor. Speed of fan, 160 R.P.M.; water-gauge, 1.2 inches. The total amount of development done was 6,310 feet.

No. 1 EAST MINE.

D. Martin, Overman; J. Caufield, T. Wilson, J. Bell, H. Dunlap, J. Mawson, and W. Austin, Firebosses.

This mine is situated 800 feet east of the tipple and at an elevation of 90 feet above it. It is opened by a rock tunnel which struck the coal at a distance of 215 feet from the surface. It is the largest producing mine which the company operates, about one-half the total output of the colliery being obtained from it. The method of working is room and pillar, entries 10 feet wide being driven in pairs, with a 60-foot pillar between. The rooms are 14 feet wide and are also driven in pairs, a 150-foot pillar being left between each pair, and a 60-foot pillar between the rooms forming the pairs. The workings are immediately above those of the old workings of No. 2 mine, and are nearly all sufficiently advanced to be clear of them.

At the time of my last inspection I found explosive gas in three places. The ventilation was good, showing 160,000 cubic feet of air a minute for 156 men and sixteen horses. This quantity was divided into four splits, as follows: Diagonal district, 31,200 cubic feet a minute for the use of fifty men and five horses; East of tunnel, 35,000 cubic feet a minute for the use of forty-eight men and five horses; West of tunnel, 30,000 cubic feet a minute for the use of fifty-eight men and six horses. There is also about 10,000 cubic feet a minute going into the East dips district, which is finished, the only men engaged being those who are taking out the material. The ventilation is produced by a double-inlet, two-compartment, reversible, belt-driven Wilson fan, rated capacity 200,000 cubic feet a minute against a water-gauge of 2 inches while running at a speed of 180 revolutions a minute. It is steam-driven by a 125-horse-power Tangye engine.

The following improvements were made during the year: No. 7 room for a distance of 1,000 feet between No. 10 and 12 levels was graded, retimbered, and laid with heavy steel, 400 feet being double-tracked. Installed Danville endless-rope-haulage engine to operate as single unit on No. 1 East main tunnel and outside incline; total length of rope, 9,000 feet. Installed one 12- x 15-inch Lidgerwood hoist in No. 2 room, No. 14 East level. Constructed overcast over No. 10 East level for the main return. Main East side return brushed, enlarged, and retimbered where necessary for a distance of 1,000 feet. Main West side return brushed, enlarged, and retimbered where necessary for a distance of 3,284 feet. Installed one 7- x 10-inch Lidgerwood hoist in No. 12 West entry. The development-work done amounts to 14,310 feet. The face of the Main tunnel is 4,925 feet from the surface.

No. 2 MINE.

William Lancaster, Overman; F. Lander, J. Bushell, and C. McNay, Firebosses.

This mine is situated on the south side of the valley, on the same elevation as the tipple and in direct line with it. The work done during the year has been confined to development-work, six places being driven for this purpose. The face of the Main level is 5,750 feet from the surface, and has advanced sufficient to permit a pair of slopes to be driven off it. These slopes will be clear of the old workings, and will be the means of developing an area of coal which had to be abandoned after the "bump" which occurred in July, 1908.

The main return has been enlarged and retimbered for a distance of 500 feet. At the time of my last inspection I found a little explosive gas in one place. The ventilation and general conditions were good. I measured 16,000 cubic feet of air a minute for twenty-six men and four horses. Speed of fan, 116 R.P.M.; water-gauge, 2.5 inches. The ventilation is produced by a double-inlet, two-compartment, reversible Wilson fan, direct-connected.

No. 3 MINE.

John Biggs, Overman; A. Kinsman, W. R. Puckey, and J. McCourt, Firebosses.

This mine is working the No. 2 seam, and is opened by a slope 2,250 feet long, driven on the full pitch of the seam, which is about 10 degrees. The method of working is room and pillar, levels being 12 feet wide and rooms 18 feet wide. The rooms are driven in sets of three, with a 60-foot pillar between each room and a 150-foot pillar between each set.

At the time of my last inspection I found a small quantity of explosive gas in two places. The ventilation was fair, the roadways and timbering being good. I measured 36,000 cubic feet of air a minute for forty-seven men and nine horses. This quantity was divided into two splits, as follows: Slope district, 14,400 cubic feet a minute for seventeen men and four horses; South level district, 20,800 cubic feet a minute for thirty men and five horses. Speed of fan, 114 R.P.M.; water-gauge, 2.5 inches. The fan is of the same type as that of No. 1 East mine.

The improvements consist of the laying of 4,100 feet of high-pressure pipe-line for compressed-air motor-haulage, and the building of ten rock stoppings to seal off the old workings of No. 2 mine, which are on the south side of the No. 3 mine main return; average size of stoppings, 6 x 14 x 20 feet. The total amount of development-work done was 7,040 feet.

No. 5 MINE.

The lowest seam of the series which has been worked at Coal creek for some years was worked in this mine. It was closed at the middle of September to protect the working in the upper measures. At the time of my last inspection I found explosive gas in one place. The total amount of development-work done was 2,695 feet.

Wolf safety-lamps are used exclusively in all the mines. With the exception of a portion of No. 1 South mine, the coal is all mined without explosives, and no coal-cutting machines are in operation. The following amount of explosives was used for all purposes at this colliery during the year: Polar Permitite, 1,140 lb.; Monobel, 2,292 lb.; gelatine, 155 lb.; dynamite, 42 lb. Estimated number of shots fired, 4,606.

In compliance with section 106 of the "Coal-mines Regulation Act," there is installed the following equipment for mine-rescue work: Four 2-hour and six ½-hour sets of Draeger apparatus; two pulmotors; seven Ceag electric lamps; nine full tanks of oxygen; and 140 2-hour cartridges. This equipment is under the charge of R. Johnstone, the colliery electrician, and was in good condition when inspected on December 24th. All officials who are physically fit have been trained in the use of the above apparatus.

During the early part of the year considerable interest was shown in first-aid work, a large number of officials and workmen attending the classes which were held at Coal Creek and Fernie.

The following are the official returns for the Coal Creek Colliery for the year 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	42,102		146,595	
" export to United States	220,951		525	
" " other countries				
Total sales		263,053		147,120
Used in making coke	213,188			
Used under colliery boilers, etc	38,033			
Total for colliery use		251,221		
		514,274		
Stocks on hand first of year	2,423		1,598	
" last of year	53		1,607	
Difference {* added to / † taken from} stock during year		†2,370		*9
Output of colliery for year		511,904		147,129

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC., INCLUDING FERNIE COKE-OVENS.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	30		12		42	
Whites—Miners	422				422	
Miners' helpers						
Labourers	70		204		274	
Mechanics and skilled labour	203		84		287	
Boys	15		11		26	
Japanese						
Chinese						
Indians						
Totals	740		311		1,051	

Owing to depression in trade, the mines did not work steadily during 1915. The following shows the number of days each month that Coal Creek Colliery was operated:—

	Days.		Days.
January	10½	August	10
February	9½	September	11½
March	9	October	17½
April	8	November	24½
May	8½	December	20½
June	9½		
July	12½	Total	151½

Name of seams or pits—No. 1 North, No. 1 South, and No. 1 East, same seam; No. B; No. 2, No. 3, and No. 9, same seam; No. 5, operations suspended September 15th, 1915.

NORTHERN EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF GEORGE O'BRIEN, INSPECTOR.

I have the honour to submit the annual report as Inspector of Coal-mines for the Northern East Kootenay Inspection District for the year 1915.

The collieries at present being operated are as follows: Michel Colliery, by the Crow's Nest Pass Coal Company, Limited, and Corbin Colliery, by the Corbin Coal and Coke Company, Limited. The Hosmer Colliery, formerly operated by the Natural Resources Department of the Canadian Pacific Railway Company, did not operate during the year.

There was one fatal accident and nine non-fatal accidents reported during the year. This is a decrease of three in the fatal class and an increase of two in the non-fatal class as compared with last year.

The fatal accident was caused by a fall of roof-rock at the working-face. This accident under ordinary circumstances should not have occurred. The deceased with his working partner had been instructed by the mine officials on the morning of the accident to take down the rock that later caused the accident. This was attempted, and failing to get it all down after two and one-half hours' work, the deceased and his partner resumed their ordinary work at the face and left the rock they had been trying to take down unsupported. An hour or so later the rock fell on deceased, causing injuries which resulted fatally thirty-six hours later. This is another case of an accident that could easily have been prevented by the miner setting a few posts.

Of the nine non-fatal accidents, three were caused by falls of roof and coal at the working-face, three by haulage, and three on the surface. On investigating the causes of these accidents, I regret to state that most of them could have been prevented if ordinary care had been taken by the men themselves.

Crow's Nest Pass Coal Company.*

MICHEL COLLIERY.

Thomas Russell, Colliery Manager.

This colliery, operated by the Crow's Nest Pass Coal Company, Limited, is situated on both sides of Michel creek, and comprises Old No. 3 and No. 3 East on the south side, and New No. 8 mine on the north side.

Owing to the depression in the coal and coke trade the mines did not work very steadily during the first six months of the year, but improved greatly in the second half of the year. The total number of days worked was 243½, 102 of which were worked in the first half and 141½ in the second half of the year. February, March, and April were the slowest months, the number of days being worked was 16, 13½, and 15½ respectively.

OLD NO. 3 MINE.

Jas. Touhey, Overman; R. L. Spruston, J. Henney, and A. Frew, Firebosses; W. Almond and W. Touhey, Shotlighters.

This mine is opened by a rock tunnel from the surface and cuts Nos. 5, 4, and 3 seams respectively. No. 3 seam, which is 970 feet from the tunnel-mouth, is the only seam from which coal was produced during the year. The method of working is pillar and stall; the entries are driven from 10 to 12 feet wide and the rooms from 14 to 16 feet wide. In Nos. 2 and 3 Slope districts the pillars average about 50 feet square, but in the West Incline district every fourth pillar is about 150 x 50 feet.

Upon my last inspection on December 22nd, 1915, I found this mine clear of explosive gas and well timbered. I measured 85,750 cubic feet of air a minute entering the mine for the use of seventy-one men and eight horses, which is 902 cubic feet to the unit, counting one horse

* *See also* page 420.

equal to three units. This quantity is divided into three splits, as follows: East side split, 36,000 cubic feet a minute for twenty-seven men and five horses; No. 3 Slope split, 19,200 cubic feet a minute for twenty-four men and two horses; West Incline split, 8,750 cubic feet a minute for twenty men and one horse. The fan-engine was running 134 R.P.M. Fan ratio, 5½ to 7; water-gauge, 2 inches.

The ventilation in this mine is produced by a 6- x 12-foot double-inlet, two-compartment, rope-driven fan, operated as an exhaust; the rated capacity of which is 190,000 cubic feet of air a minute against a 2-inch water-gauge while running at 210 R.P.M. The fan-engine is of the Tangye style, left hand, throttling, size 16 x 18 inches, 125 horse-power, built by the Erie City Iron Works, Erie, Pa. In the fan-house there is a Crosby self-recording water-gauge in addition to the ordinary U water-gauge, the inspection of which is recorded by the fan engineer every hour on the card, the same being kept on file.

I took eleven samples of mine-air from this mine during the year. The samples proved that large quantities of gas is given off for each ton of coal mined, in Nos. 2 and 3 Slope districts especially.

The coal in the East side of the mine is all pick-mined and is produced without the use of explosives. The coal in No. 3 slope is also pick-mined, but a little blasting is done, the shots being fired by competent shotfirers with electric batteries. The coal in the West Incline district is machine-mined and blasted. Monobel powder and No. 6 electric detonators are used for blasting the coal. Safety-lamps of the Wolf type are used exclusively in this mine.

The improvements completed in this mine during 1915 are as follows: Slide tunnel, 6 x 8 x 90 feet, through from surface on line with face of West incline, which is now used as a separate intake for this district. Overcast, parallel level, West incline. Main No. 3 slope, top-rock brushing, commencement of tunnel to recover seam beyond second fault. Parallel No. 3 slope, proving second fault, rock-drift, 6 x 8 x 160 feet. Return airway, No. 3 slope district, from No. 6 West to No. 1 West, enlarging and repairing, 5 x 6 x 500 feet. Main West return from top of West slant to No. 4 shaft, enlarging and repairing, 350 feet. East Incline return, repairing and centre-posting No. 5 room, 700 feet. Two pipe-lines, one 4 inches and one 3 inches, laid along No. 2 parallel slope from the Main level to No. 5 East room, 950 feet. One 3-inch line laid down the East incline from No. 6 East room in No. 2 slope to No. 5 East room, East incline, 650 feet. One 3-inch line laid from hoist to No. 4 West room, West incline, 500 feet.

Development, 1915.—West Nos. 1 and 2 inclines, 720 feet; crosscuts, 280 feet; No. 13 East slant, No. 2 slope, 650 feet.

Total Distances, Main Development.—Main level, 4,720 feet; No. 3 slope, 1,250 feet; No. 1 West incline, 1,400 feet; No. 3 West incline, 150 feet; No. 2 slope, 1,600 feet; East incline in No. 2 slope, 960 feet.

No. 3 EAST OR NEW No. 3 MINE.

Thos. Cunliffe, Overman; Ed. Hayes, J. Mason, and T. Phillips, Firebosses; B. Ball and Thos. Owens, Shotlighters.

This mine is situated about 3,000 feet south-east of the tipple and is opened by a tunnel. About 400 feet from the tunnel-mouth the Main slope is sunk for a distance of about 2,000 feet on the full dip of the seam. Levels, east and west, are driven at about 200 feet intervals on the strike of the seam, from which rooms are turned. The method of working is pillar and stall, the entries being driven from 10 to 12 feet wide and the rooms from 14 to 16 feet wide. The pillars in this mine average about 60 feet square, but occasionally much larger pillars are left in.

Upon my last inspection on December 21st, 1915, I found this mine clear of explosive gas and well timbered. I measured 98,800 cubic feet of air a minute entering the mine for the use of seventy men and eight horses, which is 1,051 cubic feet to the unit. This quantity is divided into four splits, as follows: No. 6 East split, 21,000 cubic feet a minute for twenty men and two horses; No. 8 West split, 23,100 cubic feet a minute for fourteen men and two horses; East of slope, 16,000 cubic feet a minute for sixteen men and two horses; West of slope, 19,250 cubic feet a minute for twenty men and two horses. The fan-engine was running 112 R.P.M. Speed of fan same as engine; water-gauge, 2 inches.

The ventilation in this mine is produced by an 8- x 16-foot double-inlet, two-compartment, reversible, rope-driven Wilson fan, and is operated as an exhausting unit, the rated capacity of

which is 200,000 cubic feet of air a minute against a 2-inch water-gauge while running at 180 R.P.M. The fan-engine is of the Tangye style, left hand, throttling, size 16 x 18 inches, 125 horse-power. In the fan-house there is a Crosby self-recording water-gauge in addition to the ordinary U water-gauge, the inspection of which is recorded by the fan engineer every hour on the card, the same being kept on file.

I took ten samples of mine-air from this mine during the year. The samples proved that considerable quantities of gas is given off for each ton of coal mined in some of the districts.

The coal in this mine is all pick-mined, but a little blasting is done. The shots are fired by competent shotfirers with electric batteries. Monobel powder is used for the coal, with No. 6 electric detonators. Wolf safety-lamps are used exclusively in this mine.

The coal is hoisted to the surface by means of a steam-hoist located on the surface at the mine-mouth. At this point a compressed-air locomotive gathers the cars in trips and delivers them to the tipple.

The improvements completed in this mine during 1915 are as follows: No. 6 East level, grading and retimbering, 400 feet; brushing bottom and retimbering, 150 feet; average thickness, 5 feet 5 inches. No. 5 East level, repairing and centre-posting, 800 feet. Main East side return, cleaning, retimbering, and centre-posting, 1,350 feet. Overcast Main slope at No. 8 East for East side return. No. 8 West level, brushing and retimbering, 250 feet. Pipe-lines: 1,200 lineal feet of 4-inch pipe-line laid in No. 5 East and East side return; 400 lineal feet of 3-inch pipe-line laid in No. 5 East level; 800 lineal feet of 3-inch pipe-line laid in back slope below fault.

Development, 1915.—Nos. 5 and 6 East levels, 840 feet; crosscuts, 450 feet; Main slope and parallels, 1,300 feet; crosscuts, 770 feet; No. 8 West levels, 2,570 feet; crosscuts, 1,060 feet; inclines off No. 8 West, 540 feet; crosscuts, 180 feet.

Total Distances, Main Development.—Main East level, 2,850 feet; Main slope, 2,150 feet; No. 6 East level, 1,710 feet; No. 8 West level, 2,000 feet.

NEW NO. 8 MINE.

W. Whitehouse, Overman; M. Littler, T. Baybutt, and M. D. McLean, Firebosses; John Marsh and John Newman, Shotlighters.

This mine is situated on the north side of Michel creek at an elevation of 535 feet above the tipple. This mine is opened by a tunnel driven at right angles to the strike of the seam for a distance of about 400 feet. At this point levels are driven east and west, from which three pairs of inclines are driven on the full pitch of the seam. Rooms are turned to the right off the inclines every 60 feet. The method of working is pillar and stall, the pillars being drawn after the room has reached the boundary-line. The average size of the pillars is about 60 feet square.

Upon my last inspection on December 7th, 1915, I found this mine clear of gas and well timbered. I might state that at no time during the year did I find any explosive gas in this mine. The mine is naturally moist all through and the ventilation is well conducted to the working-places. I measured 40,950 cubic feet of air a minute entering the mine for the use of fifty-four men and seven horses, which is 546 cubic feet a unit. This quantity is divided into two splits, as follows: East side split, 15,000 cubic feet a minute for thirty-five men and five horses; West side split, 23,400 cubic feet a minute for nineteen men and two horses.

The ventilation in this mine is produced by a 4- x 8-foot double-inlet, one-compartment, reversible, belt-driven Murphy fan, and is operated as an exhausting unit, the rated capacity of which is 85,000 cubic feet of air a minute against a 2-inch water-gauge while running at 205 R.P.M. At the time of inspection the fan-engine was running at 104 R.P.M. The fan ratio is 2½ to 4, and the water-gauge was 0.5 inch. The fan-engine is a centre-crank, throttling, 40-horse-power engine; size, 11 x 14 inches. It is at present operated by compressed air, which is giving good satisfaction.

The coal in this mine is all pick-mined, but considerable blasting is done. The shots are fired by competent shotfirers with electric batteries. Monobel powder, with No. 6 electric detonators, is used in the coal. Safety-lamps of the Wolf type are used exclusively in this mine.

I took three samples of mine-air from this mine during the year. The samples proved that very small quantities of gas was given off for each ton of coal mined.

The improvements completed in this mine during 1915 are as follows: No. 1 mud-tunnel cleaned and retimbered to provide additional exit from New No. 8 mine. Main level, rock-

brushing at the foot of No. 6 incline to improve haulage, 450 feet; average thickness, 3.8 feet. Overcast No. 2 incline opposite No. 1 room. No. 2 incline, top landing brushed, 100 feet. Pipe-lines were extended to No. 4 and No. 6 incline hoists; 400 lineal feet of 4-inch line on Main level; 1,000 lineal feet of 3-inch line from bottom of No. 3 incline to No. 4 incline hoist; 1,100 lineal feet of 2-inch line from bottom of No. 3 incline to No. 6 incline hoist; 60 feet of 6-inch pipe installed in original prospect-drift to drain fan-shaft and adjoining workings.

Development, 1915.—Main levels, 995 feet; crosscuts, 305 feet; Nos. 1 and 2 inclines, 1,070 feet; crosscuts, 300 feet; Nos. 3 and 4 inclines, 1,770 feet; crosscuts, 480 feet; Nos. 5 and 6 inclines, 750 feet; crosscuts, 100 feet.

Total Distances, Main Development.—Main level, 2,280 feet; No. 2 incline, 1,400 feet; No. 4 incline, 860 feet; No. 6 incline, 280 feet.

There were 25,114 shots fired and 12,557 lb. of Monobel powder used in the production of the year's output of coal. In rock-work throughout the colliery, 770 lb. of Polar Permitite was used and 810 shots fired.

Power Plant Equipment.—Eight Erie City return-tubular 150-horse-power boilers; three Abell locomotive type 125-horse-power boilers; two Northy duplex, outside centre-packed plunger feed-pumps, manufactured by the Canada Foundry Company, Toronto, rated capacity 400 gallons a minute; one Walker low-pressure, cross-compound, Reynolds-Corliss condensing, two-stage compressor, capacity 3,500 cubic feet of free air a minute, compressed to 100 lb. to the square inch; one Rand low-pressure, cross-compound, Corliss condensing, two-stage compressor, rated capacity 4,523 cubic feet of free air a minute, compressed to 100 lb. to the square inch; one Rand high-pressure, cross-compound, Corliss condensing, four-stage compressor, capacity 1,346 cubic feet of free air a minute, compressed to 1,000 lb. to the square inch; one tandem compound, centre-crank, single-valve condensing, automatic type, McEwan engine, direct-connected to one 250-kw., 1,000-ampere, 250-volt generator; one left-hand, Type D, horizontal, side-crank, tandem compound, Corliss-valve condensing-engine, direct-connected to one 250-kw., 1,000-ampere, 250-volt generator; one Canada Foundry duplex, outside centre-packed plunger-pump, size 12 x 7 x 12 inches, rated capacity 400 gallons a minute; one Smith-Vaile duplex, outside centre-packed plunger-pump, size 12 x 6 x 12 inches, rated capacity 292 gallons a minute; one Cameron duplex, outside packed plunger-pump, size 16 x 11 x 30 inches, rated capacity 480 gallons a minute. The tipple is built of steel and is equipped with two shaker screens and two picking-belts, the machinery for same being operated by electricity. There are also two Ottumwa steel box-car loaders which are operated by steam.

General Surface Improvements, 1915.—Pump-well, 12 feet diameter by 24 feet deep; tram-line siding haulage to New No. 3 mine, 480 feet; tram-line siding, New No. 8 haulage, 950 feet; screened-house coal-bunker; general slack-bin repairs, mud-sills, knee-braces, and columns; 157 new pit-cars added during 1915; Pennsylvania hammer mill pulverizer, supplied by the Pennsylvania Crusher Company, rated capacity 80 to 100 tons of mine-run coal when running at a speed of 800 R.P.M. This crusher was installed to crush New No. 8 coal for coking purposes; it is belt-connected through a counter-shaft to an Ames 125-horse-power engine; size 14 x 18 inches; New No. 8 fan and engine house.

The general and special rules are posted at each mine, also up-to-date copies of the mine plans.

The rescue equipment at this colliery is as follows: Four 2-hour sets Draeger apparatus, 1911 mouth-breathing type; five ½-hour sets Draeger apparatus; one pulmotor and inhalator combined; one inhalator in separate box; one recharging-pump; 100 2-hour regenerating cartridges; fifty 1-hour regenerating cartridges; three tanks of oxygen, each 150 cubic feet capacity; four Wolf electric hand-lamps; four Draeger electric hand-lamps; spare cylinders, wrenches, parts, etc. All of the above equipment was in good condition except the ½-hour sets of apparatus, which required new breathing-bags, the rubber linings having deteriorated.

Most of the officials of this colliery have taken a course of training in mine-rescue work and first aid. Arrangements are now being made for a number of the employees to take a course. There is a rescue-station at the colliery, owned by the Coal Company, where excellent training can be carried on.

FIRST AID.

Considerable work has been carried on during the year, a large number of the employees having taken the prescribed course, and were successful in passing at the subsequent examina-

tions held under the auspices of the St. John Ambulance Association. I am very pleased to report that the different mine officials and employees have very generously co-operated with the Department of Mines in making successful the campagin launched by the Department at the commencement of the year for "safety first."

The following are the official returns from the Michel Colliery for the year 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	36,632		69,387	
" export to United States	94,029		24,072	
" " other countries				
Total sales		130,661		93,459
Used in making coke	130,303			
Used under colliery boilers, etc.	18,285			
Total for colliery use		148,588		
		279,249		
Stocks on hand first of year	1,171		1,167	
" last of year	46		1,000	
Difference taken from stock during year		1,125		167
Output of colliery for year		278,124		93,292

NUMBER OF HANDS EMPLOYED, INCLUDING THOSE AT COKE-OVENS, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	19		9		28	
Whites—Miners	256				256	
Miners' helpers						
Labourers	34		138		172	
Mechanics and skilled labour	106		44		150	
Boys	3		8		11	
Japanese						
Chinese						
Indians						
Totals	418		199		617	

Owing to depression in trade, the mines did not work steadily during 1915. The following shows the number of days each month that Michel Colliery was operated:—

	Days.		Days.
January	18½	August	22
February	16	September	23
March	13½	October	25
April	15½	November	26
May	17	December	21½
June	21½		
July	24	Total	243½

Name of seams or pits—New No. 3 (top section of No. 3 seam); Old No. 3 (lower section of No. 3 seam); New No. 8 (Old No. 8 seam continued); No. 8 North (not operated during 1915).

Corbin Coal & Coke Company, Limited.

Head Office—Spokane, Wash.

Capital, $10,000,000.

Officers.	*Address.*
D. C. Corbin, President,	Spokane, Wash.
E. J. Roberts, Vice-President,	New York, N.Y.
A. M. Allen, Secretary-Treasurer,	Spokane, Wash.
R. S. Ord, General Manager,	Spokane, Wash.
Chas. Graham, Mine Manager,	Corbin, B.C.

Value of plant, $330,000.

CORBIN COLLIERY.

Charles Graham, Manager.

This colliery, which comprises Nos. 1, 3, and 4 mines, is situated on the East branch of the South fork of Michel creek, about fourteen miles from McGillivray Junction, on the Crowsnest branch of the Canadian Pacific Railway, and is connected to it by the Eastern British Columbia Railway.

The whole of the coal produced during the year was from No. 3 and No. 4 mines, No. 1 mine still being sealed on account of the fire mentioned in my last report.

Owing to the depression in the coal trade this colliery worked very intermittently during the year. The underground workings known as No. 4 mine were shut down for three successive months during the year, and for the remaining period work was very intermittent. At No. 3 mine, or "Big Showing," the removal of the overburden was vigorously prosecuted throughout the year and a large amount of work was done.

There were no fatal accidents reported from this colliery during the year. This is the third year in succession in which this colliery has been free from fatal accidents; a very enviable record. Two slight accidents were reported during the year, one of which occurred on the surface and the other at the working-face.

No. 3 or "Big Showing" Mine.

This is an open pit or surface operation, and is 1,200 feet higher than the Corbin townsite, or 6,200 feet above sea-level. It is reached by a standard-gauge switchback railway eight miles in length. Shay locomotives are used for hauling the railroad-cars, as the grades are very steep in places.

The seam at this point is several hundred feet thick, with very little cover. The overburden is removed by means of a steam-operated scraper and a steam-shovel. The coal is then loaded direct into railroad-cars by the steam-shovel. At the point known as L 6 an open slope has been sunk in the seam on a 30-degree pitch. The coal from this slope is hoisted by a steam-hoist and landed on a temporary trestle, where it is dumped direct into railroad-cars after passing over a 2-inch screen. There are good prospects for a large output from this mine during 1916.

No. 4 Mine.

Wm. Walker, Overman; Gomer Trehearne, Fireboss.

This mine is situated between No. 1 mine and the tipple, and is working a part of what is known as the Prime seam. The seam at this point stands nearly vertical, and in places it is

several hundred feet thick between walls. The method of working is pillar and stall; the entries are driven about 10 feet wide and 10 feet high, and the rooms about 12 feet wide by 10 feet high. The pillars are about 50 feet square. No pillars have been drawn in this mine. The levels are connected at intervals of about 200 feet with 5- x 5-foot raises.

Upon my last inspection on December 16th, 1915, I found this mine clear of gas and well timbered. The mine is naturally wet throughout, and I might state that only on one occasion during the year did I find any trace of gas in this mine.

The ventilation is produced by a 4- x 12-foot fan, direct-connected to a steam-driven engine, and is operated on the Plenum system, which at the time of inspection was giving 30,000 cubic feet of air a minute. This quantity is divided into two splits, as follows: 400 Level split, 13,200 cubic feet a minute for fourteen men and one horse, which is 835 cubic feet to the unit. The remainder of the above quantity, which forms the second split, is allowed to circulate through the lower levels, which at present are not working.

The 500 and 600 levels are ventilated by a Sirocco disk fan 3 feet in diameter, which is operated as an exhausting unit, and driven by a 3-horse-power three-phase motor running at 1,000 R.P.M. At the time of inspection I measured 12,000 cubic feet of air a minute being produced by this fan for the use of twelve men and three horses, which is 571 cubic feet to the unit.

The coal from the 400, 500, and 600 levels is lowered down an incline tramway built on the surface, direct to the tipple, where the coal is dumped over a Marcus screen and prepared for market.

The general and special rules and up-to-date copies of the mine plans are posted at the mine.

Rescue Equipment.—Two 2-hour sets Draeger apparatus, 1911 mouth-breathing type; one ½-hour set Draeger apparatus; one recharging-pump; one pulmotor and inhalator; two Draeger electric hand-lamps; three oxygen-tanks, each 100 cubic feet capacity; supply of oxygen, regenerating cartridges, spare parts, etc. All of the above equipment was in good condition.

FIRST AID.

The organization of first-aid classes under the auspices of the St. John Ambulance Association made some progress during the year, but not as good as was expected when the classes were first organized in February. The greatest reason for this is because very few English-speaking miners are left, a large number having enlisted in the various units raised in this locality.

The following are the official returns from the Corbin Colliery for the year 1915:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,000 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	3,860			
" export to United States	55,040			
" " other countries				
Total sales		58,900		
Used in making coke				
Used under colliery boilers, etc.	3,644			
Total for colliery use		3,644		
		62,544		
Stocks on hand first of year not considered				
" last of year not considered				
Difference added to stock during year				
Output of colliery for year		62,544		

Blast in Coal-seam, the Overburden of which had previously been removed—Corbin, B.C.

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
Supervision and clerical assistance	2		5		7	
Whites—Miners and helpers	20				20	
Miners' helpers						
Labourers			45		45	
Mechanics and skilled labour	3		5		8	
Boys						
Japanese						
Chinese						
Indians						
Totals	25		55		80	

Description of seams, tunnels, levels, shafts, etc., and number of same—No. 3, "Big Showing": Operations here are all on the surface, the underground work having been abandoned. Considerable work has been done this year. All stripping was done by means of the steam-shovel. No. 4 mine: Nothing to add to previous descriptions.

Description and length of tramway, plant, etc.—No essential changes from report for 1914.

SUMMARY—TABLE SHOWING ACCIDENTS OCCURRING IN B.C. COLLIERIES IN TEN YEARS—1906 TO 1915.

For the year	1906.				1907.				1908.				1909.				1910.				1911.				1912.				1913.				1914.				1915.				Total for 10 years.			
Outp't of coal—tons	1,899,076				2,219,608				2,109,387				2,400,600				3,139,235				2,193,062				3,025,709				2,570,760				1,810,967				1,972,580				24,340,984			
No. pers'ns employ'd	4,805				6,059				6,095				6,418				7,758				6,873				7,130				6,671				5,732				4,991				62,532			
Nature of Injury. / Cause of Accident.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.
Gas explosions.....	..	..	1	1	1	1	18	20	1	..	8	9	32	..	7	39	..	..	6	6	..	..	10	10	7	2	3	12	..	..	13	13	..	1	2	3	23	2	8	33	64	6	76	146
Falls of coal.....	5	6	3	14	8	15	7	30	3	6	10	19	7	7	4	18	5	16	5	26	3	5	6	14	4	7	9	20	6	4	2	12	2	6	..	8	1	3	3	7	44	75	49	168
" rock	7	8	7	22	2	7	8	17	5	10	7	22	6	13	9	28	8	15	12	35	..	5	24	29	5	9	10	24	11	9	3	23	2	14	..	16	4	7	4	15	50	97	84	231
Mine cars and horses	2	13	13	28	8	22	15	45	1	19	15	35	6	17	24	47	11	49	23	83	5	7	18	30	5	10	10	25	4	28	9	41	5	18	2	25	3	21	2	26	50	204	131	385
Powder, &c., expl'n	..	1	1	2	1	2	4	7	..	2	4	6	1	1	3	5	1	1	3	5	..	1	2	3	2	1	..	3	..	2	..	2	2	3	..	5	..	..	1	1	7	14	18	39
Hoisting, ropes, &c.	..	2	1	3	..	..	3	3	1	4	..	5	..	..	3	3	..	2	4	6	..	1	1	2	3	7	6	16	1	2	..	3	2	1	1	4	1	4	4	9	8	23	23	54
Mine timber.....	..	1	1	2	..	4	1	5	1	3	..	4	..	2	3	5	1	4	2	7	..	..	5	5	1	2	2	5	3	6	1	10	..	2	2	4	..	..	..	..	6	24	17	47
Underground—Miscellaneous	..	2	3	5	1	1	4	6	4	2	5	11	2	2	2	6	1	4	4	9	4	..	5	9	..	4	4	8	..	..	6	6	3	..	..	3	19	1	3	23	34	16	36	86
On surface—Miscellaneous	1	3	2	6	10	9	2	21	2	4	3	9	3	5	4	12	1	4	7	12	4	4	11	19	1	2	3	6	2	6	1	9	1	8	1	10	1	3	1	5	26	48	35	109
	15	36	32	83	31	61	62	154	18	50	52	120	57	47	59	163	28	95	66	189	16	23	82	121	28	44	47	119	27	57	35	119	17	53	8	78	52	41	26	119	289	507	469	1265

ACCIDENTS IN BRITISH COLUMBIA COLLIERIES DURING 1915.

CAUSES OF ACCIDENT AND NATURE OF INJURY.	NAME OF COLLIERY.																																	TOTAL FOR 1915.			
	W.F.Co. Nanaimo.			C.C. Extension.			C.C. Comox.			P.C.C. Co. S. Wellington			V.N.C. Co. E. Wellington.			I. C. & C. Co. Coal Hill.			M.C. Co. Middlesboro.			P.C. & L. Co. Princeton.			C.N.P. C.Co. Coal Creek.			C.N.P. C.Co. Michel.			C.C. & C. Co. Corbin.			Other Collieries.						
	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Total.
Gas—Explosion of																																							
Fatal	22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	23	..	..	33
Serious	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	2	..	..
Slight	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	3	..	..	..	..	..	..	..	..	..	8	..	..
Falls of Coal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7
Fatal	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	
Serious	..	1	..	..	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	
Slight	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	3	..
Falls of Rock or Roof	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	15
Fatal	2	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	4	..	..	
Serious	..	2	..	..	..	..	..	1	..	..	2	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	7	..	
Slight	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	4	..
Mine Cars and Horses	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	26
Fatal	1	..	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	2	..	1	..	..	..	3	..	
Serious	..	6	..	..	3	..	..	4	..	..	1	..	..	..	..	..	1	..	..	..	1	..	..	..	..	3	..	..	2	..	..	..	..	..	21	..	..	
Slight	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1	..	..	..	..	..	2	..	
Shots or Powder	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Fatal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Serious	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Slight	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	
Ropes, Hoisting or Haulage	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9
Fatal	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	
Serious	..	1	..	..	2	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	
Slight	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	4	..	
Post or Timber	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Fatal	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Serious	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Slight	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Miscellaneous—Underground	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	23
Fatal	..	..	..	..	..	..	..	..	..	19	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	19	..	..	
Serious	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	
Slight	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	
Miscellaneous—Surface	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5
Fatal	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	
Serious	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	3	..	
Slight	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	
Total	25	12	3	2	5	2	3	7	3	20	4	1	..	..	..	..	4	2	..	1	6	..	..	..	1	4	4	1	4	3	..	..	2	..	..	..	52	41	26	119
Number of men employed	987			517			999			263			128			131			142			56			1,051			617			80			20			4,991		

ANALYSIS OF ACCIDENTS DURING YEAR 1915.

	No. of Accidents per 1,000 Men employed.				Tons of Coal mined per Accident.			
	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.
East Kootenay District	1.14	4.57	5.15	10.92	426,286	106,571	94,741	44,872
Coast District	15.42	10.14	5.21	30.83	22,400	33,939	65,882	11,200
Total Province	10.4	8.2	5.2	23.8	37,934	48,112	75,868	16,576

PER CAPITA PRODUCTION OF COLLIERIES.

	Gross Tons of Coal mined in 1915.	Total Number of Men employed by Producing Collieries.	Tons of Coal mined per Man employed at Collieries.	Number of Men employed Underground in Producing Collieries.	Tons of Coal mined per Man employed Underground.
East Kootenay District	852,572	1,748	488	1,183	721
Coast District	1,120,008	3,230	346	2,512	446
Total for Province	1,972,580	4,978	396	3,695	534

DETAILED STATEMENT OF ACCIDENTS IN B.C. COLLIERIES DURING 1915.

COAST COLLIERIES.

REPORTED BY HENRY DEVLIN AND JOHN NEWTON, INSPECTORS.

No.	Colliery.	Date.	Name.	Occupation.	Details.
1	Comox No. 6.... (C.C.)	Jan. 7	Jap Fiero.....	Pusher.....	Caught between car and timber, severely bruising and spraining dorsal region of back.
2	South Wellington (P.C.C.M.)	" 19	Edward Keegan....	Miner	Fractured thigh and two ribs, caused by fall of top coal.
3	South Wellington (P.C.C.M.)	" 19	G. L. O'Brien	Miner's helper.	Bruised back and scalp-wound. Same accident.
4	Nanaimo..... (W.F.C.)	" 30	William Halliday..	Faceman.....	Fractured leg from fall of roof-rock.
5	South Wellington (P.C.C.M.)	Feb. 9	Olaf Lingeran.....	Miner	Drowned by inflow of water from an old abandoned mine.
6	Ditto.....	" 9	Glagorris Marvos..	"	Ditto.
7	"	" 9	Robert Miller	"	"
8	"	" 9	Jim Hornis.....	"	"
9	"	" 9	William Gilson....	"	"
10	"	" 9	William Irving....	"	"
11	"	" 9	John Stewart.....	"	"
12	"	" 9	Peter Fearon	"	"
13	"	" 9	Joseph Fearon	"	"
14	"	" 9	Thomas Watson...	"	"
15	"	" 9	Samuel Wardle....	"	"
16	"	" 9	John Hunter.....	"	"
17	"	" 9	William Anderson.	"	"
18	"	" 9	Frank Hunter.....	Miner's Helper	"
19	"	" 9	Joseph Cadr.	"	"
20	"	" 9	Frank Marvelle....	Winch-boy....	"
21	"	" 9	David Nellist	Fireboss	"
22	"	" 9	Joseph Foy.....	Mine Manager.	"
23	"	" 9	P. Finn.....	Pusher.....	"
24	Comox..... (C.C.)	Mar. 6	Chin Chun	Pithead-runner	Struck by haulage-rope, causing internal injuries; died one day later.
25	Extension..... (C.C.)	" 11	Victor Altin.	Miner	Struck finger with axe, splitting the proximal phalanx.
26	Extension..... (C.C.)	" 23	Robert Blair	"	Fingers caught between rope and pulley, amputating end of fourth finger and lacerating first finger of left hand.
27	Extension..... (C.C.)	" 31	Rocco Polifran	Driver.....	Laceration of calf-muscles on left leg, caused by being caught between car-couplings.
28	Comox No. 4.... (C.C.)	Apr. 12	Yee Chu.....	"	Fracture of breast-bone, fracture of ribs on both sides, right collar-bone, punctured lung, internal hæmorrhage, caused by being caught between top of car and stringer; fatal.
29	Nanaimo..... (W.F.C.)	May 5	Edward Blackburn.	Machineman ..	Right hand severely lacerated and two fingers taken off, caused by being caught in revolving bar of mining-machine.

ACCIDENTS IN COAST COLLIERIES—*Continued.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
30	Comox No 4 .... (C.C.)	May 10	Ronald Delany ...	Mule-driver...	Kicked by mule, causing lacerated wound over eye, with injury to eye.
31	South Wellington (P.C.C.M.)	" 17	Frank Dovan.....	Miner	Rock fell, fracturing arm.
32	Nanaimo..... (W.F.C.)	" 21	Charles Nicholls...	Driver.....	Attempting to hold trip, fell under front car, fracturing both legs at ankle.
33	Nanaimo..... (W.F.C.)	" 22	John Grey	Machineman...	Empty cars ran back into level, squeezing back of injured person between car and post.
34	Reserve ..... (W.F.C.)	" 27	John Fioretti... ..	Pusher..	Burns, bruises, shock, caused by explosion of gas.
35	Ditto.....	" 27	William Ball.....	Miner.....	Killed by explosion of gas.
36	"	" 27	Ephraim Walishvil	"	"
37	"	" 27	Alfred Williams...	"	"
38	"	" 27	Hiram Guffogg	"	"
39	"	" 27	Frederick Crew....	"	"
40	"	" 27	John Leach	"	"
41	"	" 27	James McEwen....	"	"
42	"	" 27	William McEwen..	"	"
43	"	" 27	Nick Selek.....	"	"
44	"	" 27	Fred Leschek.....	"	"
45	"	" 27	Thomas Harker....	"	"
46	"	" 27	Thomas Bewley....	"	"
47	"	" 27	Robert Kirkbride..	Driver.....	"
48	"	" 27	Edmund Beck	"	"
49	"	" 27	Robert McMillan..	Pumpman	"
50	"	" 27	Robert Haddow ...	Cager.....	"
51	"	" 27	James L. Mazs....	Rope-rider	"
52	"	" 27	J. W. Davis.....	Bratticeman...	"
53	"	" 27	Paul Vitter	Timberman ...	"
54	"	" 27	Thomas Sutter.....	" ...	"
55	"	" 27	Robert Broom.....	Overman	"
56	"	" 27	Lewis Shaw.	Pusher...	"
57	Comox No. 7.... (C.C.)	June 3	Mike Minich.....	Timberman ...	Fall of rock, causing fracture of left leg near ankle-joint.
58	South Wellington (P.C.C.M.)	" 10	Horace Barber.....	Labourer	Was jumping on moving trip, and fell, front car passing over his body, causing scalp-wound and severe internal injuries.
59	South Wellington (P.C.C.M.)	" 16	Robert Rivers.....	Miner	Rock fell from roof, causing fracture of both bones of right leg.
60	Nanaimo ..... (W.F.C.)	Aug. 8	Samuel Drake.....	Motorman	Motor skidded through trap-door, carrying motorman with it, causing one rib to be fractured and his hips to be bruised.
61	Nanaimo.... ... (W.F.C.)	" 17	John Devlin.	Miner	Struck by tail-rope; nose bruised and left knee bruised.
62	Nanaimo..... (W.F.C.)	" 17	Ernest H. Devlin..	"	Same accident; scalp-wound.
63	Nanaimo..... (W.F.C.)	" 17	Jas. Critchley.....	"	Struck by tail-rope, causing compound fracture of both bones of right leg.
64	Reserve..... (W.F.C.)	" 23	Arthur Challoner..	"	Slipped off brushing and struck side of car, fracturing two ribs and slight injury to back.
65	Wellington-Ex- (C.C.) [tension	" 30	Samuel Dixon....	"	Caught under fall of timber and rock; fatal.

ACCIDENTS IN COAST COLLIERIES—*Continued.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
66	Comox No. 2..... (C.C.)	Sept. 8	W. W. McLean ...	Loco-driver ...	Moving boiler on surface ; door fell on him, fracturing rib and bruising left groin.
67	South Wellington (P.C.C.M.)	" 22	Jong Lung.....	Rock-picker ..	Struck on head by lever of windlass on loading-jib ; fatal.
68	Comox..... (C.C.)	Oct. 6	Ah Kee.....	Miner	Rock fell from roof, striking back of injured, causing abrasion and bruise of back.
69	Wellington-Ex-[tension (C.C.)	" 6	Louis Michaux	"	Compound fracture of left tibia, caused by his leg being caught between bumper of car.
70	Comox ..... (C.C.)	" 7	Jap Ezawa.....	Loader	Struck by fall of cap-rock, causing abrasion and sprain of back, bruises to abdomen and thigh.
71	Nanaimo..... (W.F.C.)	" 8	Harry Piper.....	Driver.....	Squeezed against loaded cars, causing him to receive fracture of left fibula.
72	Nanaimo..... (W.F.C.)	" 8	Thomas Mawhinney	Miner	Face slightly injured by flying coal from shot.
73	Nanaimo..... (W.F.C.)	" 12	William Owen.....	Driver.....	Compound fracture of left leg near ankle, caused by bumper of car striking his foot.
74	Nanaimo..... (W.F.C.)	" 14	Angelo Sedola.....	Loader.....	Returned to place after being told it was unsafe ; struck by fall of rock, causing internal bleeding ; fatal.
75	Nanaimo..... (W.F.C.)	" 14	Albert Dilworth...	Machineman ..	Compound fracture of right thigh, caused by fall of rock ; died in hospital one day later from shock.
76	Nanaimo..... (W.F.C.)	" 17	Fred Danes	Timberman's [helper	Slipped and fell on loose rock, fracturing right tibia at ankle.
77	Comox..... (C.C.)	" 18	Don Lun.....	Coupler.....	Crushed between side of slope and car, causing sprain of right ankle, abrasion of right leg, abrasions and bruises of back and left shoulder.
78	Extension..... (C.C.)	" 21	Thomas Wilkinson.	Conductor	Jumped off cars while in motion and was struck by cars, causing his right collar-bone to be broken, and a slightly fractured pelvis ; fatal.
79	Comox No. 4.... (C.C.)	" 22	Lung Toey.....	Latch-kicker ..	Lacerated wounds of left forearm and hand, with fracture of bone of hand and scalp-wound, caused by car-wheel crushing hand.
80	Comox No. 6.... (C.C.)	" 27	J. T. Misaura	Miner	Simple fracture of right leg at ankle, caused by fall of top coal.
81	Comox No. 7.... (C.C.)	Nov. 2	Naska Mayamota..	"	Superficial burns of face, neck, and hands from ignition of gas by open light.
82	Nanaimo.. ..... (W.F.C.)	Dec. 1	Thomas Moore.....	"	Right ulna broken near wrist by fall of top coal.
83	Extension.....	" 13	Carl Lauderbach...	"	Fell off gob-lagging on to his back and was stunned ; injuries uncertain.

ACCIDENTS IN COAST COLLIERIES—*Continued.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
84	Extension ..... (C.C.)	Dec. 23	Frank Pelli	Miner	Ruptured uretha and possibly fracture of pelvis, caused by being struck by corner of car against a post.
85	Extension ..... (C.C.)	" 30	Wm. Atkinson	"	Fracture of right fibula and dislocated right ankle by having his feet caught in coil of rope while lowering a car.
86	Nanaimo ..... (W.F.C.)	" 31	John Fanning	"	Was driving and fell under trip, causing fatal injuries.
87	Comox ..... (C.C.)	Feb. 9	T. Fukamoto.....	Miner's helper.	Died from injuries received on February 19th, 1914; caused by fall of top coal.
88	Middlesboro..... (M.C.L.)	Mar. 5	Edward Stackhouse	Rope-rider	Struck lower part of his back while ringing signal-bell, injuring muscles of his back.
89	Middlesboro..... (M.C.L.)	May 28	Lewis Clark.....	Fireboss	Burns on hands and face from an explosion of fire-damp ignited by gob-fire; injured person was supervising work of sealing off fire-area.
90	Middlesboro..... (M.C.L.)	" 28	William Heyes....	Rope-rider	Burned on lower part of arms. Same accident.
91	Middlesboro..... (M.C.L.)	" 28	Ernest Smith.....	Miner	Burned on lower part of arms. Same accident.
92	Middlesboro..... (M.C.L.)	" 28	Oscar Myers.....	"	Slightly burned on arms. Same accident.
93	Inland C. & C. Co	June 25	Willie Brown.....	Rope-rider	Finger crushed between rope and pulley.
94	Inland C. & C. Co	July 12	Wm. McCreight...	"	Rope knocked his feet under car, causing his leg to be broken above ankle.
95	Inland C. & C. Co	" 24	George Walker	Timberman ...	Axe glanced off knot in timber and cut his foot.
96	Inland C. & C. Co	Sept. 15	William Fairley...	Driver.....	Injured hip, caused by being crushed between two cars.
97	Middlesboro..... (M.C.L.)	" 29	Leslie Cook	Miner	Fall of roof, cutting head and injuring back.
98	Middlesboro..... (M.C.L.)	Oct. 9	Angelo Picollo.....	Miner's helper.	Crushed between side of road and side of car, causing a fractured pelvis and ruptured bladder.
99	Inland C. & C. Co	Dec. 6	John Nicoll	Engineer.....	Arm broken by falling down while crossing a fence to oil a pulley.
100	Inland C. & C. Co	" 11	Robt. Stackhouse..	Timberman's [helper	Simple fracture of left leg above ankle, caused by a rock falling from the roof and rolling on his leg.
101	Corbin.... ..... (C.C. & C.)	Jan. 22	Chas. Meanazi.....	Trackman.....	Top of little finger of right hand taken off between rope and pulley.
102	Michel ..... (C.N.P.C.C.)	May 5	R. Kearney.....	Blacksmith's [helper	Dislocated left shoulder, crushed chest, and Potts fracture left ankle, caused while cutting franged end of hoist-drum loose, drum falling over on him.

ACCIDENTS IN COAST COLLIERIES—*Concluded.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
103	Michel (C.N.P.C.C.)	May 13	T. Siska	Driver	Collar-bone broken by being crushed between post and car.
104	Michel (C.N.P.C.C.)	" 19	D. Fowler	Miner	Potts fracture of left ankle and crushed toes from fall of shale.
105	Michel (C.N.P.C.C.)	June 15	Edward Stacey	"	Crushed chest and fractured rib, caused by being crushed between top of car and timber.
106	Michel (C.N.P.C.C.)	" 18	S. Butcher	Blacksmith	Crushed fingers of right hand and tip of index finger amputated while removing dirt from blocks of steam-hammer.
107	Michel (C.N.P.C.C.)	Oct. 7	E. Zarini	Miner	Internal injuries, injuries to back and hip, caused by fall of roof; died thirty-six hours later.
108	Michel (C.N.P.C.C.)	" 7	J. Slapak	Bratticeman	Lacerated fingers, caused by a small piece of roof falling on them.
109	Michel (C.N.P.C.C.)	Nov. 13	V. Vokurka	Miner	Fractured rib, caused by striking a post while getting out of the way of an oncoming car.
110	Corbin (C.C. & C.)	Dec. 15	William Wilson	"	Piece of coal fell from top and injured his knee-cap.
111	Coal Creek (C.N.P.C. Co.)	Jan. 2	Thomas France	Bratticeman	Severe cuts and bruises on head, leg, and arm from flying pieces of snow-shed while waiting outside the mine. This accident was due to an explosion in the mine.
112	Coal Creek (C.N.P.C. Co.)	" 2	Fred Gillett	Driver	Bruised arm and leg, supposed to have been caused by being thrown to the ground by an explosion.
113	Coal Creek (C.N.P.C. Co.)	" 2	John Gydosik	Trackman	Scalp-wound and bruises on shoulders, caused by same accident as above.
114	Coal Creek (C.N.P.C. Co.)	" 2	John Pawlik	"	Burned face, standing outside mine, caused by same accident as above.
115	Coal Creek (C.N.P.C. Co.)	" 2	Evan Evans	Insp. of Mines.	Overcome by gases while acting on an exploratory party; fatal.
116	Coal Creek (C.N.P.C. Co.)	May 4	Albert Smith	Driver	Fell in front of car, causing dislocation of his right hip.
117	Coal Creek (C.N.P.C. Co.)	Aug. 26	Hezekiah Biggs	Miner	Fractured right fibula and bruised left ankle, caused by car jumping track and crushing him.
118	Coal Creek (C.N.P.C. Co.)	Nov. 10	James Clark	Boss driver	Compound fracture of both bones of left leg, caused by horse attached to two cars swerving into side of level; injured man's leg was crushed between end of car and gun of harness.
119	Coal Creek (C.N.P.C. Co.)	Dec. 22	August Eiche	Miner	Dislocation of left shoulder, caused by fall of coal from roof.

PROSECUTIONS UNDER "COAL-MINES REGULATION ACT."

As is incumbent upon the Inspector, he has been obliged to lay information before the local Magistrates in a large number of cases for infractions, by the workmen in the mines, of the general and special rules, which are provided solely for their own protection. These regulations are for the general safety of all the underground employees, and the carelessness of one man endangers all his fellow workmen, whose lives are practically in the hands of such foolishly careless or criminal person.

The following prosecutions have been brought during the year for the offences noted; the judgments given by the Magistrate being shown:—

Date.	Name.	Occupation.	Mine.	Offence charged.	Judgment.
Jan. 5	John Hodgson.	Tracklayer..	West'rn Fuel	Having an open light in a safety-lamp district	Fined $10 and costs.
" 19	Jas. Martin...	Miner	S. Wellingt'n	Passing a danger-board (violation of General Rule No. 12)	Fined $10 and costs.
" 6	My Yien.....	"	Comox.....	Violating General Rule 9, subsection (*d*) section 91 (tamping a shot with coal-dust)	Fined $10 and costs.
" 9	Mah Wong....	Driver.....	"	Having matches in his possession (violation of General Rule 9)	Fined $10 and costs.
" 20	Angelo Rosso..	Miner	Coal Creek..	Using coal for tamping a shot-hole	Fined $10 and costs.
" 25	A. Chisholm...	"	Nanaimo....	Having matches and tobacco in his possession	Fined $10 and costs.
" 25	Bill Pollos ...	"	"	Same offence	Fined $10 and costs.
" 26	J. Salmond....	"	E. Wellingt'n	Damaging a safety-lamp (violation of Special Rule 67)	Fined $10 and costs.
Mar. 17	Soo Ming.....	Loader.....	Comox.....	Having matches and tobacco in his possession	Fined $10 and costs.
" 17	Yee Wee.....	"	"	Same offence	Fined $10 and costs.
" 25	Thos. Uhrinek.	Miner	Michel.....	Same offence	Fined $10 and costs.
May 19	Louie Krall....	Rope-rider..	"	Left a main door open and caused an accumulation of gas (violation of Special Rule 64)	Fined $10 and costs.
July 5	Dominico Martinello	Miner	"	Having part of a cigar in his possession (violation of General Rule No. 9)	Fined $5 and costs.
" 5	V. Vokurka...	"	"	Failure to set sprags against undermined coal	Fined $5 and costs.
" 5	Martin Shaba..	"	"	Same offence	Fined $5 and costs.

PROSECUTIONS—*Concluded.*

Date.	Name.	Occupation.	Mine.	Offence charged.	Judgment.
July 10	Lot Jones.....	Driver.....	Nanaimo....	Having open light in a safety-lamp district (violating General Rule 9)	Fined $10 and costs.
" 10	Jas. McCrachen	"	"	Same offence	Fined $10 and costs.
" 31	Thomas Keist..	Cager.....	Reserve.....	Having matches in his possession in the mine	Fined $15 and costs.
Aug. 2	John Limchuk.	Brusher....	Nanaimo....	Same offence	Fined $15 and costs.
" 23	Fred Wilson...	Miner	"	Putting powder into a hole before shotlighter examined same (violation of General Rule No. 12)	Fined $10 and costs.
" 23	Pat Gannon....	"	"	Same offence	Fined $10 and costs.
" 23	T. Mawhiney..	"	"	Firing a shot before he was told (violating General Rule No. 12)	Fined $10 and costs.
" 23	Louis Capella..	"	Michel.....	Striking another employee on the head with a safety-lamp	Fined $10 and costs.
Sep. 10	Thos. Baybutt.	Fireboss	"	Loading a second shot-hole before the first hole was fired and place examined	Fined $10 and costs.
" 10	Thos. Baybutt.	"	"	Not having place properly guarded where it was expected shots would hole through	Case dismissed.
" 16	L. Durand.-...	Miner	Coal Creek..	Not spragging undermined coal	Fined $5 and costs.
" 25	J. T. Mawson..	Fireboss	" ..	Neglecting to fence off a dangerous place	Fined $10.
Nov. 5	A. McNeill....	Shotlighter..	E. Wellingt'n	Firing a shot after being ordered not to (violation of Special Rule 72)	Fined $10 and costs.
" 5	J. Watson	Miner	E. Wellingt'n	Having shot fired after being ordered not to	Fined $5 and costs.
" 5	J. Harrison....	"	"	Same offence	Fined $5 and costs.
Dec. 9	Mah Clung....	"	Comox	Having matches in his possession	Fined $10 and costs.

METALLIFEROUS MINES SHIPPING IN 1915.

CASSIAR.

ATLIN MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Engineer	Windy Arm	J. Alexander	Carcross	Gold.

SKEENA.

SKEENA MINING DIVISION.

Granby Group	Anyox	Granby Cons. M. S. & P. Co.	Anyox	Copper, gold.

PORTLAND CANAL MINING DIVISION.

Kansas Group	Portland Canal			Sliver, lead.
Portland Van. M. Co.	"	Jno. Watkins	Prince Rupert	"
Silver Tip	"	Chas. Williams	Stewart	Copper, lead, silver.

QUEEN CHARLOTTE MINING DIVISION.

Early Bird	Moresby island	J. McLellan	Queen Charlotte	Gold.
Ikeda Mines	Ikeda bay	A. Ikeda	Ikeda	Copper, gold.

OMINECA MINING DIVISION.

American Boy	9-Mile mountain	Harris Mines, Ltd.	Hazelton	Gold, silver, lead.
Black Prince	Glen mountain	Silver Standard Mining Co	Vancouver	Silver, lead.
Copper Crown	Babine mountain	Chisholm Bros.	Telkwa	Copper, silver.
Cordillera	Kitsalas mountain	Darby & Wells	Kitsalas	Copper.
Coronado	H.B. mountain	R. J. McDonnell	Telkwa	Silver, lead.
Hunter Group	Hunter basin	Wm. Hunter	"	Copper, silver.
Rocher Déboulé	Rocher Déboulé mount.	Montana Continental Develop. Co	Tramville	Copper, silver, gold.
Silver Bell	9-Mile mountain	Geo. T. Stewart	Hazelton	Silver, lead.
Silver Cup	Hazelton	Silver Cup Mines	Prince Rupert	"
Silver Standard	Glen mountain	Silver Standard Mining Co.	Vancouver	"
Sunrise	9-Mile mountain	Hazelton Sunrise Mines	Prince Rupert	"
Victory	H.B. mountain	D. C. Simpson	Smithers	"

EAST KOOTENAY.

FORT STEELE MINING DIVISION.

St. Eugene	Moyie	Consolidated M. & S. Co.	Marysville	Silver, lead.
Sullivan	Kimberley	" "	"	"

WINDERMERE-GOLDEN MINING DIVISIONS.

Monarch	Golden	Great Western Mines Dev. Co., Ltd	Field	Silver, lead, zinc.
Silver King	Windermere	A. M. Larrabee	Wilmer	Silver, lead.

WEST KOOTENAY.

AINSWORTH MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Alpine				Lead.
Bluebell	Riondel	New Canadian Metal Co.	Riondel	Silver, lead.
Bon Ton				"
Charleston	Whitewater			"
Cork-Province	South fork, Kaslo creek.	W. H. Burgess	Kaslo	"
Early Bird	Ainsworth			"
Gallagher	"	A. D. Wheeler	Ainsworth	Silver.
Helena	"			Silver, lead.
Highland	"	Consolidated M. & S. Co.	Ainsworth	"
Martin Group	"	J. A. Carter	Zwicky	"
Montezuma	South fork, Kaslo creek.	H. Giegerich	Kaslo	"
No. 1	"	Consolidated M. & S. Co.	Ainsworth	"
Panama	Bear lake	H. Giegerich	Kaslo	Silver.
Silver Hoard	Ainsworth	Silver Hoard Mines, Ltd.	Ainsworth	Silver, lead.
Spokane-Trinket	"			"
Utica	Paddy mountain	Utica Mines, Ltd.	Kaslo	Silver, lead, zinc.
Wellington	Ainsworth	W. G. Robb.	"	Silver, lead.
Whitewater	Whitewater	J. L. Retallack & Co.	"	Silver, lead, zinc.

SLOCAN MINING DIVISION.

Black Grouse	Slocan	J. D. Ryan	Three Forks	Silver.
Buffalo	"			Silver, lead.
Galena Farm	Silverton	P. Clarke, Estate	Silverton	Silver, lead, zinc.
Hewitt-Lorna Doone	"	Silverton Mines, Ltd.	"	" "
Home Rule	Slocan			Silver, lead.
Idaho-Alamo	New Denver	Thos. Avison	New Denver	"
Ivanhoe	Sandon	Minnesota Silver Mining Co.	Sandon	"
Lucky Thought	Silverton	Consolidated M. & S. Co.	Trail	"
Lucky Jim	Zincton	Lucky Jim Zinc Mines, Ltd.	Kaslo	Zinc.
Mercury	Slocan	R. Cunning	Sandon	Silver, lead.
Mollie Hughes	New Denver	Mollie Hughes Mines	New Denver	Silver.
Mountain Con	Carpenter Creek	Mountain Con Mining Co.	Sandon	Silver, lead.
Rambler-Cariboo	McGuigan	Rambler Cariboo Mines, Ltd.	Three Forks	Silver, lead, zinc.
Reco	Sandon	J. M. Harris	Sandon	Silver, lead.
Rio	Slocan			"
Ruth Hope	Sandon	The Ruth Mines, Ltd.	Kaslo	"
Slocan Star	"	Slocan Star Mines, Ltd.	Sandon	Silver, lead, zinc.
Standard	Silverton	Standard Silver Lead Mining Co.	Silverton	" "
Surprise	Sandon	J. P. MacFadden	Sandon	" "
Wakefield	Silverton	Wm. Hunter	Silverton	Silver, lead.
Wonderful	Sandon			"

SLOCAN CITY MINING DIVISION.

Alice S.	Slocan City			Silver, lead.
Black Prince	"	J. T. Tipping	Slocan City	Silver.
Colorado	"	R. Gillette	N. Vancouver	"
Enterprise	Ten-mile creek	Enterprise (B.C.) Mines, Ltd.	Riondel	Silver, lead.
Hamilton Group	Slocan City	R. Gillette	N. Vancouver	Silver.
Ottawa Group	New Denver	Consolidated M. & S. Co.	Trail	"

NELSON MINING DIVISION.

California	Toad mountain	W. Moore	Nelson	Silver.
Dundee	Nelson	A. E. Rand	Vancouver	Gold.
Emerald	Salmo	John Waldbeser	Salmo	Silver, lead.
Exchequer	Nelson			Gold, silver.
Golden Fawn	Fawn creek	Thos. Gallon	Victoria	Gold.
Granite	Eagle creek	Crilly-Wilson Co.	Granite	"
H.B.	Deer creek	R. K. Neill	Salmo	Silver, lead, zinc.
Hope	South fork, Salmon river.	W. A. Talbot	"	Silver, lead.
Leadville	Deer creek	R. K. Neill	"	Silver, lead, zinc.
Molybdenite Group	Lost creek	B.C. Molybedenite Co.	"	Molybdenite.
Motherlode	Sheep creek	Motherlode Sheep Creek Min. Co.	Sheep Creek	Gold, silver.
Nugget	"	R. S. Lennie	Vancouver	Gold.
Ore Hill	"	W. B. DeWitt	Sheep Creek	Gold, silver.
Orinoco	Nelson			"
Perrier	Cottonwood	C. Crossley	Nelson	"
Porto Rico	Barrett creek	E. C. Wragge	"	Gold.
Queen	Sheep creek	Queen Mines, Incorporated	Sheep Creek	Gold, silver.
Queen Victoria	Nelson	B.C. Copper Co.	Greenwood	Silver, copper.
Relief	Near Erie	A. D. Westby	Erie	Gold, silver.
Summit	Sheep creek	W. B. DeWitt	Sheep Creek	"
Spokane	Bayonne camp	Laib Bros.	"	"
Zincton	Deer creek	R. K. Neill	Salmo	Silver, lead, zinc.

WEST KOOTENAY—*Concluded.*

TRAIL CREEK MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Centre Star	Rossland	Consolidated M. & S. Co.	Trail	Gold, silver, copper.
Inland Mining Co.	Paulson	Inland Mining Co.	Paulson	Gold, silver.
Josie	Rossland	Le Roi No. 2, Ltd.	Rossland	Gold, silver, copper.
Le Roi	"	Consolidated M. & S. Co.	Trail	" "
Phoenix	"	Phoenix Gold Mining Co	Rossland	Gold, silver.
Velvet	"	Wm. Whitford	"	Gold, silver, copper.

TROUT LAKE MINING DIVISION.

Ethel	Trout Lake	A. Herman	Spokane	Silver, lead.
High Grade	"	J. W. Livingston	Ferguson	"
Silver Cup	Ferguson	Ferguson Mines, Ltd	"	"

REVELSTOKE MINING DIVISION.

Lanark	Illecillewaet	Fred C. Elliott	Victoria	Gold, silver, lead.

BOUNDARY.

GRAND FORKS MINING DIVISION.

Little Bertha	Grand Forks	Granby Consolidated	Grand Forks	Gold, silver.
Maple Leaf	Franklin camp	Maple Leaf Mines, Ltd.	"	Silver, copper.
Union	Gloucester camp	Lewis Johnson	"	Gold, silver.

GREENWOOD MINING DIVISION.

Carmi	Carmi	F. J. Finucane	Spokane	Gold, silver, lead.
E. P. U.	Greenwood	W. E. McArthur	Greenwood	Gold, silver.
Granby Consolidated	Phoenix	Granby Con. M., S. & P. Co.	Vancouver	Gold, silver, copper.
Jewel-Denero	Greenwood	Jewel Denero Mines, Ltd.	Greenwood	Gold, silver.
Motherlode	"	B.C. Copper Co., Ltd.	"	Gold, silver, copper.
Rob Roy and Sally	Wallace mountain	Van. & Boundary Ck. M. & Dev. Co	Beaverdell	Silver, lead.
Skylark	Greenwood	Skylark Development Co.	Greenwood	Gold, silver.
Strathmore	Providence camp	D. McIntosh	"	"
Sunset	Greenwood	New Dominion Copper Co.	"	Gold, silver, copper.
Tipperary	Smith camp	M. J. Buchanan	Boundary Falls	Gold, silver.

OSOYOOS MINING DIVISION.

Dividend-Lakeview	Osoyoos	Dividend-Lake View C. G. M. Co.	Oroville, Wash.	Gold.
Horn Silver	"	E. W. Condit	Similkameen	Gold, silver.
Nickel Plate	Hedley	Hedley Gold Mining Co.	Hedley	Gold.
Spotted Lake	Kruger mountain	G. M. Rayburn	Oroville, Wash.	Sulphate of magnesia.

SIMILKAMEEN, NICOLA AND VERNON MINING DIVISIONS.

Aberdeen	Nicola	Aberdeen Mines Syndicate	Merritt	Silver, copper.
Copper King	"	M. H. Bresnik	"	Gold, silver, copper.
Copper Star	"	Wm. McNeil	"	Silver, copper.
Red Buck	Similkameen	C. M. Snowden	Princeton	Gold, silver, copper.
St. Paul	Vernon	Rembler Paul	Kelowna	Gold.

YALE, ASHCROFT, AND KAMLOOPS MINING DIVISIONS.

Glossie	Ashcroft	J. M. Burr	Ashcroft	Gold, silver, copper.
Iron Mask	Kamloops	Kamloops Copper Co.	Kamloops	" "
Rainbow	Yale			Silver.
Snowstorm	Ashcroft	Stuart Henderson	Victoria	Gold, silver, copper.

LILLOOET.

LILLOOET MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Coronation	Bridge river	Coronation Gold Mines, Ltd	Victoria	Gold, silver.
Wayside	"	D. C. Paxton	Cincinnati	Gold.

COAST.

VANCOUVER MINING DIVISION.

Britannia	Howe sound	Britannia Mining & Smelting Co.	Britannia Beach	Gold, silver, copper.

NANAIMO MINING DIVISION.

Little Billy	Texada island	H. W. Treat	Seattle, Wash.	Gold, silver, copper.
Marble Bay	"	Tacoma Steel Co.	Tacoma, Wash.	" "
Valdez Id. Copper Co	Valdes island	F. Rosher	Victoria	Copper.

VICTORIA MINING DIVISION.

Willow Grouse	Sooke	R. G. Mellin, Lessee	Sooke	Gold, silver, copper.

CLAYOQUOT MINING DIVISION.

Leora	Elk river	W. W. Gibson	Victoria	Gold.

LIST OF CROWN-GRANTED MINERAL CLAIMS.

CROWN GRANTS ISSUED IN 1915.

CASSIAR.

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
Aldebaran	Skeena	Pedro Salinas and Wm. J. Vaughan	1072	41.82	Aug. 24
Amur Fraction	"	The Granby Consolidated M. S. and P. Co.	3350	19.0	Oct. 21
Anaconda	Portland Canal.	Helen Flewin, Herbert Cecil Flewin, Walter Ross Flewin, John Claude Butterfield, Chas. Bertram Flewin, Wm. Percival Flewin, and Edward C. Flewin.	2878	31.48	Mar. 11
Barney	"	Portland Canal Mg. Co., Ltd. (N.P.L.)	421	41.20	Aug. 3
Barney Fraction	"	Portland Canal Mining Co., Ltd. (N.P.L.)	409	3.0	Aug. 3
Bell	Omineca	Hugh A Bigelow, Jas. S. Kennedy, Jas. S. Macdonald, Gus A. Rosenthal, and Thos. T. Dunlop, each as to a 1/5 interest	3487 R. 5	51.17	Sept. 10
Black Bear	Skeena	Pedro Salinas	1071	35.48	Aug. 24
Bonanza	"	The Granby Consolidated M. S. and P. Co., Ltd.	1667	48.59	Oct. 25
Bonanza Fraction	"	The Granby Consolidated M. S. and P. Co., Ltd.	3348	23.47	Oct. 26
Brenan Fraction	"	The Granby Consolidated M. S. and P. Co., Ltd.	1674	7.66	Oct. 26
Bunker	"	The Granby Consolidated M. S. and P. Co., Ltd.	2222	45.45	May 8
Canadian Verdee	Atlin	Frank Saucier	215	51.35	May 10
Chickmunstone	Queen Charlotte	James Emery Corbett	613	29.0	Jan. 8
Chickmunstone Fraction	"	James Emery Corbett	614	9.66	Jan. 8
China Boy	"	James Emery Corbett	616	22.51	Jan. 8
Comstock	Portland Canal.	Helen Flewin, Herbert Cecil Flewin, Walter Ross Flewin, John Claude Butterfield, Charles Bertram Flewin, William Percival Flewin, and Edward Clarence Flewin.	2877	24.44	Mar. 11
Comstock Fraction	"	Ditto	2882	26.0	Mar. 11
Copper Cheaf	Queen Charlotte	James Emery Corbett	617	50.05	Jan. 8
Copper King	"	James Emery Corbett	601	51.65	Jan. 7
Copper Queen	"	James Emery Corbett	610	7.95	Jan. 7
Cornelius	Portland Canal.	Hercules Mines, Ltd.	1523	32.9	Feb. 22
Discovery or Silver King	Stikine	B. Grief, C. M. Coulter, B. C. McCormack, Alex. Vreatt, Geo. H. Whitney, F. E. Bronson, E. Busby, and John Maloney.	2863	46.55	Jan. 23
Edward	Queen Charlotte	James Emery Corbett,	607	24.33	Jan. 7
Ella	"	James Emery Corbett	609	38.5	Jan. 7
Ena Fraction	"	James Emery Corbett	620	0.39	Jan. 8
Emerald	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	1672	41.86	Oct. 26
Emma	"	The Granby Consolidated M. S. and P. Co., Ltd.	1669	43.29	Oct. 25
Emma Fraction	"	The Granby Consolidated M. S. and P. Co., Ltd.	1673	8.02	Oct. 26
Empire	Portland Canal.	Hercules Mines, Ltd.	1524	10.6	Feb. 22
Ethel	Omineca	The Hazelton Sunrise Mines, Ltd. (N.P.L.)	593	30.0	Nov. 15
Ethel Fractional	"	The Hazelton Sunrise Mines, Ltd. (N.P.L.)	599	2.04	Nov. 15
Glacier	Portland Canal.	Hercules Mines, Ltd.	1522	44.0	Mar. 1
Gertie	"	Helen Flewin, Herbert Cecil Flewin, Walter Ross Flewin, John Claude Butterfield, Charles Bertram Flewin, William Percival Flewin, and Edward Clarence Flewin.	2879	24.16	Mar. 11
Herbert	"	Portland Canal Mining Co., Ltd. (N.P.L.)	417	43.9	Aug. 3
Hidden Treasure	Omineca	The Hazelton Sunrise Mines, Ltd. (N.P.L.)	597	23.26	Nov. 15
Home Stake No. 1	Skeena	James Lucius Hatch	1529	51.65	Aug. 25
Ida	Queen Charlotte	James Emery Corbett	608	46.48	Jan. 7
I'll Chance It Fraction	Skeena	Pedro Salinas	1073	46.8	Aug. 24
Ina Fraction	Queen Charlotte	James Emery Corbett	622	13.3	Jan. 8
Indian Boy	"	James Emery Corbett	606	3.17	Jan. 7
Kaian	Skeena	Charles McCague	2226	48.93	Feb. 15
Leckie Fraction	Portland Canal.	Hercules Mines, Ltd.	1525	6.6	Feb. 25
Lipton No. 3	"	William Spurck	1550	47.6	Oct. 12
Lipton No. 4	"	William Spurck	1551	16.51	Oct. 12
Lizzie	"	Helen Flewin, Herbert Cecil Flewen, Walter Ross Flewin, John Claude Butterfield, Charles Bertram Flewin, William Percival Flewin, and Edward Clarence Flewin.	2880	47.3	Mar. 11
Lookout	Atlin	Albert Creelman Smith	380	33.27	Oct. 18
Long Shot	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	3352	35.64	Oct. 21
Lottie	Queen Charlotte	James Emery Corbett	605	38.73	Jan. 7
Maple Bay Fraction	Portland Canal.	Helen Flewin, Herbert Cecil Flewin, Walter Ross Flewin, John Claude Butterfield, Charles Bertram Flewin, William Percival Flewin, and Edward Clarence Flewin.	2881	10.82	Mar. 11
Maple Leaf	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	2223	39.05	May 8
Martha Ellen	Portland Canal.	Hercules Mines, Ltd.	1521	47.9	Mar. 1
Mildred	Atlin	Charles Murphy	213	51.65	Nov. 10
Moody	Queen Charlotte	James Emery Corbett	600	51.65	Jan. 7
Mosquito	Portland Canal.	Portland Canal Mining Co., Ltd. (N.P.L.)	428	42.3	Aug. 9
North Star	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	1668	44.22	Oct. 25
Noonday	Omineca	The Hazelton Sunrise Mines, Ltd. (N.P.L.)	596	24.37	Nov. 15

CASSIAR.—*Concluded.*

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
The Plato	Atlin	James Alexander and John Dunham	968	46.89	Feb. 25
Prince	"	Arthur Jennings	381	28.31	Nov. 10
Princess Alexandria	Portland Canal.	William Noble, William Henry Collison, William Edwin Collison, John Maxwell Collison, Henry Alexander Collison, Arthur James Collison, and Charles Clifton Perry, administrator of estate of Matthias Dangelli,	500	17.36	Mar. 12
Princess Alice	"	Ditto [deceased, intestate]	498	40.73	Mar. 12
Princess Maud	"	"	499	47.16	Mar. 12
Princess May	"	"	489	33.03	Mar. 12
Princess Royal Fraction	"	"	752	14.85	Mar. 12
Princess Victoria	"	"	497	44.19	Mar. 12
Princess Louise	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	1671	40.89	Nov. 26
Ona Fraction	Queen Charlotte	James Emery Corbett	624	32.49	Jan. 8
Richard II	Prince Rupert	Portland Canal Mining Co., Ltd. (N.P.L.)	429	13.6	Aug. 9
Robin	Queen Charlotte	James Emery Corbett	602	24.76	Jan. 7
Sadie	Portland Canal.	Portland Canal Mining Co., Ltd. (N.P.L.)	420	48.5	Aug. 3
Sadie Fract	"	Portland Canal Mining Co., Ltd. (N.P.L.)	408	4.7	Aug. 3
Seal	Queen Charlotte	James Emery Corbett	619	51.65	Jan. 8
Silver King (or Discovery)	Stikine	B. Grief, C. M. Coulter, P. C. McCormack, Alex. Vreatt, G. H. Whitney, E. Busby, F. E. Bronson, and John Maloney	2863	46.55	Jan. 23
Star Light	Skeena	Thomas McRostie	1528	51.64	Aug. 25
Stars and Stripes	Queen Charlotte	James Emery Corbett	612	27.32	Jan. 8
St. Denis	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	3349	51.65	Nov. 18
Sunrise	Omineca	The Hazelton Sunrise Mines, Ltd. (N.P.L.)	594	38.0	Nov. 15
Sunset	"	The Hazelton Sunrise Mines, Ltd. (N.P.L.)	594	38.0	Nov. 15
Sunshine	Atlin	Hugh McDonald	379	38.58	Nov. 10
Sun Rise	Skeena	Thos. McRostie and James L. Hatch	1530	50.0	Sept. 7
Tasoo	Queen Charlotte	James Emery Corbett	604	37.19	Jan. 7
Una Fraction	"	James Emery Corbett	621	4.08	Jan. 8
Union Jack	"	James Emery Corbett	611	14.44	Jan. 7
Vadso Fraction	Skeena	The Granby Consolidated M. S. and P. Co., Ltd.	3351	20.70	Oct. 21
Victoria	Omineca	John G. Grant, Christena Grant, and Neal Grant	598	51.65	Oct. 18
Warwick	Queen Charlotte	James Emery Corbett	615	27.33	Jan. 8
Wedge Fraction	"	James Emery Corbett	603	4.04	Jan. 7

EAST KOOTENAY.

Approach	Fort Steele	Angus McLeod	10994 G. 1	51.65	Nov. 16
Comet	"	The Consolidated M. and S. Co., Ltd.	12007 G. 1	51.61	May 17
Dixie	"	The Consolidated M. and S. Co. of Canada, Ltd.	12004 G. 1	47.27	May 17
Helen Fraction	"	The Consolidated M. and S. Co. of Canada, Ltd.	11994 G. 1	38.83	May 20
King George	"	The Consolidated M. and S. Co. of Canada, Ltd.	10210 G. 1	51.65	May 17

WEST KOOTENAY.

Alberta	Ainsworth	The Consolidated M. and S. Co., Ltd.	10700 G. 1	19.58	Feb. 16
Bismark	"	Neil Franklin Mackay, George Bentley Gerrard, and Henry Giegerich	11273 G. 1	35.37	April 23
Black Stone	Nelson	Herbert Ridley Townsend, official administrator, administrator of the estate of Pierre Dionne, deceased intestate	9055 G. 1	51.39	May 21
Bluebird	"	Thos. P. Moran and Wm. Gosnell	9357 G. 1	44.78	Jan. 12
Blue Stone	"	Herbert Ridley Townsend, official administrator, administrator of the estate of Pierre Dionne, deceased intestate	9054 G. 1	51.65	May 21
Buckless	"	Harcourt Penn Dickenson and Joseph Caron	12078 G. 1	51.65	Jan. 12
Cecilia May Fractional	Ainsworth	The Consolidated M. and S. Co., Ltd.	10698 G. 1	7.34	Jan. 15
Daisy Fractional	Trail Creek	The Consolidated M. and S. Co. of Canada., Ltd.	11478 G. 1	0.1	June 28
Dickenson	Nelson	Harcourt Penn Dickenson and Joseph Caron	12079 G. 1	51.65	Jan. 12
Dixie	"	George G. Eitel	10264 G. 1	45.58	June 1
Dreadnaught	Windermere	John Hopkins Taynton and William Walter Taynton	11031 G. 1	51.65	June 29
Eddie	Nelson	George H. Green	12186 G. 1	31.81	July 21
Enderby	Trout Lake	Patrick Henry Murphy	9128 G. 1	51.65	Oct. 16
Gladstone Fraction	Ainsworth	Daniel Patrick Cosgriff and Philip Thomas Corrigan	9657 G. 1	33.16	Dec. 9
Highland Laddie	"	Neil Franklin Mackay, George Bentley Gerrard, and Henry Giegerich	11275 G. 1	18.69	April 23
Hope Fractional	"	Ferdinand Ralph Wolfle	9659 G. 1	34.6	Jan. 28
Jas. R. Fractional	"	Ferdinand Ralph Wolfle	9660 G. 1	48.12	Jan. 28
Kootenay Bell	"	Jean Joseph Brochier and Charles Warburton Young	11287 G. 1	45.57	Aug. 23
Last Chance	Nelson	Thomas P. Moran and William Gosnell	9358 G. 1	51.52	Jan. 12
Last Dollar Fractional	"	George G. Eitel	10269 G. 1	.63	June 1
Laurel	Revelstoke	John Newell, O. Robert Dahl, and George W. Jeffs	7638 G. 1	51.65	Oct. 25
Link Fractional	Ainsworth	Lachlan McLean	9655 G. 1	24.96	Feb. 3
Manatoba	"	The Consolidated M. and S. Co. of Canada, Ltd.	10699 G. 1	44.25	Feb. 16
Markinch	"	Robert Mitchell	10472	39.4	Aug. 30
Mayflower	Nelson	Hugh F. McCaslin	9189 G. 1	35.21	Nov. 17
Mayflower	"	Thomas P. Moran and William Gosnell	9356	50.29	Jan. 12
Mountain Goat	Ainsworth	Neil Franklin Mackay, George Bentley Gerrard and Henry Giegerich	11274 G. 1	41.66	April 23
New York Fractional	"	The Consolidated M. and S. Co. of Canada, Ltd.	10697 G. 1	49.0	Jan. 15
No. 1 Fractional	"	" "	10695 G. 1	14.5	Jan. 14
No. 2 Fractional	"	" "	11297 G. 1	26.90	Jan. 16

WEST KOOTENAY.—*Concluded.*

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
No. 3 Fractional	Ainsworth	The Consolidated M. and S. Co. of Canada, Ltd	10702 G. 1	43.64	Jan. 15
No. 4 Fractional	"	" "	10701 G. 1	11.75	Feb. 16
Number Six Fractional	"	" "	10710 G. 1	51.07	Jan. 16
No. 7 Fractional	"	" "	10714 G. 1	20.34	Jan. 25
Northrop Fractional	"	" "	11296 G. 1	39.96	Jan. 16
Okanagan	Trout Lake	Patrick Henry Murphy, Bruce White, and Alexander Christie Cummins	9127 G. 1	50.30	Oct. 16
Ore Hill No. 3	Nelson	George G. Eitel	10265 G. 1	21.49	June 1
Pansy Fractional	Slocan City	Mary Susan McNaught	11732 G. 1	22.32	Nov. 27
Planet	Nelson	Sheep Creek Bonanza M. Co., Ltd. (N.P.L.)	11745 G. 1	32.68	May 19
Planet No. 2	"	Sheep Creek Bonanza M. Co., Ltd	11746 G. 1	27.31	May 19
Rio Fraction	Ainsworth	Daniel Patrick Cosgriff and Philip Thomas Corrigan	9656 G. 1	19.15	Dec. 9
Silver Bell	Revelstoke	John Newell, O. Robert Dahl, and Geo. W. Jeff	7637	51.65	Nov. 25
Standard	Nelson	Geo. G. Eitel	10267 G. 1	46.03	June 1
Standard	"	Sheep Creek Bonanza M. Co., Ltd. (N.P.L.)	11747 G. 1	31.41	May 19
Truro	Ainsworth	Robert Mitchell	10473 G. 1	50.08	June 30
U. T. K. Fractional	"	Ferdinand Ralph Wolfle	9658 G. 1	46.69	Jan. 28

BOUNDARY.

Black Bess	Vernon	Rembler Paul, Angus Woods, and Edward H. McDaniel	4186 G. 1	51.65	Aug. 7
Boston	Similkameen	William H. Armstrong	704 G. 1	51.60	June 22
Grand View	Yale	Joseph Gibson	931 G. 1	51.65	May 19
Grass Roots	Kamloops	Mark Sweeton Wade	1496 G. 1	51.65	July 23
Hidden Treasure	Greenwood	William Edward McArthur	1551 S.	43.39	April 30
International	Yale	Luke Gibson	932 G. 1	51.65	May 12
Little Gem Fractional	Similkameen	David O. Day and Douglas M. French	383 S.	14.5	Feb. 25
Minerva	Vernon	Rembler Paul and Edward Herbert McDaniel	4187 G. 1	51.6	Aug. 7
Mount Zion	Kamloops	James Frisken	1643 G. 1	51.65	Nov. 10
Nellie A	Osoyoos	William Arnott	265 S.	32.6	Jan. 14
Night Hawk	Kamloops	James Frederick Shaw	1747 G. 1	32.15	Nov. 29
Oneota	Similkameen	William H. Armstrong	705 G. 1	51.65	June 22
Oro Fino	"	William H. Armstrong	706 G. 1	40.0	June 22
Presidential Tryangle Fr.	Osoyoos	Leonard H. Patten and Frederick Stone	266 S.	15.25	Jan. 14
Sterlingham Fractional	Greenwood	William Farney	1901 S.	36.55	April 14
Sunlight	Similkameen	Charles Willarson	369 S.	40.50	Nov. 28
Sylvester K. Fractional	Greenwood	Adolph Sercu	2386 G. 1	1.28	June 30
Three Forks	"	Hugh Campbell	172 G. 1	42.01	Dec. 9
Tin Cup	"	David O. Day and Douglas M. French	635 S.	51.35	Feb. 23
Toughnut	Vernon	Rembler Paul, Angus Woods, and Edward H. McDaniel	4189 G. 1	51.65	Aug. 7
Tulameen	Similkameen	William H. Armstrong	707 G. 1	41.52	June 22
Vera Fractional	"	Thomas M. Day and Douglas M. French	1790 S.	10.4	Mar. 29
Zilpah	Vernon	Rembler Paul, Angus Woods, and Edward H. McDaniel	4188 G. 1	51.5	Aug. 7

VANCOUVER ISLAND AND COAST.

Bob Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	3700 G. 1	48.20	Nov. 15
Bowena No. 1	"	Bowena Copper Mines, Ltd. (N.P.L.)	4052 G. 1	51.55	Feb. 25
Brook	"	Britannia Mining and Smelting Co., Ltd	4015 G. 1	36.77	Jan. 21
Copper Crown Fractional	"	Britannia Mining and Smelting Co., Ltd	2409 G. 1	3.23	Jan. 21
Copper Mound Fractional	"	Britannia Mining and Smelting Co., Ltd	3937 G. 1	48.18	Jan. 20
Crackerjack Fraction	Nanaimo	Andrew A. Logan	445	1.91	Jan. 22
Dandy Fractional	"	John Danaher and Andrew A. Logan	444	15.77	Jan. 13
Emerald	Vancouver	Bowena Copper Mines, Ltd. (N.P.L.)	4050	51.65	Feb. 25
Emerald No. 1	"	Bowena Copper Mines, Ltd. (N.P.L.)	4051	50.68	Feb. 25
Gem	Nanaimo	John Danaher and Andrew A. Logan	441	34.67	Jan. 12
Gerald D	"	John Danaher and Andrew A. Logan	442	41.17	Jan. 12
Harold D	"	John Danaher and Andrew A. Logan	443	16.02	Jan. 13
Hell Diver	"	Olive Graef Treat	145	29.09	Jan. 8
Hub Fractional	"	Dorsey E. McLaughlin	800 A.	34.27	May 26
Iron Alice	Victoria	Lars N. Anderson, Elizabeth Lipsky, Mary Hammond Ely (formerly Mary Hammond Shaw), executrix, and Carl Stromgun, executor of the will of Sidney Shaw, deceased, and Olive Snaith	514	49.09	Feb. 2
Iron Belle	"	Ditto	515	39.37	Feb. 2
Iron Cross	"	"	516	51.63	Feb. 2
Iron Hand	"	"	517	30.60	Feb. 2
Jew Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	3946 G. 1	1.6	Jan. 20
Lake View	"	" "	4253 G. 1	41.57	Nov. 10
Last Chance	"	" "	4255 G. 1	40.63	Nov. 10
Maple Fractional	"	" "	4009 G. 1	43.41	Jan. 21
Mountain Chief	"	" "	4254 G. 1	49.31	Nov. 10
Mountain Lion	"	" "	4251 G. 1	46.0	Nov. 10
Mountain	"	" "	4017 G. 1	51.39	Jan. 21
Mountain View	"	" "	4252 G. 1	42.41	Nov. 10
Nellie Fraction	"	" "	3701 G. 1	15.45	Jan. 20
No. 1 Fractional	"	" "	2734 G. 1	48.43	Jan. 19
No. 2 Fractional	"	" "	2735 G. 1	51.43	Jan. 19
No. 3 Fractional	"	" "	2737 G. 1	50.60	Jan. 19
No. 4	"	" "	2890	51.65	Jan. 19
No. 5 Fractional	"	" "	2893 G. 1	51.49	Jan. 20

VANCOUVER ISLAND AND COAST.—*Concluded.*

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
No. 8 Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	2891	42.31	Jan. 19
No. 9	"	" "	2892 G. 1	47.38	Jan. 20
No. 10	"	" "	2895 G. 1	51.28	Jan. 20
No. 49	"	" "	3718 G. 1	48.03	Nov. 10
No. 50 Fractional	"	" "	3941 G. 1	46.39	Nov. 10
No. 69 Fractional	"	" "	3944 G. 1	51.40	Nov. 10
No. 70 Fractional	"	" "	3940 G. 1	51.26	Nov. 10
No. 71	"	" "	2925 G. 1	51.65	Nov. 10
No. 72	"	" "	2926 G. 1	51.65	Nov. 10
No. 73 Fractional	"	" "	3942 G. 1	48.79	Nov. 10
No. 74 Fractional	"	" "	4022 G. 1	50.70	Jan. 21
No. 88 Fractional	"	" "	3956 G. 1	36.21	Nov. 16
No. 91 Fractional	"	" "	2897 G. 1	50.51	Nov. 10
No. 92 Fractional	"	" "	2896 G. 1	50.88	Nov. 10
No. 103 Fractional	"	" "	4256 G. 1	47.34	Mar. 19
Pearl Fractional	"	Edward Murphy and Ira Furry	4038 G. 1	30.29	Sept. 30
Plumb	"	Britannia Mining and Smelting Co., Ltd	3503 G. 1	50.30	Nov. 10
Red Mountain	"	" "	4258 G. 1	51.65	Nov. 10
Red Mountain No. 1	"	" "	4257 G. 1	51.65	Nov. 10
Red Mountain No. 2	"	" "	4250 G. 1	51.65	Nov. 10
Robertson	Victoria	William Archibald Robertson	48	51.65	May 21
Rod Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	3699 G. 1	24.90	Jan. 20
Roy Fractional	"	" "	2898 G. 1	0.7	Nov. 10
Sophia	"	Sophia Cameron	2170 G. 1	51.65	Nov. 21
Star Fractional	"	Edward Murphy and Ira Furry	4037 G. 1	45.22	Sept. 30
Sound	"	Britannia Mining and Smelting Co., Ltd	4024 G. 1	51.65	Jan. 21
Sound Fractional	"	" "	4016 G. 1	49.11	Jan. 21
Surprise Fractional	"	" "	3938 G. 1	40.84	Jan. 20
Torse No. 1	Alberni	Charles L. Betterton and Henry H. Jones	1279	45.86	April 28
Torse No. 2	"	" "	1280	35.9	April 28
Torse No. 3	"	" "	1281	37.8	April 28
Torse No. 4	"	" "	1282	51.65	April 28
Vananda Copper	Vancouver	Britannia Mining and Smelting Co., Ltd	2894 G. 1	50.19	Jan. 20
Weasel Fractional	"	" "	4023 G. 1	0.03	Mar. 19
Wood Pecker	Nanaimo	Harry Whitney Treat	98	51.44	Jan. 8

DEPARTMENT OF MINES.

VICTORIA, B.C.

HON. LORNE A. CAMPBELL	*Minister of Mines.*
R. F. TOLMIE	*Deputy Minister of Mines.*
WM. FLEET ROBERTSON	*Provincial Mineralogist and Assayer.*
D. E. WHITTAKER	*Provincial Analyst and Assistant Assayer.*
JOHN D. GALLOWAY	*Assistant Provincial Mineralogist.*
THOMAS GRAHAM	*Chief Inspector of Mines, Victoria.*
HENRY DEVLIN	*District* ,, *Nanaimo.*
JOHN NEWTON	,, ,, ,,
GEO. O'BRIEN	,, ,, *Fernie.*
THOMAS H. WILLIAMS	,, ,, ,,
ROBERT STRACHAN	,, ,, *Merritt.*
JAMES MCGREGOR	,, ,, *Nelson.*

GOLD COMMISSIONERS AND MINING RECORDERS.

Mining Divisions.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Atlin Mining Division	Atlin	J. A. Fraser	W. G. Paxton	
Sub-office	Discovery			R. Webster.
"	Telegraph Creek			H. W. Dodd.
"	Haines (U.S.)		(Com. for taking Affidavits)	Risdon M. Odell.
Stikine Mining Division	Telegraph Creek	H. W. Dodd	H. W. Dodd	
Sub-office	Boundary	"	"	William Strong.
Liard Mining Division	Telegraph Creek.	"	"	
Sub-office	Porter			Chas. H. Smith.
"	McDame Creek			Amos Everson.
Skeena Mining Division	Prince Rupert	J. H. McMullin	J. H. McMullin	
Sub-office	Alice Arm			H. H. Carney.
"	Kitimat			Geo. L. Anderson.
"	Port Simpson			J. R. C. Deane.
"	Essington			A. Forsythe.
"	Copper City			P. R. Skinner.
"	Terrace			C. E. Doolittle.
"	Stewart (Portland Canal)			P. S. Jack.
"	Anyox			F. A. McKinnon.
Portland Canal M.D.	Stewart	J. H. McMullin (at Prince Rupert)	P. S. Jack	
Bella Coola Mining Div.	Prince Rupert	J. H. McMullin	J. H. McMullin	
Sub-office	Bella Coola			Frank Broughton.
Queen Charlotte Min'g D.	Queen Charlotte	E. M. Sandilands	E. M. Sandilands	
Sub-office	Jedway			W. Prescott.
"	Masset			C. Harrison.
"	Lockeport			William Morgan.
Omineca Mining Division	Hazelton	Stephen H. Hoskins	Jas. E. Kirby	
Sub-office	Fort Grahame			John Ross.
"	Fort St. James			Alex. C. Murray.
"	Manson Creek			W. B. Steele.
"	Telkwa			T. J. Thorp.
"	Fort St. John			F. W. Beatton.
"	Copper City			P. R. Skinner.
"	Terrace			C. E. Doolittle.

GOLD COMMISSIONERS AND MINING RECORDERS—*Continued.*

Mining Divisions.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Omineca M.D.—*Con.*				
Sub-office	Babine Portage			R. J. Cameron.
"	Fort Fraser			J. E. Hooson.
"	Junction Finlay &	Parsnip Rivers		Wm. Fox.
"	Pacific			T. H. McCubbin.
"	Smithers			Walter Noel.
"	Burns Lake			C. R. O'Hara.
"	Houston			Frank L. Mosher.
"	Usk			Jas. L. Bethurum.
Peace River Mining Div.	Fort St. John	S. H. Hoskins	F. W. Beatton	
Sub-office	Hudson's Hope	(at Hazelton)		Thomas A. Mansell.
"	Pouce Coupe			G. J. Duncan.
Cariboo Mining Division	Barkerville	C. W. Grain		
Sub-office	Quesnel			Geo. Milburn.
"	Fort George			T. W. Herne.
"	McBride			Henry Taylor.
Quesnel Mining Division	150-Mile House	C. W. Grain	Arthur Sampson	
Sub-office	Quesnel	(at Barkerville)		George Milburn.
"	Quesnel Forks			Grant Grinder.
"	Barkerville			C. W. Grain.
Clinton Mining Division	Clinton	E. C. Lund		
Lillooet "	Lillooet	John Dunlop	John Dunlop	
Kamloops Mining Division	Kamloops	E. Fisher	L. S. Brown	
Ashcroft "	Ashcroft	" (at Kamloops)	H. P. Christie	
Sub-office	Lytton			Thos. Somerville.
Nicola Mining Division	Nicola	E. Fisher (at Kam.)	W. N. Rolfe	
Yale "	Yale	" "	L. A. Dodd	
Sub-office	Hope			George Blue.
Similkameen Mining Div.	Princeton	Hugh Hunter	Hugh Hunter	
Sub-office	Hedley			F. M. Gillespie.
Vernon Mining Division	Vernon	L. Norris	H. F. Wilmot	
Greenwood Mining Div.	Greenwood	W. R. Dewdney		
Sub-office	Vernon			H. F. Wilmot.
"	Rock Creek			H. Nicholson
"	Beaverdell			E. F. Ketchum.
Grand Forks Min. Div.	Grand Forks	S. R. Almond	S. R. Almond	
Osoyoos Mining Division	Fairview	J. R. Brown	R. D. Tweedie	
Sub-office	Olalla			R. W. Northey.
"	Hedley			F. M. Gillespie.
Golden Mining Division	Golden	W. W. Bradley	F. H. Bacon	
Windermere "	Wilmer		W. A. Lang	
Fort Steele Mining Div.	Cranbrook	N. S. A. Wallinger.	H. S. Clark	
Sub-office	Steele			Joseph Walsh.
"	Fernie			Ronald Hewat.
"	Moyie			John P. Farrell.
"	Marysville			Alfred Dryden.
Ainsworth Mining Div	Kaslo	R. J. Stenson	A. McQueen	Wm. J. Green.
Sub-office	Howser			W. Simpson.
"	Trout Lake			A. N. Vars.
Slocan Mining Division	New Denver	R. J. Stenson (at	Angus McInnes	
Sub-office	Sandon	Kaslo)		W. J. Parham.
Slocan City Mining Div.	Slocan	R. J. Stenson	Thos. McNeish	
Trout Lake Mining Div.	Trout Lake	"	A. N. Vars	

GOLD COMMISSIONERS AND MINING RECORDERS—*Concluded.*

Mining Division.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Nelson Mining Division	Nelson	John Cartmel	S. S. Jarvis	
Sub-office	Creston			Guy Constable.
"	Ymir			Geo. S. Coleman.
"	Sheep Creek			James Thompson.
"	Salmo			G. A. Kennington.
Arrow Lake Min. Division	Nakusp	John Cartmel	Walter Scott	
Sub-office	Vernon	(at Nelson)		H. F. Wilmot.
Revelstoke Mining Div.	Revelstoke	Robt. Gordon	R. S. Squarebriggs.	Newton R. Brown.
Lardeau Mining Division.	Beaton	" (at Revelstoke)	William A. Strutt.	Mrs. A. H. Strutt.
Trail Creek Mining Div.	Rossland	H. R. Townsend	M. S. Morrell	
Nanaimo Mining Division	Nanaimo	John Kirkup	John Kirkup	
Sub-office	Ladysmith			John Stewart.
"	Alert Bay			H. F. Helmsing.
"	Vananda			David Jones.
"	Rock Bay			W. H. Lines.
"	Granite Bay			Henry Twidle
Alberni Mining Division	Alberni	S. McB. Smith	S. McB. Smith	
Clayoquot "	Clayoquot	" (at Alberni)	W. T. Dawley	
Quatsino "	Quatsino	" "	O. A. Sherberg	
Victoria Mining Division.	Victoria	Herbert Stanton	Herbert Stanton	
New Westminster Min. D.	New Westminster.	F. C. Campbell	I. Wintemute	
Sub-office	Harrison Lake			L. A. Agassiz.
"	Chilliwack			J. Pelly.
Vancouver Mining Div.	Vancouver	John Mahony	A. P. Grant	

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Z.

ERRATUM.

Referring to table on page 271 showing shipments from the *Snowstorm* group, the figures given in the columns for gold and silver are the total ounces of gold and silver contained in the respective shipments, and not the assay per ton. As this form may be misleading, the following table gives the data in the usual form:—

	Weight.	Assays.		
		Gold.	Silver.	Copper.
	Tons.	Oz.	Oz.	Per Cent.
No. 1	32.183	0.10	6.77	31.64
No. 2	34.642	0.07	6.46	30.78
No. 3	29.291	0.09	5.88	27.47

LIST OF ILLUSTRATIONS.

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1916.

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Victoria, Government Printing Office, 1916.

Author.

Robertson, William Fleet. *(Provincial Mineralogist.)*

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